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New Ways of Reading: The Impact of an Interactive Book on Young Children's Story Comprehension and Parent-Child Dialogic Reading Behaviors

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Dedication

To my amazing, smart, incredible, stunning, wonderful, electrifying, beautiful, resourceful, elegant, brilliant, patient, supportive, sensitive, kind, and understanding wife, Vanessa.

ABSTRACT OF THE DISSERTATION

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Doctor of Philosophy, Graduate Program in Psychology
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The rise of interactive technologies provides a chance to expand children's informal learning opportunities in a new direction, with the potential to support children's physical, social, and cognitive development. As emergent literacy skills are extremely important in establishing literacy trajectories upon school entry, technologies that foster early reading skills may play an important role in children's learning. Although interactive literacy toys are often presumed to have qualities that scaffold young children's literacy skills when used alone, far less research is given to the use of interactive literacy toys in supporting parent-child reading sessions.

This study examined the role of a screen-based interactive book on 4.5- to 5.5-year olds' emergent literacy skills, including story understanding, story sequencing ability, and ability to freely recall story narrative. Ninety-six children read a book in one of four conditions: an interactive book with a parent, an interactive book alone, a non-interactive version of the book with a parent, and a print book with a parent. In addition to looking at the role of interactivity generally, the study examined the use of interactive

features that were not closely tied to the central story content, classified here as seductive details. Seductive details may be distracting and interfere with learning by disrupting the coherence of a story or distracting from the main narrative. Parents and children in all conditions were observed to examine the impact of interactive, non-interactive, and print book reading on parent-child dialogic reading behaviors.

Analyses revealed that use of interactive features was unrelated to children's story understanding, free recall, or sequencing abilities. Inreased use of seductive details in the interactive book was also unrelated to emergent literacy outcomes. Parental involvement was significantly related to children's story understanding, but not to children's free recall or sequencing abilities. Although the types and frequencies of parental dialogic reading behaviors differed by reading group, they were unrelated to children's individual performance on the story comprehension variables. Findings are discussed in terms of multiple ways to support emergent literacy and the value of parent involvement in print and interactive reading experiences.

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CHAPTER 1 – INTRODUCTION AND LITERATURE REVIEW

New interactive toys blend the traditional domains of "television" and "toy," turning the television screen into a responsive, interactive partner for young children. Companies including Leapfrog™, V-Tech™, and Fisher Price™ have numerous products sold to parents of young children that blur these lines. Many of these products purport to support early literacy development, yet there is little independent research to validate these claims. For example, Leapfrog advertises that their Tag Learning System builds listening and reading comprehension, phonics, vocabulary, word recognition, book and print basics, and phonological awareness ("Leapfrog: Tag reading system," n.d.). Reviews in the popular press also indicate support for interactive reading devices as useful learning tools (Gudmundsen, 2005). Searches on widely-used research databases turn up only brief mentions of these types of products, and few studies involve substantial, independently-conducted research (see review in Shamir & Korat, 2009). The use of literacy-related interactive toys may complement early literacy skills in young children's development if they are well-designed and targeted appropriately; multimedia features may complement traditional forms of story-reading with visual aids, sound effects, interactive games, and so on, enhancing children's motivation to read and hear stories (Glasgow, 1996). However, the lack of research in this field makes it difficult to ascertain how these devices support children and what kinds of interactive features are helpful or distracting in the learning process.

Exposure

Research in this area is timely. Studies by the Kaiser Family Foundation reveal

that very young children are widely exposed to a variety of screen media, including television, DVDs, computers, and video games (Rideout, Vandewater, Wartella, & Kaiser Family Foundation, 2003). As of 2003, almost 50% of children under 6 had used a computer, including more than a quarter of 4- to 6-year-olds who used computers every day. Additionally, over 60% of parents indicated in the same survey that educational interactive toys, like talking books, were "very important." In a nationally representative survey, parents of children 6 months to 6 years old reported that 14% of children read an electronic book on a typical day (Rideout, Hamel, & Kaiser Family Foundation, 2006). As with all new technologies, increasing acceptance by parents and widespread popularity have raised questions regarding how these types of media may enhance or detract from children's cognitive and academic development. Some critics believe electronic toys reduce the range and types of interactions children engage in compared to the kind of open-ended play that traditional toys provide (Cordes & Miller, 2000; Levin & Rosenquest, 2001).

Children's interactions with technologies like televisions, computers, and toys can be considered contexts for informal learning, meaning they may occur outside traditional educational settings like school in the course of everyday activities. Informal learning encompasses a broad range of learning opportunities that may also include interactions with other people in children's environments, such as parents or siblings. Learning with educational electronic toys in unstructured environments like the home may broaden the range of learning opportunities beyond formal, structured schooling. The premise of educational television programming like *Sesame Street* and *Mr. Rogers' Neighborhood*

was that television could help children learn in their homes (Fisch & Truglio, 2001a; Pecora, 2007). Researchers knew children were watching a lot of television and sought to maximize the benefits of viewing by capitalizing on the technology's most engaging traits – quality writing, production value, etc. (Palmer & Fisch, 2001). The rise of interactive technologies provides a chance to expand children's informal learning opportunities in a new domain, if the capabilities and features of these products are well-designed with regards to children's physical, social, and cognitive development. Considering the increased affordability and availability of interactive toys and the increased time children are spending with them (Rideout et al., 2006; Rideout et al., 2003), there are frequent opportunities for informal learning.

The Role of Emergent Literacy

One of the critical areas for informal learning is building emergent literacy skills. Distinct from literacy perspectives that see formal school-based instruction as the beginning of reading acquisition, emergent literacy refers to the developmental antecedents of formal reading, covering literacy-related behaviors that occur prior to formal schooling (Whitehurst & Lonigan, 1998). There are many components of emergent literacy, including children's semantic and conceptual knowledge of language, an understanding of the conventions of print (in English, reading left to right and top to bottom), knowledge of letters, and an awareness of linguistic units such as phonemes, syllables, and words (Whitehurst & Lonigan, 1998). Two interdependent domains of literacy are key to children's emergent literacy: outside-in and inside-out skills (Whitehurst & Lonigan, 1998, 2001). Outside-in information refers to sources of

information that exist outside printed text that support print understanding, such as vocabulary, conceptual knowledge, and story schemas. To understand a sentence in a storybook, a child might need outside knowledge of the world, semantic knowledge, and knowledge of the context in which the sentence was embedded. Inside-out information refers to information within text that aids in decoding print into sound and sound into language, such as letter knowledge or phonemic awareness. The ability to integrate information from both domains contributes to successful reading.

Low levels of emergent literacy in preschool children are not a cause for concern in and of themselves; children with lagging skills can still learn to read (National Research Council, 1998; Whitehurst & Lonigan, 1998). However, the reason emergent literacy skills are vital is that, "schools provide an age-graded rather than skills-graded curriculum in which early delays are magnified at each additional step as the gap increases between what children bring to the curriculum and what the curriculum demands" (Whitehurst & Lonigan, 1998, p. 865). The National Reading Panel (2000) and National Research Council (1998) have found that children who have insufficient reading skills early are less likely to catch up to the reading skills of their peers, with deleterious academic effects. Literacy trajectories are established early; children who enter school with deficient early literacy experiences are more likely to follow a negative developmental pattern, falling behind in critical skills like automaticity and understanding alphabetic principles (Crijnen, Feehan, & Kellam, 1998; Stanovich, 1986). Additionally, these children are less likely to have enjoyable reading experiences, resulting in decreased motivation and fewer exposures to print. Differences between poor

and good early readers magnify over time. One study reported an 88% probability that a poor reader at the end of first grade would be a poor reader at the end of fourth grade, compared to a 12% probability of being a poor reader if a child was an average reader (Juel, 1988).

Although in-classroom literacy interventions are traditionally used to address this disparity, several media producers have attempted to address this problem in other ways. The PBS Ready to Learn initiative targeted literacy and emergent literacy as skills that can be enhanced in part through television and other technologies (Vogel, Uhl, & Boller, 2002). Programs like *Sesame Street* and *Between the Lions* both address these issues by emphasizing traditional reading skills such as phonemic awareness, decoding, vocabulary knowledge, and understanding the meaning of text; summative research has been useful in describing these programs' positive impact on children's literacy (Fisch & Truglio, 2001b; Linebarger, 2006). Studies of *Sesame Street* showed that children between 3 to 5 who watched the program had stronger gains on content that had been emphasized within the program, such as learning letter and word learning (Ball & Bogatz, 1970; Bogatz & Ball, 1971). There have also been well-documented finding on long term effects on letter-word knowledge, vocabulary size, and school readiness, independent of parent education, family size, child gender, and parental attitudes (Rice, Huston, Truglio, & Wright, 1990; Wright et al., 2001). Thus, there is a well-established literature on how informal learning through media can have important short- and long-term benefits.

There are many examples of interactive toys that purport to support emergent literacy skills as well, but there is fair less research on the impact of interactive literacy

toys. However, the prospect of a more interactive exchange between the child and the technology holds great promise for promoting learning. Wartella and colleagues (2000) take the Vygotskian view (see Vygotsky, 1978 for a review) that learning involves how to enact roles in specific activities, known as situated knowledge. Acquiring situated knowledge requires performance of an activity and communication with socializing agents like parents or peers, who teach children about activities and how they should enact their roles in these activities (Gauvain, 2001). The promise of interactive learning toys is that they act in a manner similar to other socializing agents, by supporting learners in participating in activities, so that children may learn situated knowledge as active participants. For interactive literacy toys to be useful in supporting early reading skills, children need to be able to demonstrate a generalization of skills acquired while using interactive toys in other contexts beyond the device itself. For example, an interactive book that tries to promote free recall of a story might aid a child in performing free recall of other stories in a preschool classroom. However, in practice, the utility of interactive technologies in learning is only beginning to be studied. It is unclear whether the types of active involvement afforded by interactive toys influence areas like comprehension and retention, or whether it can influence users' sustained engagement.

Calvert, Strong, and Gallagher (2005) examined how user control impacted preschool children's attention to and learning of content from a computer story. The authors asserted that children's control over the story would lead to a greater likelihood of learning content. Children were placed into groups that had varying control over the story. In groups in which adults controlled the situation, children displayed less interest in

the story and were less attentive over repeated exposures. When the children controlled the mouse to interact with the story, attention remained steady throughout. Although both groups remembered story content equally, user control was highly effective as an engagement feature that facilitated children's attention to, and interest in, the computer content. While no differences in learning were found, the authors speculated that changes to the design of the computer content might improve learning.

Interactive Media

The range of capabilities and features of interactive media have made it difficult to define interactivity (Wartella et al., 2000; Wartella, Lee, & Caplovitz, 2002). Interactivity in a racing video game may not easily be compared to a word processor or a discussion board on the Internet; the nature of the interaction and the cognitive demands for each activity may differ. Differences between interactive devices may seem minor, but pose the same problem; using a handheld electronic book with an enhanced pen as an interactive input may be qualitatively different in terms of user experience from an on-screen electronic book that uses a mouse. It is possible that the differences in user input are overshadowed by the commonalities in content. Disentangling dimensions of interactivity may depend on the research question asked. One simple definition is that interactive media is media that is dependent on user input, determined by the particular affordances of a technology (Fisch, 2004b; Shuler, 2007). User input might be conceived of at different levels, from the physical input of using a mouse to the social input of writing a comment on a web page and participating in an online conversation. Fisch (2004b) provides one approach to interactivity, suggesting the examination of specific

format issues unique to a technology. Format issues arise out of the users' interaction with a particular medium and consider the requirements and constraints inherent in that use. The affordances of a device will impact how a user interacts with it, how accessible it is, and how useful an audience will find it.

One of the first considerations for users of a media form will be the degree of print literacy it requires. Television viewing does not usually require print literacy, and thus offers few restraints to users who have low or no-literacy skills. Most video games also do not require much in the way of print literacy, especially in games in which children are inducted into the game slowly and with verbal instruction, reducing the need to read written instructions. Given their reliance on print literacy, electronic books may be difficult for a child to read without assistance, thus they usually include a reading mode wherein a digital narrator reads the story aloud. By contrast, internet activities might require substantial print literacy, both in being able to navigate to sites and also in the nature of games that might be played online. Because of limited bandwidths, designers of online games may seek to provide written material instead of relying on spoken sound files because text is quicker to download. Thus, online activities that require substantial reading may be more difficult for young children.

A related format concern regards the amount of parental involvement needed. A child who turns on the TV by herself might need assistance gaining access to interactive materials, especially online. Parents may assist children by providing access when interactive media requires skills they may not possess, such as fine motor control of devices or navigating difficult menu systems. For television, the presence of a parent can

enhance learning of educational concepts (Comstock & Scharrer, 2007). Parents may facilitate understanding of television content by asking questions or talking about what is on. Likewise, parents can use interactive technologies with their children, linking what they are doing with outside experiences or other activities. In doing so, parents may help children to generalize experiences outside of the interactive technology itself, perhaps by drawing connections between reading with an interactive book and reading in school. Providing consistency and linkages between activities at home and school activities help children prepare for school (Gauvain, Savage, & McCollum, 2000).

If literacy skills are needed (i.e. in reading game directions or engaging in written communication with others) and a child does not possess them, a parent might be needed to assist. Many *Sesame Street* online activities are designed with parent-child joint use in mind, both in establishing how much support a child is likely to need from an adult and in testing activities with parent-child pairs (Revelle, Medoff, & Strommen, 2001). Thus, two main roles for parents are in providing access to interactive media and in building on their children's experiences (e.g. through connecting a game to a personal experience, or in conversations outside the context of the interactive media) (Fisch, 2004c).

A major difference between television and interactive media lies in the way they are paced. Television, excluding the use of DVRs and VCRs, has a set pace that cannot be controlled. Children's processing of television content must therefore fit the pace of the program, and not the other way around (Fisch, 2004c). One of the greatest advancements of interactive technology, and perhaps the feature most beneficial to those trying to leverage positive uses of interactive technology, is that users can set their own

pace. Children using an interactive book, for example, can review particular sections over and over again for enjoyment or for comprehension reasons. However, the downside of self-pacing is that in certain cases, children might not be able to progress in a game unless they have completed a specific action. This could increase frustration and de-motivate children to continue to play, or prevent children from accessing specific educational content. A well-designed educational interactive product will deploy hints or provide other assistance so children may proceed through the desired content (Revelle et al., 2001).

Lastly, the usability of technologies plays a significant role in how users interact with them. Television is a simple technology; even children as young as 12 months know how to turn on the television, even if they might not understand the content (Rideout et al., 2003). However, interactive technologies may pose significant challenges to children. Designers of interactive media must keep in mind children's motor development and executive functioning skills when designing how specifically the child will interact with it. A large body of work speaks to this issue. Strommen (1993) tested 3-year-olds' ability to use a simple controller to move an on-screen character to a specified location and found that they had great difficulty controlling continuous movements (i.e. holding down a directional button until the character gets to the desired point). This kind of input may place substantial cognitive burdens on young children, requiring them to access and coordinate multiple schemas involved in initiating movement by depressing the directional button, holding the button, and then releasing the button at a specific time, while requiring a constant monitoring of the screen and the controller (Strommen, 1993).

Preschoolers may also have difficulty coordinating relatively small handheld actions, such as moving a mouse to a small on-screen icon. Specifically, children lack appropriate inhibitory control; it is difficult to stop a movement at the appropriate moment once it has been initiated (Revelle, 2003). Other research demonstrates that 3-year-old children using a trackball were more accurate than those using a mouse, which is far more common in people's homes (Strommen, Revelle, Medoff, & Razavi, 1996). Simplifying controls to reduce the information processing load can enhance the usability of a device. Revelle and Medoff (2002) pointed to the usability of an interface in which on-screen options are visually connected to four corresponding colors or shapes on a controller (e.g. a red square on-screen associates with a red square button). In the researchers' tests, 3- to 4-year-olds were able to successfully interact with on-screen choices with very few errors. Although effective, this interface constrains the design of programs because the number of on-screen options are limited to the number of buttons.

Researchers involved in studying interactive technologies should be cognizant of some of the differences outlined above, but also should be aware of many of the commonalities that interactive technologies share with television. Fisch (2004b) described commonalities as content issues that apply equally regardless of the media platform. For example, formal features may elicit and maintain attention if the content is comprehensible and appealing (Calvert, 1999). Calvert (2004) describes formal features as the grammar of technology, usually conceived of as the audiovisual production features that help in structuring and marking content. At a macrolevel, this includes the amount of visual action versus static scenes (i.e. of characters talking or thinking) and the

pacing of the show (i.e. how fast the narrative moves or new information is given). At a microlevel, techniques like zooms and cuts can be used in either type of media to help focus children's attention. The presence of animation, common in many children's television shows and interactive media, is a formal feature that draws children's attention (Huston, Bickham, Lee, & Wright, 2007; Huston & Wright, 1983). Formal features are not just limited to visual effects; audio effects such as background music, which set a mood or tune, and sound effects, which draw attention to on-screen events, are frequently used across media platforms. Studies have found that women's voices draw children's attention more than men's, a potential reason narration is often done by a woman in children's programs (Anderson & Lorch, 1983). Formal features should not only engage attention, but also guide viewers of television or users of interactive media to important aspects of the content to improve learning.

The electronic book used in the present study, Read With Me DVD *Curious George Goes to a Chocolate Factory*, can be described in terms of the formal features described above. The electronic book falls somewhere between an animated show and a book. The visual superiority hypothesis suggests that processing visual information may interfere with children's ability to process important audio content, impeding their ability to attend to narration or understand the story (Calvert, 2004, 2006). In this electronic book, there is less visual action, as depicted in characters' gross motor movements through space, than a typical cartoon, although more than the static images in a book, so the visual superiority effect may not hold (Calvert, 1999). An interactive book may benefit by using enough visual action to elicit and maintain attention, but not so much

that it distracts from the story. The interactive book is also animated, a formal feature that is attractive to children (Huston et al., 2007; Huston & Wright, 1983). Similar to using cuts, it uses the effect of "virtual" page turning when moving between pages of the story. Sound effects are used throughout to enhance moments in the story, such as the playing of a violin during a page when a character is making music. Additionally, a woman narrator reads the story, a choice that may also contribute to recruiting and maintaining children's attention (Anderson & Lorch, 1983).

Interacting with Computers

One of McLuhan's (1964) contributions to media theory, "the medium is the message" (p. 7), presaged decades of research examining the structural properties of different mediums. In his idea, each medium has unique properties that shape content in specific and predictable ways. Thus, if we know enough about the characteristics of a medium (such as whether it requires literacy, whether it has an audio and visual component, or whether it is interactive), it becomes possible to predict how the medium impacts thought processes and learning. In this theory, television may be seen as passive, promoting visual images that require little deep processing (Singer, 1980). Following this logic, new interactive technologies may have different structural properties that impact thinking in ways that could be very different from other previous mediums and from each other.

Parents often assume interactive technologies promote higher level thinking or have other cognitive or academic benefits. In a survey of parental attitudes toward computers, 72% of parents indicated that using a computer was mostly helpful to their

children's learning, compared with 22% who thought video games were helpful (Rideout et al., 2003). It is possible that parents assume that content differs substantially between computers and video game consoles, or that there are underlying structural qualities to computer use that are more beneficial than video games. The lure of educational interactive toys is that time spent with them might play a significant role in academic achievement or cognitive development, regardless of the quality or the content. However, as Strommen (2003) noted, electronic media have changed and evolved so rapidly that it is difficult to define their properties in a systematic fashion. As electronic media are constantly changing, it is nearly impossible to research the effects of a specific medium in a meaningful way; researchers are often left reading studies done in the last 5 to 10 years that seem antiquated and with little relevance to the current technological world. For example, a study of the relationship between video games and aggression that used the classic video game "Space Invaders" seems out-of-date in a media environment that produces a myriad of realistic first-person shooting video games (Silvern & Williamson, 1987)

Strommen (2003) also noted a major failing of the McLuhan framework – namely that McLuhan's ideas are overly dependent on the notion that human thought is readily shaped by media forms. Strommen argues that human thought is not so malleable as to be easily shaped by the media; rather, human thought is malleable only within biologically-constrained brain structure. Part of our evolutionary heritage is that our minds respond to specific stimuli in predictable ways based on our biology. Specifically, we are excellent at detecting and reacting to social cues, both consciously and

unconsciously. Although examining affordances of technology is one way of examining the nature of interactivity, several authors have pointed out that it makes more conceptual sense to examine interactivity (and media generally) through a social lens (Luckin, Connolly, Plowman, & Airey, 2003; Reeves & Nass, 1996; Richert, Robb, & Smith, in press; Strommen, 2003). Instead of looking at interactions with media as a function of the medium itself, it is far more useful to look at it through the prism of the social human mind. If we respond to media with social expectations, then it is not only the media form that is of consequence, it is the content itself.

Because content in all media forms is overwhelmingly populated by humans and human-like characters, we are really sharing a type of interaction with another social partner (Reeves & Nass, 1996; Richert et al., in press; Strommen, 2003). Studying the medium may be less informative for making predictions about media effects than studying our social reactions to media content. As the content of video games, online networks, television shows, music, radio, etc. is primarily composed of and by people, we are likely to respond to the people in psychologically predictable ways. Further, even when content is not human, we still respond socially to media as if it were human (Reeves & Nass, 1996). If media are perceived as being social partners, even unconsciously, it will impact how children react to them. For example, Reeves and Nass (1996) found that people rated computers better when the computers praised them; people in a group that used computers that offered no praise gave lower ratings. This argument is another way of saying that content is what is most important, and what drives interactions with computers. In this case, the content is intentionally social and meant to capitalize on

people's desires to be rewarded. Improving learning from media requires sensitivity to children's social expectations and reactions and might be achieved through a variety of means, including by providing contingent feedback or utilizing a character with whom the child has an emotional relationship (e.g., Elmo from *Sesame Street* or Dora from *Dora the Explorer*) (Strommen, 2000).

Interactive Media and Literacy

Much of the past research into children's ability to learn from television has come from studies of high-quality educational program such as *Sesame Street* and *Between the Lions*, which have carefully focused curriculum goals. For example, research on *Sesame Street* has examined how well children learned language and literacy-related goals, such as vocabulary acquisition, phonemic awareness, and print awareness (see review in (Fisch & Truglio, 2001a). In a large national survey, 4-year-old preschoolers who viewed *Sesame Street* exhibited more emergent literacy skills, including recognizing letters of the alphabet and telling stories when pretending to read (Zill, Davies, & Daly, 1994a, 1994b). The same study found that gains in these skills were especially evident among children from low-income families. In another study, viewing *Sesame Street* was a significant predictor of vocabulary scores for 5-year-old children who started watching when they were 3 to 3½ years old (Rice et al., 1990). This was true even after accounting for parental education, gender, family size, and parental attitudes toward television.

Parental coviewing was not a prerequisite for language gains, meaning children were learning when they watched alone. Learning effects held through high school; adolescents who were frequent viewers at age 5 had significantly higher grades in

English, read more books for pleasure, and reported higher levels of motivation to achieve (Huston, Anderson, Wright, Linebarger, & Schmitt, 2001). Research on *Between the Lions* also shows the potential positive effects of television on young children's emergent literacy skills; 6- to 7- year old viewers of the program showed higher word recognition and standardized reading test scores, as well as improved performance on phonemic awareness and letter-sound tasks (Linebarger, Kosanic, Greenwood, & Doku, 2004). Although this research speaks to the usefulness of educational television in informal learning environments, it does not necessarily speak to the potential or risks of interactive media.

Interactive books offer many opportunities for users to engage with them, by giving access to clickable "hotspots" that reveal multimedia such as sounds or animations or through games and activities that are interspersed through the story. In creating an experience that goes beyond viewing to require user participation and input, there is an opportunity to engage in and practice emergent literacy skills, such as responding to story comprehension questions, identifying letters, or engaging in other literacy-related activities. Although interactive media are often cited for their potential as a learning tool (e.g. Kirkorian, Wartella, & Anderson, 2008; Shore, 2008; Wartella & Jennings, 2000; Wartella et al., 2000), it is also possible that interactivity may have a hidden cost. Seductive details (a term borrowed from the research literature on textbooks) are defined as interesting or entertaining information or content that is only tangentially related to the main topic, but is irrelevant to the author's intended theme (Garner, Brown, Sanders, & Menke, 1992). In print books, seductive details may involve things like personal

anecdotes (i.e. a story of George Washington and the cherry tree in a passage about the first president's accomplishments), but the idea may be applied to electronic interactive books as well. For example, extra animations, sound effects, and games that occur when users access them can be engaging, but not contribute to children's understanding of a story. These types of details, embedded in the interactive elements of the storybook, may be distracting and interfere with learning by disrupting the coherence of a story or by priming inappropriate schemas around which users organize a story (Harp & Mayer, 1998).

The research on learning from interactive media thus far has provided mixed results. In experiments with children ranging from 4- to 7-years old comparing interactive and printed books, interactive elements came at the cost of repeated readings of an electronic book; it took far longer to get through a story, leaving less time to read it again in a timed session (de Jong & Bus, 2002; Ricci & Beal, 2002). In a study comparing print and electronic book reading with 4- to 6-year-olds, de Jong and Bus (2002) examined how many times children read a book over six 15-minute sessions. The children who used an interactive book could click on various hotspots that revealed animations and play games that included characters and objects from the story but were only loosely related to the story. Even though the electronic version of the book was almost half as long as the printed version of the story (492 words versus 907 words), most children reading the interactive version only heard about half of the story, between 1.5 and 2.5 times, compared to children in the printed book condition who heard the full story six times. However, when given sufficient time to complete a reading of an electronic story,

children would do so, even though it took longer (de Jong & Bus, 2004).

Beyond engagement, the effect of hotspots on story memory and understanding is unclear. In one study of electronic books, children were placed in either a read-only condition or a condition in which children could click on any of the 500 available hotspots throughout the story (Ricci & Beal, 2002). After reading the story, children were asked to freely recall what they could about the story, and answered factual narrative, comprehension, and inference questions. Contrary to what was expected, the inclusion of hotspots did not impede children's story memory for facts, their ability to make inferences, or their performance on picture-sequencing tasks. However, there was also no indication that story interactivity was beneficial to memory; even though those who did the interactive version spent longer with the story, it did not lead to better memory.

A study that compared an interactive story with an adult-led reading of a printed book found no differences in children's understanding of the story (de Jong & Bus, 2004). However, adults were strictly guided during their readings with a protocol that established the amount of time spent reading, comments and questions to ask during reading, and instructions on where to insert comments and questions. Therefore, adults may not have been as sensitive or flexible enough to children's individual needs during the reading. Although this experiment may demonstrate that an interactive story may be as effective as adult-led reading in certain limited circumstances, it does not address the question of whether an interactive story is an adequate replacement for an adult in more typical reading circumstances in which a child and a live partner contingently respond to each other.

One factor that does seem to play an important role in emergent literacy is the type of interactive features that are enabled for the user. Many electronic books offer several modes that a user can access that allow a reader to progress through a story but with different features enabled, such as dictionaries, word highlighting, games, and hotspots (de Jong & Bus, 2003; Korat & Shamir, 2004, 2008). In examining the potential of different modes, Korat and Shamir (2008) studied 5- and 6-year-old children who were divided into three groups: a "read story only" group, a "read with dictionary" group, and a "read and play" group. All children worked individually and only received assistance from an experimenter if they changed the mode while going through the story. Children in the "read with dictionary" group, which provided an oral reading of the text along with definitions of difficult words that appeared automatically at the end of each page, improved most on measures of word meaning. Children in the "read story and play" and "read with dictionary" groups showed greater improvement in word recognition than the "read story only" group. In fact, the "read story only" group showed no improvement on any of the emergent literacy skills measured in the study, leading the researchers to conclude that the interactive features are plausible means of supporting young children's early literacy. Specifically, increasing the level of participation with the toy, either by engaging with an interactive dictionary (in the "read with dictionary" mode) or by allowing interaction with objects onscreen (in the "read story and play" mode), were sufficient to improve performance on emergent literacy outcomes.

There are also relevant individual differences in how children learn from electronic books. In comparing children from low- and middle-socioeconomic status

(SES) backgrounds, Korat and Shamir (2008) found differential effects; although both groups showed improvement in word meaning skills in the "read with dictionary" and "read story and play" modes, low-SES children's emergent literacy levels showed relatively greater improvement rates, specifically as related to word recognition and sub-syllabic segmentation skills. This finding may be particularly important, as it complements research suggesting educational television may be more beneficial for children from disadvantaged families because of a lack of competing cognitively stimulating resources (Linebarger & Wainwright, 2007).

Scaffolding

Learning occurs when children are repeatedly exposed to the shared understandings and practices of their culture (Gauvain, 2005). For the purposes of this study, reading is understood to be a cultural practice, usually learned through a set of meaningful actions that are valued by the members of the community. Learning occurs in formal settings, such as school, but may also occur in informal settings, such as shared book-reading sessions between parents. In fact, literacy instruction and learning is a profoundly social process that involves more than just the individual child; the degree to which a child participates in literacy-related activities across multiple contexts has numerous consequences for children's reading success (Gauvain et al., 2000). Participating in learning experiences with more experienced partners is critical to children's reading development, but also their cognitive development overall (Gauvain et al., 2000; Rogoff, 1998).

For example, shared book reading is a recurring activity that has been linked to later literacy outcomes (Bus, van IJzendoorn, & Pellegrini, 1995). During a book-reading session, a parent may engage in a variety of behaviors to increase children's comprehension of a story or to help them decode print, such as asking follow-up questions or slowly sounding out a difficult word. Though parents are an important part of the reading process, one of the allures of new interactive technologies is that they may be able to engage children in some of the typical practices associated with learning to read and therefore could be used as a learning tool. An interactive device could be used by the child alone or with a parent. As noted above, the degree to which parents are needed to help children use interactive media is an important consideration when describing a medium's usefulness, effectiveness, and appeal. Because young children may not be able to play an interactive game or read a book by themselves, it may be helpful for a parent or other more competent partner to assist them.

Parental presence and participation extends what children could do by themselves through the process known as scaffolding. In their seminal paper on the tutorial process, Wood, Bruner, and Ross (1976) introduced the concept of scaffolding. They described scaffolding as the interaction between an adult and child or tutor and student in which the more experienced partner controls parts of a task that are beyond the learner's capabilities, allowing the learner to focus on only those parts in which he is competent. An effective tutor is able to successfully devise both a theory of the task at hand and possible solutions as well as a theory about the learner and what he or she is able to accomplish (Wood et al., 1976). This latter component requires constant adjustment over

time as the child becomes more competent at the task. Knowledge of the child's age is important, as the tutor has to adjust her or his approach to a child's developmental capabilities (Gauvain, 2005).

Wood et al. (1976) observed six principal functions of the tutor during the scaffolding process. First, the tutor must recruit the child's attention, getting her to attend to the task. Second, the tutor must simplify the task by reducing the number of constituent acts needed to achieve a solution. Third, the tutor must keep the child focused on the task and ensure that he or she is moving toward the next step in a solution. Fourth, the tutor demarcates the most relevant aspects of a task from the irrelevant ones. Fifth, the tutor assists in controlling the child's frustration without creating an overdependence on the tutor. Finally, the tutor may serve as a model during a task, performing an idealized version of the solution. This last function may actually include an pseudo-imitation of the child's solution, demonstrating something the child has already done in a more idealized form with the goal of having the child imitate the solution in a manner that is closer to the tutor's.

Thus, while solving a problem, parents or more competent partners help to manage some of the responsibility for engaging in and completing an activity so a child can participate beyond what he or she could do by himself or herself (Gauvain, 2001). Parents must be sensitive to their child's abilities and needs and finely tune their own actions on an on-going basis for scaffolding to be effective. Missteps during the scaffolding process described by Wood et al. (1976) can hinder learning. For example, failing to keep a child on task or maintaining attention on the problem, would adversely

affect the child's ability to solve a problem. Allowing the child to become too frustrated or disillusioned by a problem would also be indicative of poor scaffolding.

Vygotsky (1978) theorized that optimal learning occurs when a more experienced partner assists children in their zone of proximal development (ZPD), which he defines as, "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peer" (Vygotsky, 1978, p. 86). It is within this zone that effective scaffolding occurs. As opposed to other developmental theories that focus on children's individual competence, Vygotsky believed that what a child was able to know, do, or think with social support was more important for cognitive development (Gauvain, 2001). Experience with other people is thus the critical mechanism underlying development as it leads to a reorganization of the child's thought processes and abilities at a higher cognitive level.

Although scaffolding is traditionally conceived of as taking place in inter-personal exchanges, more recent conceptions include the use of learning artifacts, such as computer software, which may provide some of the same functions as a more competent human partner (Luckin & du Boulay, 1999; Sherin, Reiser, & Edelson, 2004). Luckin and colleagues (1999) described a software system that draws upon the Vygotskian notion of ZPD, dynamically adapting to an individual's capability. Because effective instruction requires the more competent partner to provide the appropriate quantity and quality of assistance, Luckin's team created software for a science classroom, Ecolab, which would fill the same purpose. Ecolab was designed as an interactive learning environment for

children 10- to 11-years-old to learn about the food chain. In creating a theoretical framework for this project, Luckin introduces the term *zone of available assistance* (ZAA), to refer to the quantity and quality of assistance that is available for the more competent partner to give to the child. The software they created needed to be able to deal with a variety of users in different situations. How that assistance is selected and proffered to that child's ZPD is key to effective scaffolding. The *zone of proximal adjustment* (ZPA) is the process by which an appropriate action from the ZAA is selected for a given task. A weak or limited ZAA will hamper what may get selected for the ZPA. The goal of Luckin and colleagues' project, and by extension, other educational software, is to maximize the ZAA and target the ZPA so that it most closely fits with the child's ZPD. Ecolab is a software manifestation of this process, first assessing the child's ZPD and then matching different helping styles and tools for children of differing abilities.

Analysis of children's interactions with Ecolab showed that the software could adjust to the user, although the authors noted that the adjustments made by the computer may or not have been optimal for the learner (Luckin & du Boulay, 1999). Mean learning gains differed according to the initial ability group of the children. Children in the high ability group performed best with a system in which the software made suggestions about the activities and difficulty level the children would engage in and the child could choose, perhaps because these children were able to make decisions for themselves about how difficult an activity they could try and how much help they needed. Low ability learners performed best with a system in which the children took the most responsibility for selecting an activity and requesting help, perhaps because this system allowed them to

spend as much time as they wanted with simpler activities and did not extend them too quickly. Average ability users performed best with a system that took the most control in deciding which activities a child should participate in and the level of help needed. Although the latter system produced the most consistent learning gains across all groups, closer analysis revealed that it was not optimal for children of all abilities. Although Ecolab had limitations in how sensitively it could adapt to users' needs, it provides a useful framework for designers trying to integrate theory with practice, clarifying how teaching software might address children's learning within their ZPD.

Although the term scaffolding is used frequently when describing educational interactive games, its incorporation into interactive products usually only embodies a few of the principles listed by Wood and colleagues (1976) and discussed above. For example, one role of the scaffolder is to monitor the level of difficulty, reducing difficulty when necessary to help the child extend beyond what he or she could achieve individually. In a computer game, there might be several levels of difficulty available such that as a child progresses, the game increases in difficulty. In the context of a learning game, it is important that advanced levels place increased demands on children's cognitive skills, rather than on motor coordination or dexterity (Revelle, 2003). Revelle (2001) describes a game from Sesame Workshop that focuses on size relationships. On an easy level, the child must select the longer or shorter of two objects with a large size discrepancy. The software assesses how well a child performs on the level; if the child passes a predetermined threshold of success, he or she is advanced to the next level. In this game, when a child is correct three times, the game moves to a level in which the

child again picks between the longer or shorter object; however, the size discrepancy is reduced. If the child has difficulty with this level, the software can move the child back to an easier level. This design ensures children are given enough support to engage within their ZPD, but can monitor progress if the child is not succeeding and adjust the difficulty as necessary. A weakness inherent in this design is that the program does not know the reason a user is failing. A child may be having difficulty because he or she is confused, inattentive, frustrated, distracted, or other unknown reason. However, the recourse provided by the program is always the same: it adjusts the difficulty. Although adjusting the difficulty may help some children, this solution does not necessarily match with children's needs. Human partners can more readily detect the reasons for children's struggle, but this issue has not been solved in children's educational software.

Another type of scaffolding often offered by software is a progressive hint structure system that provides hints when users make errors, focusing children on the relevant aspects of a problem rather than just pointing out that the answers are wrong (Revelle et al., 2001). For example, in a shape-teaching game, if a child is asked to find a triangle out of a set of different shapes but is incorrect, the hint system can provide a relevant clue such as "look for the shape with three sides." The hint system is designed to give only as much assistance as needed, which can be useful for helping children separate the most relevant aspects of a task from the irrelevant aspects, an important component in scaffolding. However, the hint system is still limited to the designer's best guesses as to why children may be wrong and often provides the same hints regardless of children's ability or knowledge.

Luckin and colleagues (2003) hypothesized that the impact of scaffolding in interactive technologies is partially dependent on how scaffolding is provided. Emphasizing not just the content of the help provided by a digital collaborator, but also how help is provided, the researchers noted that learners do not necessarily use available help in an effective manner. This is true in human and computer interactions. The emphasis in most software scaffolding is that of the computer desktop as helper; Luckin and colleagues (2003) made the helper a physical object outside of the computer. In a study of 4- to 6-year old children, the helper took the form of a soft plush doll that could move, speak, and respond to a child's physical interaction, wirelessly linked to a desktop computer. The child could play games on the computer with the doll at his or her side, soliciting assistance and other useful information from the doll by squeezing its ear. In the course of playing a hide-and-seek game on the computer, for example, a child who squeezed the doll's ear for help would receive a hint like, *"You're near Pal's hiding place"* or "*You're sort of far away from Pal."* The doll also acted as a manager of children's emotions by providing reinforcements or congratulations for accomplishing tasks within the game. However, examination of transcripts of children's comments during computer play revealed that reinforcements were often counter-productive, as they were given at inappropriate times, were not helpful to the task, or irritated the child. Further, the help provided was often inadequate for the child's need, e.g. the doll gave hints that were not specific to the child's problem. More often than not, children in the study were more likely to initially seek assistance from human partners, parents, the

researcher, or peers, only using the toy when prompted by the researcher. However, once they learned how to use the toy to get help, the children were more apt to use it.

Compared to help offered from an on-screen icon within the game, children solicited help more from the doll, pointing to the importance of the interface in determining human-computer scaffolding interactions (Luckin et al., 2003). Although not a total success as a collaborative learning partner, the researchers concluded the technology had potential, especially because children sought help when the tasks were too difficult. A more sophisticated scaffolding system that was better able to adapt to children's needs, integrated with a child-friendly interface such as a stuffed animal would likely yield a richer collaborative learning experience. An important but underemphasized conclusion of Luckin et al.'s (2003) study is the importance of human presence, even when scaffolding systems are in place within the software. Children were frequently observed trying to solicit help from the people in their environment before trying to get assistance from the toy, indicating a potential missing component in the use of interactive technologies - a parent or other supportive partner may need to be present to scaffold his or her child into a scaffolding software system.

Parental Scaffolding of Media

Scaffolding in book-reading. Joint book-reading involving a parent and a child is a common routine in many Western societies, playing an important role in becoming literate and in preparing preschoolers and kindergartners for school (Bus, 2001a). Shared reading, also known as dialogic reading, is often identified as a primary strategy to enhance emergent literacy skills and is thus extremely important for young children prior

to and during formal schooling (Whitehurst & Lonigan, 1998). One meta-analysis of over 30 studies of parent-child book reading found that joint book-reading was positively related to language growth, reading development, and emergent literacy outcomes in preschoolers (Bus & van Ijzendoorn, 1995). Other studies of dialogic reading interventions have found significant positive changes in children's language development lasting at least 6 months after the intervention (Whitehurst et al., 1994). The context and routine of dialogic reading may differ depending on the parent, the child, the type of book, reading skill, and so on. In the context of reading a book, dialogic reading requires adults to be active participants, listening to children, extending children's responses, asking questions, praising children's responses, and so forth (Whitehurst et al., 1994; Whitehurst & Lonigan, 1998). Interactions could include a parent holding up a book and labeling pictures, reading a child's favorite book multiple times, making sound effects to emphasize parts of a story, or any number of other book- and print-related behaviors. Book reading provides many opportunities for scaffolding. A less capable partner, the child, requires the assistance of a competent partner, usually a parent, in order to read the book successfully. For an infant or toddler, the parent might assist by physically positioning the book for the child, turning pages, or pointing at pictures and labeling, whereas a parent might assist a preschooler by asking questions about the plot, or making comments that link the book to the child's own experiences (Bus, 2001b; Taverne & Sheridan, 1995; Whitehurst & Lonigan, 1998). These actions are done in a way to keep the child engaged and elicit participation with the parent and book.

One of the main roles a parent can play in joint book reading is in eliciting interest in the book and making it personal or relevant for that child (Bus, 2001b). As noted above, getting the child's attention and keeping her focused on the activity are key aspects of effective scaffolding (Wood et al., 1976). Parental difficulty fulfilling this role can have deleterious consequences on reading development. A history of negative parent-child interactions might also have a negative impact, making reading experiences less enjoyable or less sustainable, which could hinder later reading development (Bus, 2001a). Bus (2001b) suggested that book reading be considered in terms of the social-construction hypothesis; that is, joint book reading is a socially created experience. Text and illustrations in the book become embedded in the social interaction between the parent and the child; thus, understanding the emotional relationship between the parent and child can provide valuable information about their book reading. Building off the attachment literature, Bus (2001a) hypothesized that children construct mental representations of their interactions with parents that contribute to their expectations and predictions about future interactions. As a result, children who are insecurely attached may have negative expectations of parental help during joint book reading and may show less interest overall because their enjoyment of the activity is heavily dependent on parental help. Less securely attached children could also have parents who are less successful at scaffolding reading interactions.

Conversely, children who have a history of enjoyable joint book reading sessions have better expectations and enjoy these interactions more, leading to a greater desire to read with parents and engage with books. In a study of frequent readers, who read at least

once a day, and infrequent readers, who read twice a week or less, Bus and van IJzendoorn (1995) found that there were significantly more insecurely attached children in the infrequent reading group than in the frequent reader group. From this data, the researchers hypothesized that less secure caregivers would not be as successful in constructing or maintaining an enjoyable joint book reading with their children, and that there would be fewer supportive interactions during the reading.

The actual content of the book reading interaction differed across parent-child dyads as well. In a cross-sectional study of joint book reading, Bus and van Ijzendoorn (1988) found that mothers of securely-attached children gave more formal reading instruction than mothers of anxious children. After using the Strange Situation paradigm (Ainsworth, Waters, & Wall, 1978) to measure attachment security between mothers and children, mothers were observed reading together in a laboratory playroom. Secure dyads also engaged in a more fluid interactional style with fewer digressive tactics on the part of the child and less maternal disciplining. In other words, their interactions were smoother and appeared more pleasant than those in less secure dyads. As a result, even when reading a simple picture book, insecurely attached children between 44 and 63 weeks old paid less attention, more often trying to get out of their mothers' laps, attending to other things in the environment, and responding less to story content and pictures (Bus & van Ijzendoorn, 1997). Because parents in secure dyads tended to engage in increased interactions around formal aspects of book reading (i.e. giving explanations, asking questions, making comments on the text, helping children to spell words, naming

letters, etc.), it might be beneficial to seek ways to assist parents in less secure dyads in book reading interactions.

In addition to engaging children, parents should also be sensitive to their children's changing capabilities. As children mature and gain more experience with books and text, the types of scaffolding offered to the child should change (Bus, 2001a). For instance, for younger children with less reading experience, adults tend to read in a more straightforward narrative style, focusing on the interpretation of the illustrations and story; for older children with more experience, extra attention is given to formal aspects of reading, through reading instruction by the parent and protoreading (i.e. naming letters or familiar words) by the child (Bus, 2001a; Bus & van Ijzendoorn, 1988). This could be considered an example of fading, reducing the support where a child can accomplish part of a task by himself (Wood et al., 1976), while changing the nature of the elements of the book to be highlighted.

Scaffolding with Screen Media. Examining parental scaffolding of media in a manner similar to parent-child book-reading is not a new idea; there is already an established research literature on the benefits of coviewing, during which parents could engage in scaffolding behaviors to enrich their children's experiences. Years of research on coviewing speak to the importance of parental presence and engagement in facilitating children's learning from media. Coviewing is the parental act of watching television and video content with children. However, there is a wide spectrum of behaviors associated with coviewing that mediate television's effects.

In the simplest sense, coviewing is parent-child viewing with no discussion about the content (Dorr, Kovaric, & Doubleday, 1989). This can be thought of as a parent viewing with her or his child and not attempting to engage the child in interactions about the content of what is on the screen. On the other end of the spectrum, Desmond and colleagues (1985) described a more complex form of coviewing as an "active effort by parents and others to translate the complexities of…the television medium into terms capable of comprehension at various levels of cognitive development" (p. 463). In other words, parents determine how to make content assessable in a manner sensitive to their children's needs. Actions involved in this form of instructive mediation could include talking about what is on the screen, imitating actions (like singing or dancing), or labeling on-screen objects (Valkenburg, Krcmar, Peeters, & Marseille, 1999).

Lemish and Rice (1986) examined the nature of coviewing between mothers and children during viewings of *Sesame Street* and found that there were many common elements with joint book-reading. For example, mothers labeled objects on the screen, asked questions about content, repeated dialogue from the program, and related on-screen events to the child's real-world experiences. Given that these behaviors during joint book-reading have been linked to emergent literacy skills, it seems plausible that they might also be beneficial to learning emergent literacy skills while viewing television.

Research on the effectiveness of coviewing has been mixed, as not all coviewing behaviors are educationally beneficial. In a longitudinal study, Rice and colleagues (1990) compared viewing diaries in which parents had indicated which of the child's viewing experiences were alone and which were with a parent. Surprisingly, Rice et al.

found that television viewed alone at age 3 predicted increases two years later on the Peabody Picture Vocabulary Test (PPVT), a test of receptive vocabulary. Coviewing was not associated with any gains to later vocabulary. It should be noted that the diary simply recorded parental presence and not the qualities of coviewing. When those behaviors are taken into account, the results are more informative for best practices. In a study of parents who coviewed *Sesame Street* with 3- and 4-year-olds, investigators found that the coviewing children could identify a set of letters and numbers when an adult asked them to name them during the program. The effect was not found when the parents themselves named the letters and numbers while coviewing (R. A. Reiser, Tessmer, & Phelps, 1984; R. A. Reiser, N. Williamson, & Suzuki, 1988).

The idea of coviewing takes on a different meaning when using electronic interactive books; many electronic books include features intended to replicate what a parent might do in a book reading interaction or while watching television with a child, for example, asking questions about the story. These kinds of interactive elements in electronic book are traditionally conceived as the interactive toy scaffolding the child. However, the standard conception of a child-toy dyad may be incomplete; most studies of learning from electronic books include conditions in which the level of interactivity within the device itself is varied (de Jong & Bus, 2002, 2004; Korat & Shamir, 2008; Ricci & Beal, 2002). Less studied is the role of parents in using interactive reading software with children. Interactive features meant to engage a child might also be useful in providing a context for parents to interact with their children in a more comfortable fashion. If one of the problems with less sensitive reading dyads is the lack of

engagement with the text, an electronic version might be able to fulfill that function, keeping the child interested and motivated. Considering the importance of dialogic reading in enhancing emergent literacy skills, it is plausible to hypothesize that an interactive reading book might serve a facilitative role in changing the way parents use interactive books with children and in how they read traditional printed books. If parents are unsure or unaware of how to scaffold more formal aspects of reading, well-designed reading software might help parents to participate sensitively in a book-reading type setting. Examinations of the utility and effectiveness of interactive books should also include an examination of parents' behaviors during an interactive book reading. Parent-child dyads in which parents possess less positive beliefs about dialogic reading or are insensitive to children's needs during shared book reading may benefit more from using an interactive book than parent-child dyads who already have established positive shared reading experiences.

To summarize, building emergent literacy skills is critical to children's future reading success. Interactive books may provide an opportunity for building emergent literacy skills by engaging children and providing supportive behaviors to scaffold reading, if interactive features are closely tied to learning goals. As with print book reading, parental involvement during interactive book reading may be especially helpful in building children's early literacy skills.

The Current Study

The purpose of this study is to examine a screen-based interactive storybook device, the Read With Me DVD System, on children's story understanding, ability to

freely recall the story, and ability to sequence main events from the text. Another goal of this study is to examine the impact of interactive, non-interactive, and print book reading on parent-child dialogic reading behaviors, which are critical to developing emergent literacy skills. Based on research showing the positive impact of coviewing television and the importance of dialogic reading (Lemish & Rice, 1986; Reiser et al., 1984; Reiser et al., 1988; Whitehurst et al., 1994; Whitehurst & Lonigan, 1998), it is hypothesized that children who use the device with their parents will score higher on post-reading measures of story comprehension than those who use the interactive book alone. Additionally, parents with less positive views of dialogic reading may derive additional benefit from using the device compared to reading print books, as the interactive book may provide assistance to parents who are less successful in engaging their children during book readings.

As existing research has provided mixed results about the effectiveness of interactivity as a learning tool, the study examines if interactive features help or hinder children's engagement with and understanding of story content. Since previous studies have found mixed results regarding children's ability to learn story content from interactive books, the interactive book used in this study was selected because of design and control features that may be more appropriately matched to children's physical and cognitive development (Revelle & Medoff, 2002). As such, it is hypothesized that children who use an interactive book will score higher on post-reading tests of story comprehension. In addition to examining how interactivity contributes to learning generally, the study will look at the role of seductive details within the electronic

storybook, or the interactive features that are not closely tied to the main points of the story. Research on the use of seductive details in textbooks (Garner et al., 1992; Harp & Mayer, 1998) and the distracting nature of hotspots in some interactive books (Ricci & Beal, 2002) speaks to the problem of utilizing interesting, but distracting information. Although entertaining and appealing to young children, these seductive details may interfere with children's processing and retention of main story content.

CHAPTER 2 - METHODS

Participants

Participants were 96 English-speaking children (M = 59.23 months, SD = 6.01) and their parents from Riverside County and surrounding communities in southern California. All children were between 4.5- to 5.5-years old. Six children were dropped from the study because of incomplete information or because children were unable to follow the study protocol, leaving 90 children for analysis. There were 49 male and 41 female children, representing European American (45.6%), Latino/Hispanic (30.0%), African-American (12.2%), Asian-American (5.6%), and other multi-ethnic/unknown groups (3.4%). Efforts were made to recruit from a wide range of income classes and cultural backgrounds. Children with developmental delays or other disabilities that prevented them from participating fully were excluded from the study. Participants were recruited through flyers at libraries and child care centers, online postings on Craigslist.com, and targeted mailings. Each participating parent received $20 compensation for their time.

Measures

Media Survey Questionnaire. All parents completed a survey assessing their home media environment, media habits, and personal attitudes toward media. The measure was derived from Rideout et al.'s (2003) survey of young children's media environments. Examples of media environment questions include "How many electronic educational toys, like LeapFrog, if any, do you have in your household?" and "How many children's books do you have in your home?" An example of a media attitudes

question includes “In general, do you think playing electronic educational toys such as Leapfrog products, talking books, etc. mostly helps or mostly hurts children’s learning, or doesn’t have much effect either way?” In addition to providing information about children’s media exposure, parents were asked to reflect on their own media exposure and habits for their last “typical” day. A sample question includes: “When someone is at home in your household, how often is the TV on, even if no one is actually watching it?” The media questionnaire was used to ensure equal representation of children from different home media environments in each group.

Additionally, because the study used a well-known and popular character, Curious George, several questions were asked to assess children’s familiarity and liking of the character. A sample question assessing children’s preference for the character includes, “Compared to other stories, how much does your child enjoy Curious George stories?” A full list of all questions can be found in the Appendix A.

Demographic questionnaire. All parents filled out a questionnaire about their ethnic background, income, and education level. Income was represented as a continuous variable, while education was represented on an ordinal scale (see Appendix A).

Parental Reading Belief Inventory (PRBI). The Parental Reading Belief Inventory (DeBaryshe & Binder, 1994) was given to parents to evaluate attitudes and behaviors surrounding joint book-reading. The PRBI assesses parental attitudes about how and what children learn from reading, as well as parental beliefs about their own self-efficacy as reading teachers. Questions on the PRBI assess the value parents place on children’s active verbal participation during dialogic reading sessions, whether limited

resources are an obstacle to reading, the malleability of language development, and positive or negative affect associated with reading. Example questions include, "reading aloud is a special time we love to share," "schools are responsible for teaching children, not parents," and "when we read I try to sound excited so my child stays interested." All parents rated the extent to which they agreed with each question on a 4-point Likert scale, from strongly agreeing to strongly disagreeing with each statement. Beliefs about joint book-reading are highly predictive of the quality of book-reading interactions, the degree to which parents engage in shared book reading, and the level of children's interest in books (DeBaryshe & Binder, 1994). The PRBI has a minimum score of 42 and a maximum score of 168.

Child Behavior Checklist (CBCL). Parents also completed the Child Behavior Checklist (Achenbach & Rescorla, 2000) to assess parents' perceptions of their children's behaviors, which may inform their interactions during interactive and print book readings. Parents answered 99 questions, including questions about problems, disabilities, parental concerns, and child strengths. The CBCL items are scored from 0 to 2 (0=not true, 1=somewhat or sometimes true, or 2=very true or often true, on the basis of the preceding 2 months), with a minimum score of 0 and a maximum score of 198.

Peabody Picture Vocabulary Test. (PPVT-4). To assess linguistic and cognitive development, child participants were given the Peabody Picture Vocabulary Test – 4th Edition. The PPVT-4 correlates .66 with the Group Reading Assessment and Diagnostic Evaluation (GRADE), a measure of reading achievement that includes phonological awareness, visual skills, concepts, and listening comprehension. The PPVT-4 is

appropriate for use with individuals aged 2 years 6 months through 90 years and older and took about 10 to 15 minutes to administer. In the test, an examiner orally presented a stimulus word with a set of pictures, and the test taker was asked to select the picture that best represented the word's meaning. A ceiling score for each child was obtained after a child made eight or more errors in a set of pictures. Individual scores were obtained by subtracting the number of errors from the total ceiling score. All raw scores were converted to a standard score to account for age. As defined by the PPVT manual, an average standard score is 100 (SD =15).

Free Recall. Following the reading of the story, children were asked to freely recall as much as they could about the story. This item was scored on a point system that takes into account children's ability to remember main points and details from the story. Two research assistants came up with lists detailing the maximum number of moments that could be seen as individual story units, which were integrated into a single list representing 47 possible free recall units.

Story Sequencing Activity. To assess children's ability to put story events in the correct order, children were given six pictures from the story and asked to put them in the order in which the events occurred in the book. Each picture was a full-color, full-page page from the printed book version of *Curious George Goes to a Chocolate Factory*. Selected pictures involve important moments from the story and have a clear logical order. The pictures selected from the printed book look identical to screenshots from the electronic version. Each picture put in a correct sequence was given 1 point for a

maximum of 5 points. For example, if a child put the pictures in the following order: 2, 3, 5, 6, 4, 1 – she received 3 points.

Story Understanding Questionnaire. After completing the free recall and sequencing activities, participants were asked a series of questions that relied on factual recall of main information from the narration and children's ability to infer from the text. A sample factual recall question included, "Where did this story take place?" A sample inference question included, "How do you think the workers felt when they saw George putting the chocolates in boxes?" Questions were scored for correctness and specificity of answers. The total maximum score was 15 (see Appendix B).

Interactive Prompt Use. On each page of the book, two research assistants noted how many unique interactive features and prompts were accessed. In other words, there might be six interactive prompts available, but a child might only access three of them. Children could activate up to a total of 77 unique interactive prompts over 13 story pages. Additionally, as it was possible to activate identical story prompts repeatedly on the same page, the total number of prompts, including repeats was calculated. In other words, if six interactive prompts were available on a page, a child might access all of them more than once resulting in a higher total number of prompt activations. Interobserver agreement for *total unique prompts* and for *total number of prompts* was 100%.

After scoring the total number of prompts, a rater examined the activity on each page of the interactive book and counted the number of prompts activated that were classified as seductive details. Seductive details were defined as interactive prompts that were not related to central story content. Two research assistants identified interactive

features fitting this definition, with an interobserver agreement rate of 90%. When disagreements occurred, research assistants discussed the disagreement with the lead researcher until a consensus was formed. Of the 77 interactive prompts throughout the book, 20 were classified as seductive details.

Dialogic Book Reading Behaviors. All children and parents were videotaped reading the interactive or printed story. Two research assistants examined each video the interaction and coded for parent-, child-, and device-centered book-reading behaviors. An interrater reliability analysis using the Kappa statistic was performed to determine consistency among raters. Coders indicated the frequency of six common joint book reading behaviors: labeling and vocabulary development, verbal expression, activating prior knowledge, book structuring, vocabulary development and print awareness. It was possible for one interaction to be rated in two categories; for example, if a parent asked a question about a picture on the screen and the child responded by nodding, a code would be given in the labeling/vocabulary development category for the adult and the verbal expression category for the child. Book reading codes were derived from Taverne and Sheridan's (1995) assessments of parent-training interventions during book readings (see Appendix C). Each category of behaviors was summed individually, and a total score of all behaviors was also calculated. The interrater reliability for the raters was found to be Kappa = 0.81 ($p < .0.01$).

Joint Book Reading Affective Ratings. As the affective dimensions of interactions around the story are potential moderators of children's learning, the story reading interaction was coded for parent and child engagement, enjoyment, and frustration.

Parents and children were separately rated at three times during the book reading: during the beginning of the book (corresponding to pages 5 – 13 of the printed book), the middle of the book (pages 14 – 21), and the end of the book (pages 22 – 24). The book was broken into parts based on discussions among the experimenters about the structure of the book and what constituted the beginning, middle, and end of the story. For each section of the book, two research assistants used a 5-point Likert scale to rate children and parents separately on engagement, enjoyment, and frustration. Engagement was defined as whether the parent or child was focused on the activity or seemed to be paying attention to the activity. Enjoyment was coded by whether the parent or child seemed to be enjoying the activity, through such actions as smiling, laughing, or not physically pulling away from the activity. Lastly, frustration was defined as whether the parent or child evidenced annoyance, anger, or other negative struggles during the activity (see Appendix D). The interrater reliability for engagement was Kappa = 0.85, $p < .01$, for enjoyment, Kappa = .86, $p < .01$, and for frustration, Kappa = .82, $p < .01$. Coders also rated how successful the interaction was overall, as indicated by raters' overall impressions of parents' and children's engagement and enjoyment of the activity, Kappa = .89, $p < .01$.

Materials

Read With Me DVD System – Curious George Goes to a Chocolate Factory. Based on previous research indicating the advantages of using a simple controller with only a few colorful buttons, so as not to overwhelm children's cognitive capacities (Revelle & Medoff, 2002), a device appropriate for 4.5- to 5.5-year-olds was selected. The Read With Me DVD System is an interactive reading device that reads books to

children and allows children to play story comprehension games. Electronic books come on DVDs and load in standard DVD players. A simple controller is used to move forward or backward through the book, as well as to respond to prompts during the book. The electronic book used, *Curious George Goes to a Chocolate Factory,* is targeted at children ages 3 to 6. Hearing the book read aloud in "read-only" mode takes approximately 6 minutes. The interactive mode of the story, which includes story questions and prompts, may take anywhere from 6 minutes to 45 minutes depending on how often the user responds to interactive prompts. Each question has three options for response, which are used in several ways. A multiple choice question such as "In the story, George loves to eat something. What is it? Chocolate? A hamburger? Flowers?" can be answered by pressing one of three color-coded buttons. Not all prompts take the form of questions; some prompts elaborate on the story. For example, one prompt says, "Inside the factory, a tour guide tells all about how chocolates are made. A tour guide is like a teacher telling everything about chocolates." Prompts encouraging reflection sometimes occur after a prompt has been responded to, such as, "Have you ever been so full that your tummy hurt?"

Procedure

Parents brought their children to the Childhood Cognition Laboratory at the University of California, Riverside for a 90-minute play session. Upon entering the lab, the experimenter played with the child until the child acclimated to the lab environment and could interact with the experimenter comfortably. All children were then assessed with the PPVT-IV, a widely-used assessment of children's receptive vocabulary. In the

test, an examiner orally presented a stimulus word with a set of pictures and the child was asked to select the picture that best represents the word's meaning. While the child completed the PPVT-IV, parents completed the Media Survey Questionnaire, the Parental Reading Belief Inventory, and the Child Behavior Checklist. Children were then placed into one of four story-reading groups as described below. Following the story, children were asked a series of questions to gauge their story understanding, their ability to freely recall the story, and their ability to correctly sequence story events. To avoid cueing information during post-reading measures, children were always asked to free recall first, followed by sequence pictures, then specific story understanding questions. Based on parents' answers in the media exposure survey, efforts were made to include children with varying levels of interactive media experience in each condition.

Group 1. In the *interactive reading with parent* group, children were able to access the interactive features of the book, but a parent sat next to them and was encouraged to participate in the reading. There were between 1 and 8 possible interactive features on each page that could be accessed by pressing a button on the controller. Parents were not given specific instructions on how to use the device with their child, but were told to use the device as if they were using it in their homes.

Group 2. In the *interactive reading alone* group, children were allowed to use the interactive features that were available on every page of the electronic book. Children completed the entire story by themselves while parents waited in a hallway outside the testing room. To prevent difficulties arising from separating parents and children, parents in the hallway could be seen through an open door but were far away enough to

discourage children from trying to recruit their assistance. If children tried to recruit parents' help, parents were instructed to redirect their children's attention to the book by saying "Finish the story," or "Keep going with the story."

Group 3. In the *non-interactive with parent* group, children were not allowed to use the interactive features of the storybook, and viewed the story on television uninterrupted, similar to watching a cartoon. As there is conflicting evidence on whether interactive features are detrimental to story memory and understanding (de Jong & Bus, 2004; Korat & Shamir, 2008; Ricci & Beal, 2002), this condition examined the impact of a story when interactivity has been removed.

Group 4. In the *print book reading with parent* group, children read a print version of *Curious George Goes to a Chocolate Factory* with a parent. The text of the story is identical to the interactive version, and each of the illustrations appears in the interactive story as well. Parents were told to read the book as if they were reading at home.

CHAPTER 3 - RESULTS

Descriptive Analyses

Ninety participants were included in these analyses. There were 23 children in the *interactive reading with parent* condition, 21 in the *interactive reading alone* condition, 22 in the *non-interactive with parent* condition, and 24 in the *print book reading with parent* condition. Groups did not significantly differ on demographic variables, media exposure, PPVT-IV scores, PRBI, or CBCL scores (see Table 1). Parents indicated that their children watched television for 80.13 (SD = 51.39) minutes a day, were read to for 30.19 (SD = 18.90) minutes a day, and played with electronic educational toys for 30.94 (SD = 30.97) minutes a day. Scores on story comprehension outcome variables, including story understanding, free recall, and sequencing, are available in Table 2. None of the children reached a ceiling score on any of the story comprehension variables. A univariate analysis of variance (ANOVA) with reading group as the between-subjects factor found significant differences in how long children spent reading the story $F(3, 87) = 23.63$, $p < .01$. Post-hoc analyses showed that children in the *interactive with parent* condition (M = 18.78, SD = 7.73) were involved in the story for significantly longer than children in any other group. Children in the *interactive alone* condition were involved with the story for significantly longer than children in the *non-interactive with parent* group.

Correlational analyses were conducted on the outcome variables and on individual difference characteristics of participants, including scores on the PPVT-IV, measures of media experience such as typical exposure to books, television, computers, and other

interactive media, and demographic variables identified in related literature as having a relationship to early literacy skills, such as parental education and income level (see Table 3). Children's age, by months old, was significantly correlated with story understanding (r = .355, n = 90, p < .01.), free recall (r = -.289, n = 90, p < .01), and sequencing (r = .410, n = 90, p < .01). PPVT scores were also significantly correlated with story understanding (r = .467, n = 90, p < .01.), free recall (r = .224, n = 90, p < .05), and sequencing (r = .345, n = 90, p < .01). However, age and PPVT scores are not independent; because PPVT scores were scaled to account for age, only PPVT scores were used in the appropriate analyses to avoid violating the assumption of orthogonality. The CBCL Total Problems score was significantly negatively correlated with story understanding, r = -.259, n = 87, p < .05. Correlation analysis revealed no relationship between how much children reported liking Curious George, how often children viewed programs featuring Curious George, or how many books parents owned that included Curious George, and story understanding, free recall, or sequencing variables.

A series of planned comparisons were completed to test several questions of interest relating to the role of interactivity and parent support in children's story understanding. Rosenthal and Rosnow (1991) advise planning *t*-tests before data are collected. If there are unexpected results for *t*-tests (i.e. results that were not hypothesized), it is advisable to compute an overall *F* to protect against chance results. As many of the theoretically driven questions regarding the role of interactivity and parental involvement in learning from interactive books were already well-defined, appropriate contrasts using pre-planned *t*-tests were conducted. In addition to calculating

statistical significance, effect sizes were also calculated. Estimates of effect size, presented with tests of significance, allow for a more complete understanding of the meaning of results. When findings are non-significant, but have a medium or large effect size, it is not advisable to conclude that the independent and dependent variables are not related (Rosenthal & Rosnow, 1991). Rather, there may be an issue of statistical power that could be rectified with a larger sample. The major risk involved with computing multiple *t*-tests is the probability that one or more significant differences may be found through chance alone, a Type-I error. In order to correct for the familywise error rate, Bonferonni corrections were used to establish a corrected alpha on each set of *t*-tests for outcome variables. All planned comparisons are listed in Table 4, Table 5, and Table 6. When a result was statistically significant and had a medium or large effect size, a follow-up ANCOVA was conducted to determine the nature of the relationship between the independent and dependent variables. Where appropriate, variables found to be significantly correlated with outcome variables were included as covariates in ANCOVAs.

Use of Interactive Features

Before assessing what impact interactivity might have on children's story comprehension, or parents' or children's dialogic reading behaviors, participants' use of interactive features was examined. Two groups were able to use interactive features of the electronic book, the *interactive with parent* group and the *interactive alone* group. Figure 1 shows the changes in prompt activation over the course of the story. Generally,

activation of interactive prompts increased over the first two pages then decreased, so children on average were using less than a single prompt per page by the end of the story.

An independent samples *t*-test showed that children who read the interactive story with a parent activated significantly more total prompts overall ($M = 21.05$, $SD = 13.79$) than children who read the interactive story alone ($M = 10.50$, $SD = 10.63$), $t(37) = 2.64$, $p = .01$, $d = .87$, a large effect. Children who read the interactive story with a parent also activated significantly more unique prompts ($M = 15.05$, $SD = 9.32$) than children who read the interactive story alone ($M = 10.63$, $SD = 2.51$), $t(37) = 2.64$, $p = .01$, $d = .87$, a large effect. Lastly, we examined the presence of seductive details, interactive features that do not tie in with central story content, comparing the number of prompts classified as seductive details in each interactive group. Despite the fact that children in the *interactive with parent* condition activated significantly more prompts, they did not activate significantly more seductive details ($M = 5.90$, $SD = 4.54$) than children in the *interactive alone* group ($M = 3.56$, $SD = 4.80$). However, the number of total prompts, unique prompts, and seductive details activated were not correlated with story comprehension variables (see Table 7). As a result, they were not included as covariates when ANCOVAs were conducted.

Does interactivity impact story comprehension?

Interactivity was hypothesized to positively impact children's abilities to understand, recall, and sequence a story. To test this, the *interactive with parent* and *interactive alone* groups were collapsed to form a single group representing the use of interactive features, and compared to the *non-interactive with parent* group with an

independent samples *t*-tests to examine whether the groups had significantly different free recall, sequencing, and understanding scores. An independent samples *t*-test found that among the groups which used the Read With Me DVD device, children who were able to access interactive features did not score significantly better than children who could not access interactive features of the electronic book on story understanding, free recall, or sequencing. While unexpected, analyses proceeded to examine what other factors impacted story comprehension and under what circumstances interactivity might be beneficial for children's learning.

Does parental involvement impact a child's story comprehension?

Parental involvement was also hypothesized to positively impact children's abilities to understand, recall, and sequence a story. To test the effect of parent involvement generally, the *interactive with parent*, *non-interactive with parent*, and *print book with parent* groups were collapsed to form a single group representing parental presence while reading the story, and compared to the *interactive alone* group using an independent samples *t*-tests to examine whether the groups differed significantly on free recall, sequencing, and understanding scores The "parental involvement" group scored higher on the measure of story understanding ($M = 9.16$, $SD = 2.85$) than the group that read the story without parent support ($M = 7.48$, $SD = 3.30$), indicating that parental presence was related to story understanding. This difference was significant, $t(88) = 2.28$, $p = .02$, representing a medium-sized effect, $d = .57$. However, after applying a Bonferonni correction, the difference between the groups became non-significant. There were no differences in performance on free recall or sequencing.

As a medium effect size was detected for story understanding, a follow-up ANCOVA was conducted on story understanding with availability of parent involvement (parental involvement versus no parental involvement) as the between-subjects factor. Correlation analysis revealed that PPVT and CBCL scores were significantly related to the dependent variable, so both were included as covariates. Preliminary checks were conducted to ensure the assumptions of normality, linearity, homogeneity of variance, homogeneity of regression slopes, and reliable measure of the covariates were not violated. No significant interactions between the covariates and story understanding were detected, suggesting the differences in story understanding among groups did not vary as a function of the covariates. There was a significant effect of parental involvement on story understanding after controlling for PPVT and CBCL scores, $F(1, 83) = 6.84$, $p = .01$, $d = .58$. Additionally, PPVT was significantly related to children's story understanding, $F(1, 83) = 19.12$, $p < .001$. However, as the parental dialogic reading behaviors were unrelated to children's story understanding, free recall, or sequencing, the specific nature of parental support that supported learning is unclear. Possible explanations for the relationship between parent involvement and story understanding are reviewed in the discussion.

Does using an interactive book with a parent benefit a child's story comprehension more than using an interactive book alone?

Although children who used the non-interactive version of the electronic book performed as well as children who accessed interactive features, it was possible that there were differences among users of the interactive book. We hypothesized that for users of

interactive books, children who used them with a parent would perform better than children who used them alone. An independent sample *t*-test compared the *interactive with parent* and *interactive alone* groups on story understanding, free recall, and sequencing. Children who used the interactive book with their parents performed better on the story understanding measure (M = 9.48, SD = 2.31) than children who used the interactive book by themselves (M = 7.48, SD = 3.30). This difference was significant, $t(42) = 2.3.5$, $p = .02$, representing a medium-to-large sized effect, $d = .73$. However, after applying a Bonferonni correction, the difference between the groups became non-significant. There were no differences in performance on measures of free recall or sequencing.

As a medium- to large effect size was detected for story understanding, a follow-up ANCOVA was conducted on story understanding with interactive group (*interactive with parent* versus *interactive alone*) as the between-subjects factor. Again, correlation analysis revealed that PPVT and CBCL scores were related to the dependent variable, so both were included as covariates. Preliminary checks were conducted to ensure that the assumptions of normality, linearity, homogeneity of variance, homogeneity of regression slopes, and reliable measure of the covariates were not violated. No significant interactions between the covariates and story understanding were detected, suggesting that the differences on story understanding among groups did not vary as a function of the covariates. PPVT was significantly related to children's story understanding, $F(1, 41) = 10.82$, $p = .002$. There was also a significant effect of parental involvement on story understanding after controlling for PPVT and CBCL scores, $F(1, 41) = 8.91$, $p = .005$, d

= .78. Again, as the measured parental dialogic reading behaviors were unrelated to any of the story comprehension variables, the results suggested parents impacted children's learning through other means.

Does using an interactive book with a parent benefit a child's story comprehension more than reading a print book with a parent?

Dialogic reading remains an important part of building early literacy skills, but it is usually conceived of in relation to print book reading. Given that most research to date on electronic books has compared learning from an interactive book experienced alone to reading a print book with a teacher or parent (e.g. de Jong & Bus, 2004), the issue of parental involvement with interactive books remained unexplored. To examine the impact of parental involvement during an interactive book, children who used the interactive book with their parents were compared with children who read the print book with parents using an independent samples *t*-test. Results showed no significant differences in scores between the groups on measures of story understanding, free recall, or sequencing; children reading an interactive book with their parents performed as well as children reading a print book with their parents.

Can using an interactive book alone be as effective as reading a book with a parent?

The interactive elements of electronic learning toys are often thought of as providing the kinds of support that live social partners typically provide. However, the range of support that can be provided is limited by what has been coded into a device. To test whether reading a print book with a parent is more effective than reading an interactive book individually, an independent samples *t*-test compared the *interactive*

alone and *print book with parent.* Contrary to what was expected, there were no differences between children who read a book with their parent and children who used the interactive device alone on story understanding, free recall, or sequencing.

Does reading a book on-screen impact a child's story comprehension?

Although interactivity across combined groups (i.e., *interactive with parent* and *interactive alone*) did not predict story comprehension, it was also possible that children's story comprehension was impacted by the mode of presentation (i.e. on-screen or printed book). The on-screen presentation of the story had many formal features that were absent from the print book version, including sound effects, music, animations, editing cuts, and zooms. A visual superiority hypothesis would suggest the highly salient nature of the televised presentation might distract children, shifting attention away from the narration toward the visuals (Beagles-Roos & Gat, 1983; Calvert, 1999; Greenfield, Farrar, & Beagles-Roos). Alternatively, the presence of visual and audio information may support children's memory and comprehension (Bus, Verhallen, & de Jong, 2009; Calvert, 1999). To test how children's story learning was impacted by a televised presentation, the *interactive with parent, non-interactive with parent*, and *interactive alone* conditions were collapsed to form a single group that experienced the story via the television screen, and were then compared to the print book group, using separate independent samples t-tests for the different measures of story comprehension. The "screen media" group did not score significantly better than the *print book* group, which did not view the story on a screen, on story understanding, free recall, or sequencing.

To summarize, interactivity was not predictive of children's scores on story understanding, free recall, or story sequencing. There was a significant effect of parental involvement on story understanding, although there was no relationship between parent's specific dialogic reading behaviors and story comprehension outcomes. Children who used the interactive book with a parent outperformed children who used the interactive book alone on the measure of story understanding. Children who used the interactive book with a parent or used the interactive book alone scored at the same levels on all story comprehension variables as children who read the print book with a parent. Finally, children reading the book on-screen performed as well on the story comprehension variables as children who read a print book.

Supportive Dialogic Reading Behaviors

In addition to examining how interactive reading impacted children's story comprehension, we also examined how using an interactive book impacted parents' reading behaviors. Parents participated in all conditions except the *interactive alone* condition and were observed for specific dialogic reading behaviors. Frequencies of parent behaviors are available in Table 8. An ANOVA was conducted on parent support behaviors with parent-supported reading group (interactive with parent, non-interactive with parent, and print book with parent) as the between-subjects factor. The ANOVA did not include behaviors related to helping children use the device as there was not a parallel form of support in print book readings. Follow-up planned contrasts examined the role of user control and interactivity on parent behaviors. The results of the ANOVA indicated a statistically significant difference between the groups, $F(2, 65) = 20.59$, $p < .001$. A

follow-up planned contrast found that there were more supportive behaviors in groups where parents and children had control over the pacing of the story (*interactive with parent* and *print book with parent*) as compared to the group where there was no control (*non-interactive with parent*), $t(63) = 6.32$, $p < .001$, $d = 1.59$. One of the questions in the current study was whether parents using an interactive book would engage in similar numbers and kinds of dialogic reading behaviors as parents reading a printed version of the same book. However, a second planned contrast found no difference in the number of parental dialogic reading behaviors between the *interactive with parent* group versus the *print book with parents* group, $t(63) = 1.26$, $p = .21$, $d = .32$.

We also hypothesized that parents who scored low on the PRBI, and thus placed less value on dialogic reading behaviors, might benefit from using an interactive book. The interactive book could model dialogic reading behaviors, encouraging parents to become more active than they would normally be in print reading situations. To check this possibility, the interactive reading with parent group was split at the mean of parents' PRBI scores ($M = 145.88$) to create a high-PRBI and low-PRBI group, indicating the level of value placed on dialogic reading. A high score indicates a belief that parents are valuable teachers for children's reading skills and positively correlates with dialogic reading behaviors (DeBaryshe & Binder, 1994; DeBruin-Parecki, 1999) A two-way ANOVA of two PRBI (high vs. low) by two reading groups (interactive reading with parent and print book reading with parent) groups was performed to see if parents who placed low value on dialogic reading would engage in more dialogic reading behaviors when using an interactive book. The results of the ANOVA showed no significant effect

of PRBI group, reading condition, or interaction between PRBI group and reading group. In other words, regardless of parents' beliefs about the value of dialogic reading, they engaged in similar numbers of dialogic reading behaviors when reading a print book as when reading an interactive book.

In addition to differences in the number of supportive behaviors, differences in the kinds of support offered were also examined (see Table 8). A series of one-way between-groups ANOVAs were conducted to explore differences between the *interactive reading with parent, non-interactive with parent,* and *print book with parent* groups on labeling and vocabulary development, verbal expression, prior knowledge, book structure, print awareness and reinforcement. All ANOVAs were followed with post-hoc Tukey HSD tests.

There was a significant effect of group on labeling and vocabulary development, $F(2, 65) = 6.60$, $p = .003$. Post-hoc comparisons indicated that the mean score for the *interactive with parent* ($M = 3.38$, $SD = 3.34$) group and *print book with parent* ($M = 3.65$, $SD = 2.73$) groups were significantly higher than the *non-interactive with parent* condition ($M = 1.09$, $SD = 1.23$). There was also a statistically significant effect of group on verbal expression, $F(2, 65) = 12.27$, $p < .001$. Post-hoc comparisons showed that the mean score for the *interactive with parent* ($M = 6.52$, $SD = 2.87$) group was significantly higher than the *non-interactive with parent* condition ($M = 2.68$, $SD = 2.36$) and *print book with parent* ($M = 4.43$, $SD = 2.39$). Analyses showed a significant effect of group on reading behaviors that invoke prior knowledge, $F(2, 64) = 13.21$, $p < .001$, with parents in the *print book with parent* group using more of these behaviors ($M = 4.39$, SD

= 3.22) than children in the *interactive reading with parent (M* = 2.00, *SD* = 2.17) or *non-interactive with parent* groups (*M* = .71, *SD* = 1.42). A one-way ANOVA with reading group as the between-subjects variable revealed a significant effect of group on behaviors that highlighted book structure, $F(2, 64) = 9.38$, $p < .001$. The mean scores for parents in the *interactive reading with parent* (*M* = 3.90, *SD* = 4.47) and *print book reading with parent* (*M* = 5.70, *SD* = 2.98) were significantly higher than for parents in the *non-interactive with parent* condition (*M* = 1.48, *SD* = 1.63). A one-way ANOVA with reading group as the between-subjects variable revealed a significant effect of group on parent behaviors related to print awareness, $F(2, 65) = 16.77$, $p <.001$. Parents in the *print book with parent* group used significantly more print awareness behaviors (*M* = 4.26, *SD* = 2.30) than parents in the *interactive reading with parent* (*M* = 2.29, *SD* = 2.81) or *non-interactive with parent* groups (*M* = .54, *SD* = .91). The *interactive reading with parent* group also scored significantly higher on print awareness behaviors than the *non-interactive with parent* group. Lastly, a one-way ANOVA with reading group as the between-subjects variable revealed a significant effect of group on how much reinforcement was provided during the reading, $F(2, 63) = 10.36$, $p < .001$. Parents in the *interactive reading with parent* conditions provided significantly more reinforcement (*M* = 2.85, *SD* = 3.06) than parents in the *non-interactive with parent* (*M* = .05, *SD* = .22) or *print book with parent* groups (*M* = 1.26, *SD* = 1.63).

Interestingly, a similar pattern of behaviors was found among parents who read the interactive or non-interactive version of the story with their children. Verbal expression, book structure, and labeling and vocabulary development, in that order, were

the most used behaviors in those groups. By contrast, parents who read the print book engaged the most in book structure behaviors, verbal expression, and prior knowledge behaviors, in that order. The differences in the patterns of behavior suggest that the screen-based book offers different affordances for parents to be involved in a reading.

Children using interactive books also may receive support from the device itself. Two groups had access to the interactive features of the electronic book, the *interactive reading with parent* and *interactive alone* groups. As described above, children in the *interactive reading with parent group* accessed more of the electronic book's prompts. Because the electronic book had no ability to monitor children's reading abilities or involvement, the types of support provided by the device were determined by the programmed content on each page of the book. Analyses of differences in the types of dialogic reading support offered are thus an artifact of the total number of times a child elected to access interactive features. Independent samples *t*-tests were conducted to compare differences in the types of device-provided dialogic-reading behaviors between the *interactive reading with parent* and *interactive alone* groups. Analyses revealed that children in the *interactive reading with parent* group received more labeling and vocabulary development support, $t(35) = 2.29$, $p = .03$, more prompts asking children to access their prior knowledge, $t(35) = 2.40$, $p = .02$, and more reinforcement, $t(35) = 2.96$, $p = .001$ (see Table 9).

Use of an interactive book with a parent may also contribute to the total number of dialogic reading behaviors, resulting in a greater number of helping behaviors above and beyond what the interactive book provides by itself (see Figure 2). A univariate

analysis of variance (ANOVA) was conducted on total support (parent and device supportive behaviors combined) with reading group (interactive with parent, non-interactive with parent, interactive alone, print book with parent) as the between-subjects factor. The ANOVA did not include behaviors related to helping children use the device as there was not a parallel form of support in print book readings. Follow-up planned contrasts examined the influence of parental support and user control on total supportive behaviors. The results of the ANOVA indicated a statistically significant difference between the groups, $F(3, 85) = 35.24$, $p < .001$. As expected, a follow-up planned contrast found that there were more total supportive behaviors in groups with parental support (*interactive with parent, print book with parent,* and *non-interactive with parent*) as compared to the group where there was only device support (*interactive alone*), $t(82) = 3.21$, $p = .001$, $d = .71$. A second planned contrast found that there were more total supportive behaviors in groups in which there was user control over the pacing of the story (*interactive with parent* and *print book with parent)* as compared to the group where there was no control over the pacing of the story (*non-interactive with parent*), $t(82) = 7.38$, $p < .001$, $d = 1.63$.

Finally, it was possible that parents may have believed that the interactive book provided enough support and eased off providing additional support to their children while reading. To test this, a final planned contrast examined whether there were more total supportive behaviors when parents used the interactive device with their children as compared to when parents read the print book with their children. As expected, there

were more total supportive reading behaviors when parents read the interactive book with their children than when parents read the print book, $t(82) = 6.65$, $p < .001$, $d = 1.47$.

To summarize, although there were clear differences in the frequencies of parent support and total support between groups, there were no relationships between any of the individual supportive reading behaviors or the total number of supportive reading behaviors and any of the story comprehension variables.

Child Dialogic Reading Behaviors

Children experienced the story in a variety of ways, with and without parent support, and with and without interactivity. Dialogic reading behaviors include those behaviors that children exhibit during story reading sessions and are an important part of the joint-reading process (see Table 10). A univariate analysis of variance (ANOVA) was conducted on child dialogic reading behaviors with reading group (interactive with parent, non-interactive with parent, interactive alone, print book with parent) as the between-subjects factor. Planned contrasts examined whether there were increased child dialogic reading behaviors in groups with parental support versus those without, in groups with user control over pacing versus those without, and between children who used the interactive book with parents and those who read a print book with parents. The results of the ANOVA indicated a statistically significant difference between the reading groups, $F(3, 81) = 34.37$, $p < .001$. As expected, a follow-up planned contrast found that there were more child dialogic reading behaviors in groups with parental support (*interactive with parent, print book with parent*, and *non-interactive with parent*) as compared to the group in which there was only device support (*interactive alone*), $t(81) =$

5.9, $p = .001$, $d = .1.3$. A second planned contrast found that there were more child dialogic reading behaviors in groups where there was user control over the pacing of the story (*interactive with parent, print book with parent,* and *interactive alone)* as compared to the group where there was no control over the pacing of the story (*non-interactive with parent*), $t(81) = 7.59$, $p < .001$, $d = 1.68$.

Finally, it was expected that children in the *interactive reading with parent* group would engage in more dialogic reading behaviors than children in the *print book with parent* group because there would be two potential reading partners: the device and the parent. However, a final planned contrast revealed children who read the print book with parents engaged in more dialogic reading behaviors than children who used the interactive book with their parents, $t(81) = -2.93$, $p = .004$, $d = .65$.

As with the parental dialogic reading behaviors, there were differences in the kinds of dialogic reading behaviors in which children engaged (see Table 10). A series of five one-way between-groups ANOVAs were conducted to explore differences between the *interactive reading with parent, interactive alone, non-interactive with parent,* and *print book with parent* groups on labeling and vocabulary development, verbal expression, prior knowledge, book structure, and print awareness. All ANOVAs were followed with post-hoc Tukey HSD tests.

There was a significant effect of group on labeling and vocabulary development, $F(3, 83) = 7.15$, $p < .001$. Post-hoc comparisons indicated the mean score for the *interactive with parent* ($M = 1.43$, $SD = 1.43$) group was significantly greater than the *non-interactive with parent* condition ($M = .38$, $SD = .74$) and the *interactive alone*

conditions (*M* = .11, *SD* = .32). The *print book with parent* (*M* = 1.21, *SD* = 1.35) group scored significantly higher than the *interactive alone* condition (*M* = .11, *SD* = .32) and the *non-interactive with parent* condition (*M* = .38, *SD* = .74).

There was also a statistically significant effect of group on verbal expression, $F(3, 84) = 25.07$, $p < .001$. Post-hoc comparisons indicated that the mean score for the *interactive with parent* condition (*M* = 7.90, *SD* = 4.10) was greater than the *non-interactive with parent* condition (*M* = 2.34, *SD* = 1.99) and the *interactive alone* conditions (*M* = 2.16, *SD* = 3.06). The *print book with parent* (*M* = 8.96, *SD* = 3.70) group scored significantly higher than the *interactive alone* condition (*M* = 2.16, *SD* = 3.06) and the *non-interactive with parent* condition (*M* = 2.34, *SD = 1.99*).

Analyses showed a significant effect of group on reading behaviors that invoke prior knowledge, $F(3, 82) = 3.64$, $p = .016$, with children in the *interactive reading with parent* group using more of these behaviors (*M* = 2.85, *SD* = 2.30) than children in the *non-interactive with parent (M* = 1.04, *SD* = 1.24). There was a significant effect of group on behaviors that highlighted book structure, $F(3, 82) = 12.73$, $p < .001$. The mean scores for children in the *print book reading with parent* (*M* = 3.96, *SD* = 3.36) were significantly higher than for children in the *interactive with parent* (*M* = 1.95, *SD* = 2.74), the *non-interactive with parent* condition (*M* = .52, *SD* = .75), and the *interactive reading alone* condition (*M* = .10, *SD* = .32). Groups also differed on how many behaviors were related to print awareness, $F(3, 82) = 8.42$, $p <.001$. Children in the *print book with parent* group exhibited significantly more print awareness behaviors (*M* = 2.39, *SD* = 2.93) than parents in the *interactive reading with parent* (*M* = .65, *SD* = .88),

interactive reading alone (*M* = .05, *SD* = .23), or *non-interactive with parent* groups (*M* = .38, *SD* = .97).

To summarize, there were more child dialogic reading behaviors in groups where there was parental support and in groups that had control over the story. Additionally, children who read a print book with parents engaged in more dialogic reading behavior than children who used the interactive book with parents. There were significant differences between groups in the types of behaviors that children engaged in.

Engagement, Enjoyment, and Frustration

In addition to interactivity and parental support, one of the important aspects of story reading is the affective climate surrounding the interaction. The three affective qualities measured, parent engagement, enjoyment, and frustration, were significantly correlated (see Table 3). Means and standard deviations can be found in Table 11. As the affective qualities of the reading interaction could have an impact on children's participation in and learning from the story reading, a multivariate analysis of covariance (MANCOVA), with reading group as the between-subjects variable, was conducted to examine the impact of reading condition on levels of parental engagement, enjoyment, or frustration. The amount of time reading the story was included as a covariate, as any of the dependent variables would be expected to relate to how long a story reading occurred, especially if it was too short or too long. There was a significant multivariate effects of reading condition, Wilks Lambda = .88, $F(3, 56) = 2.94$, $p = .05$ and reading time, Wilks Lambda = .86, $F(3, 56) = 3.05$, $p = .04$. There was also a significant multivariate

interactive between condition and reading time, Wilks Lambda = .86, $F(3, 56) = 2.98$, $p = .04$.

Deeper investigation of between-subjects effects revealed no significant impact of reading condition or reading time on parent enjoyment or parent engagement. However, there were main effects of reading condition, $F(1, 58) = 5.88$, $p = .018$, and reading time $F(1, 58) = 8.19$, $p = .006$, on average parent frustration. There was also a statistically significant interaction between condition and reading time, $F(1, 58) = 8.22$, $p = .007$, indicating that differences in parent frustration between groups vary as a function of reading time. To assess these differences, parent frustration was estimated by a separate slopes model, which obtains the slope of covariates for each group. There was no significant relationship between reading time and parent frustration in the *non-interactive with parent* or *print book with parent* groups. However, reading time was a small, but significant predictor of parent frustration in the *interactive reading with parent* group, b = .019, $p < .001$, indicating that the increased time spent reading positively predicted parent's level of frustration. Importantly, reading time was positively correlated with device dialogic reading behaviors, $r = .61$, $p < .01$, which may mean that increased usage of device in the *interactive reading with parent* condition led to longer readings and increased frustration among parents the longer the reading took, and the more frustrated parents got. Even though reading time predicted parent frustration in the *interactive reading with parent* group, it is important to note that the average levels of frustration within all parent groups were quite low, in comparison to measures of engagement and enjoyment (see Figure 3).

Since children's affective experiences of the reading experience could also play a role in their participation in and learning from the story reading, a multivariate analysis of covariance (MANCOVA), with reading group as the between-subjects variable, was conducted to examine whether reading condition produced different levels of child engagement, enjoyment, or frustration. Means and standard deviations can be found in Table 11. Again, all dependent variables included in the MANCOVA were significantly correlated (see Table 3). Amount of time reading the story and PPVT scores were included as covariates. The MANCOVA showed no significant effects of reading condition on child enjoyment or engagement.

However, there were main effects of reading condition, $F(2, 70) = 4.09$, $p = .021$, reading time, $F(1, 70) = 10.73$, $p = .002$, and PPVT, $F(1, 70) = 9.68$, $p = .003$, on average child frustration. There was also a statistically significant interaction between condition and PPVT, $F(3, 70) = 3.46$, $p = .017$, and condition and reading time $F(3, 70) = 3.63$, $p = .012$, indicating that differences in child frustration between groups varied as a function of children's PPVT scores and time spent reading the story. To check this, child frustration was estimated using a separate slopes model. There was no significant relationship between PPVT and child frustration in the *non-interactive with parent* or *print book with parent* groups. However, PPVT was a small, but significant predictor of children's frustration in the *interactive reading with parent* group, b = -.027, $p = .005$, and the *interactive alone* group, b = -.015, $p = .023$, indicating that children with higher PPVT scores were less frustrated when using the interactive book. Additionally, reading time was a significant predictor of child frustration, b = .038, $p = .023$, indicating that

children in the *interactive alone* condition who read the story for longer periods of time were more frustrated. Again, because of the correlated nature of reading time and supportive device behaviors, reading time may actually reveal that increased use of interactive device features leads to more child frustration.

CHAPTER 4 – DISCUSSION

The goal of this study was to examine the role of an interactive book on children's emergent literacy skills. Specifically, the study assessed the role of interactivity on story comprehension skills, including story understanding, story memory, and sequencing. The study also examined whether seductive details in an interactive storybook would distract from children's learning. Finally, the impact of interactive storybooks on parent-child joint book-reading behaviors was assessed. To examine these questions, one study was conducted in which children read a *Curious George* storybook in four ways: children read an interactive version of the book with a parent, an interactive version of the book without a parent, a non-interactive version of the story with a parent, or a print book version of the story with a parent. All children were pre-tested with the PPVT-IV, a measure of language and cognitive development. Interactions were observed for specific supportive reading behaviors and general engagement, enjoyment, and frustration. Children in all groups generally performed well in answering questions relating to their understanding of their story, sequencing pictures from the story, and freely recalling parts of the story. Interactivity and parental support were examined as potential predictors of differences between groups.

Children's use of interactive features was not related to their comprehension of the story. Additionally, increased exposure to seductive details in the interactive book was unrelated to story comprehension. Of all the independent variables tested, only parent involvement was significantly related to children's story understanding after controlling for language development and parents' perceptions of children's behaviors,

although the frequency of parental dialogic reading behaviors was unrelated to children's performance. The types of parental support offered varied by group. Findings are discussed in terms of the advantages and limitations of interactive, non-interactive, and print book joint-reading sessions.

Using an Interactive Book

Interactive books provide children with a different kind of experience than print books; they often provide ways to interact with on-screen content, involve animations and games, or otherwise engage children through user participation. The current study examined the extent to which children used interactive features of the electronic book and how it impacted story comprehension and parent participation. Many of these features took the form of prompts that simulated supportive reading behaviors, such as asking children about the story's setting, or asking children to reflect on their own experiences as they related to the story. These kinds of dialogic reading behaviors have been linked to children's emergent literacy skills when parents read print books with their children (Bus, 2001b; Kaderavek & Sulzby, 1998; Ninio, 1983; Rodgers, 2005; Taverne & Sheridan, 1995). Interactivity may also strengthen story comprehension and retention through increased engagement and motivation (Calvert et al., 2005; Ricci & Beal, 2002). In the research reported above, children in the interactive reading groups were as engaged in the story activity as children in non-interactive and print book reading groups. The inclusion of device-provided dialogic reading behaviors in the interactive book was hypothesized to benefit children's reading in part because it emulated social interactions by asking for user participation and responding contingently to children's input. Results showed that

children who used the interactive book with a parent activated more of the interactive features than children who used it alone. However, the study found no relationship in either group between accessing the supportive prompts and any of the story comprehension variables.

It was also possible that some of the content of interactive features accessed by children in the present study might be disruptive. As with television, children under 10 often have difficulty distinguishing between central content, the important information in a story, and incidental content, which is irrelevant to plot comprehension (Collins, 1983). Interactive features, when well planned by media creators, could direct children to central story content. Otherwise, they could inadvertently lead children to selectively attend to unimportant or peripheral content. Engagement with interactive features could be disruptive to children's abilities to form a coherent mental representation of the story because it interrupts transitions between parts of the story (Harp & Mayer, 1998).

In the materials used for the research reported above, on one page of the story, children were shown a still frame from the story with a character missing and asked to find what was missing from the picture. Although potentially entertaining, finding a missing character was not critical to understanding the story and may incorrectly lead children to believe the story had something to do with a missing character, which it did not. In another example, children were asked to count the number of chocolates in a box displayed on the screen. Though engaging and helpful to building to numeracy skills, this activity may have disrupted the flow of the story without reinforcing information that was central to story understanding. Interactive features that did not link to central story

content were classified as seductive details. When examined, however, children's use of seductive details was unrelated to story comprehension variables. This finding supports the results from at least one other study that found no relationship between children's access to irrelevant interactive "hotspots" and story memory (Ricci & Beal, 2002).

Beyond the content of interactive features, interactivity itself could be considered a seductive detail. Children could have become over-involved with the device itself, taking cognitive resources that otherwise could have gone to story comprehension, and directed those resources to figuring out how to use the device or matching their actions with the device controller to the screen (Revelle & Medoff, 2002; Strommen, 1993; Strommen et al., 1996). To examine this, children who had access to interactive features were compared to children who experienced the non-interactive version of the story, but no significant differences on the story comprehension variables were observed.

This indicates several possibilities. First, interactivity itself may not be disruptive to story comprehension. Children are growing up immersed in digital technologies and may be used to the kinds of interruptions that interactivity provides. In fact, parents reported that children in this sample spent roughly 30 minutes a day with electronic educational toys. Although none of the children had any prior exposure to the specific device used in this study, it is possible that children had schemas for how to use these types of devices, which would enable them to divert more of their cognitive resources to reading the story and less to dealing with interactive disruptions.

A second possibility is that interactivity is distracting, but the kinds of interactivity offered by the device under study was limited enough that children were able

to overcome the distractions. Because one hypothesis of the study was that children who used the interactive version of the story would perform better than children who used the non-interactive version, we selected an interactive book that did not provide an entirely open environment. Other studies have used interactive books in which children could click on numerous onscreen hotspots at their own choosing (de Jong & Bus, 2002; Korat & Shamir, 2008). However, the device in the current study only had one to eight interactive prompts per page, and children could only activate them after the full page had been read. Providing restrictions on and structure to children's interactions during the story may have helped children to retain important story content and prevented them from becoming too distracted. This is in line with other research that found that having access to numerous interactive inserts and features on-screen encouraged passive viewing and harmed children's ability to make sense of a story (Labbo & Kuhn, 2000). At least one other study has found that using an electronic book with fewer animations and interactive features aided story memory in four- to five-year-old children (de Jong & Bus, 2004). Structured interactivity may also explain why seductive details failed to have any impact on children's learning; there may have been too few opportunities to be distracted from central story content.

To summarize, children who used the interactive book did not score better on post-reading tests of story comprehension than children who used the non-interactive book. Additionally, for the two groups that were able to use the interactive version of the story, the total number of interactive prompts and the total number of unique interactive prompts were unrelated to children's post-reading performance. Although children who

read the interactive version of the story with a parent activated more total prompts and more unique prompts, it did not make them any more likely to remember story content. This may suggest that the impact of interactivity in an electronic book plateaus, meaning that after a certain point, children derive no additional benefits. It may also mean that interactivity was not a factor in children's learning for either group. This seems more likely because children who read the non-interactive version of the story performed as well as the children who read the interactive versions. In either case, it appears that the differences that were found in children's story understanding were driven by other factors, specifically parent involvement. As with parental mediation of television, the involvement of a parent seems to facilitate the learning of content (Comstock & Scharrer, 2007).

The Importance of Parental Involvement

One of the main goals of the study was to examine the impact of parental support on children's story comprehension in a variety of reading situations. Reading with children is one of the most important predictors of early literacy and later school success (Crijnen et al., 1998; National Reading Panel, 2000; National Research Council, 1998; Stanovich, 1986). However, new technologies have made it possible to read books in different ways, engaging children not just through print and static illustrations, but through active animations, interactivity, and highlighted text. One of the potential advantages of interactive books is that children may experience them in ways that previously required the support of a more experienced reader. Among other features, interactive books can read text aloud, ask story comprehension questions, direct attention

to important story points, and reinforce content with games or other activities. However, when a child uses an interactive book without a parent or more experienced partner, he or she may also lose some of the most important elements of live joint-story book reading: engagement with a live social partner, assistance tailored to the needs of the child, and a history of enjoyable shared storybook reading experiences (Bus, 2001b; Sulzby, 1985; Whitehurst et al., 1988, 1994). Thus, it was important to consider the nature of reading an interactive book with a parent; children who read an interactive book with a parent can get tailored support from a parent, as well as have access to desirable interactive features.

It was hypothesized that interactive books might provide a context for low-scaffolding parents to engage in dialogic book readings with their children. Since parental beliefs about reading are highly correlated with parental dialogic reading behaviors, the PRBI was used as a proxy for determining high and low scaffolding parents. However, parents who placed less value in the importance of dialogic reading, and were thus less likely to engage in supportive reading behaviors, did not engage in any more dialogic reading behaviors when they used the interactive book than when they read the print book. This does not mean that interactive books do not aid parents who are less sensitive scaffolders; the results only show that parents at all scaffolding levels use similar numbers of dialogic reading behaviors in interactive and print readings. It is possible that a single reading with an interactive book was insufficient to demonstrate an impact on parental dialogic reading behaviors, so additional research would be desirable to determine if using an interactive book increases the frequency or diversity of dialogic

reading behaviors over time for low-scaffolding parents, or whether it increases the likelihood that low-scaffolding parents will read again with their children.

In comparing children who used the interactive book with and without a parent, results showed a medium- to large effect size for story understanding, even though the groups were not significantly different. Follow-up analysis found parental involvement was a significant predictor of children's story understanding, meaning that using an interactive book alone could not produce the same benefit as using an interactive book with a parent. This finding undermines the idea that an interactive book can provide effective reading scaffolding comparable to a live parent.

More generally, although there was no significant difference between all of the groups which had parent involvement (*interactive with parent, non-interactive with parent* and *print book with parent*) and the group that did not (*interactive alone)*, there was a considerable effect size of parent involvement. As such, a follow-up analysis was conducted, which showed that level of parental involvement was positively related to children's story understanding. It may be that having a parent present is enough to keep children attentive to the story and set an expectation about learning from the story.

Story understanding has been linked to print decoding skills, vocabulary, and metacognitive skills, and is one of the primary components of emergent literacy skills (National Research Council, 1998). As story comprehension skill at school entry is strongly predictive of later literacy, efforts to improve children's story understanding can have long lasting impacts well beyond the preschool years (Wells, 1985; Whitehurst et al., 1988). Establishing emergent literacy skills prior to school entry can increase the

chances of establishing a positive reading developmental trajectory and improve the odds of academic success (Crijnen et al., 1998; National Research Council, 1998; Stanovich, 1986). Encouraging multiple types of reading experiences to support emergent literacy skills may be desirable, especially for children who are naturally drawn to interactive books. Some children and parents may find the use of interactive book a welcome complement to traditional print book reading. Even though interactivity was not demonstrated to be related to improved outcomes, interactive books can be part of a set of tools for developing the emergent literacy skills that are the precursors to formal reading, but only when parents participate in the activity.

There are several possible reasons that parent involvement was unrelated to children's free recall of the story or their ability to sequence the story using pictures. The free recall question was open-ended, encouraging children to remember as many details from the book as possible. On average, children could recall fewer than four individual story units, and recall was correlated with children's PPVT scores. It may be that children's performance on the free recall task is determined more by children's verbal ability at this age than other factors, such as parental involvement or interactivity. Additionally, in contrast to the open-ended nature of the free recall task, the story understanding questions provided cues that linked specifically to the story. It is possible that having parents read with children provides the support necessary for children to remember important information from the story when presented with specific questions. In fact, many of the types of support offered by parents in the study involved asking questions relating to the story, such as asking children to label something on a page or

asking questions to get children to think about what happened on the page they just read. These are common parent reading behaviors (Sulzby, 1985; Taverne & Sheridan, 1995; Whitehurst et al., 1988). However, no parents asked his or her child to spontaneously recall everything that happened in a story, or had their child retell the parent the story after it concluded. Thus, parents may not have engaged in the behaviors necessary to produce meaningful differences in free recall.

Similarly, experiencing an interactive version of the story without a parent was sufficient to produce equal scores on sequencing as experiencing the story with a parent. In both cases, the story was salient enough that children could sequence the story at similar levels regardless of parental support. Children across conditions were able to sequence about 3.5 pictures out of 5. Sequencing scores were also correlated to children's PPVT scores, suggesting that children's ability to correctly sequence parts of a story after reading is related to their verbal ability

It was also hypothesized that children who used an interactive version of the book would perform better on post-reading measures of story understanding, free recall, and sequencing than children who used the interactive book alone. Results showed that children who read an interactive book with a parent performed better on the story understanding measure than the children who used it alone, but not on free recall or sequencing. As mentioned above, the effect was not related to the frequency with which interactive features were accessed; parental involvement was the determining factor. However, it is unclear exactly how parental involvement impacted children's scores. Children in the interactive alone condition had less than a quarter of the total support

(about 15 supportive behaviors) as children who read the interactive book with a parent (about 60 supportive behaviors). Children who read with a parent were also more active users of interactive features. As a result, there was additional focus on labeling and vocabulary development, prior knowledge, and reinforcement. This was in addition to the parent support that the children who read alone lacked. However, neither the total number of parental dialogic reading behaviors nor the frequencies of individual dialogic reading behaviors were related to children's scores. Parental involvement seemed to have an impact through other means, perhaps by cueing children to think of the story reading as a learning experience. Based on prior shared reading experiences in classrooms and in the home, children may have reading schemas that cue them to increase their attention and actively remember the story because reading partners tend to ask children about books as they are read aloud. Indeed, the majority of parents indicated on the PRBI that they were active during story readings, asking questions, labeling, and otherwise engaging children in books. Other research has shown similar learning effects when parents and children coview television together (e.g. Collins, 1983; Friedrich & Stein, 1973), finding that parent presence and verbal comments can significantly improve children's learning from educational television (Fisch, 2004a).

Even though parental dialogic reading behaviors were not predictive of children's story comprehension, it is still interesting to examine differences in the types of parental dialogic reading behaviors in each group since they have been found to be predictive of emergent literacy skills in other studies (Bus & van Ijzendoorn, 1995; Whitehurst et al., 1994; Whitehurst & Lonigan, 1998, 2001). Not surprisingly, participants who used the

non-interactive version of the story, and did not have control over the pace of the story, spent far less time involved with the story. Generally, the less time spent with the story, the fewer parental dialogic reading behaviors were observed. As a result, parents in the non-interactive group used the fewest number of each type of dialogic reading behavior, although they performed just as well as the other groups that read with parents on the story comprehension measures. This fits with other investigations that have found that children using non-interactive audio-visual presentations perform as well on story memory tasks as children using interactive versions (Ricci & Beal, 2002).

Parents who read the print book tried to connect the story more to children's earlier experiences (prior knowledge) than parents who read the interactive or non-interactive version of the book. Even though the text was available to children in the interactive conditions as well, parents using the print book were more likely to encourage children to attend to print characteristics of the book, such as letters and sounds. This makes sense, considering that parents were the ones actively reading the text aloud, while a narrator read the on-screen versions. By contrast, parents in the interactive condition were more likely to model verbal fluency by expanding on children's utterances or commenting on the story as it was read (verbal expression). Parents in the interactive condition were also more likely to provide positive or negative reinforcement than parents in the non-interactive or print book conditions by making comments like "good job" or "stop that." This is likely the result of the nature of using a new device with a child. Although children were trained to use the interactive book, it was still a less familiar experience than reading a print book. As such, parents may have needed to

correct their children if they struggled with the device or praise them when they used it correctly. Above all, parents in the interactive reading group most frequently assisted children in using the device itself.

Differences in the frequencies of dialogic reading behaviors within each group indicate that the affordances of reading a book on-screen differ from the affordances of reading a book in print. Parents alter their scaffolding behaviors to suit the needs of the medium. For interactive books, parents' behaviors are more related to helping children use the device itself. When reading a print book, parents are more focused on connecting the story to prior knowledge or highlighting aspects of print. When parents had no control over the story, they engaged in fewer dialogic reading behaviors overall, which could be advantageous in that situation because trying to engage their children too frequently while the story was proceeding might have disrupted their children's comprehension. Each pathway had value in helping children read the story and was sufficient to produce statistically equal scores across the parent-assisted conditions.

Children's Participation in Story Reading

Child involvement was not related to performance on post-reading tests of story comprehension. Children were active participants in all reading conditions, and there were significant differences between groups. Children were more likely to engage in dialogic reading behaviors when parents were involved, indicating the importance of a live social partner when reading. Children also engaged in more dialogic reading behaviors when involved in groups in which there was control over the pacing of the story. This is not surprising, considering that children in the group in which there was no

control, the non-interactive reading group, also spent less time involved with the story. Generally, the longer children spent reading the Curious George story, the more they were able to participate.

It was hypothesized that children who read the interactive book with a parent would engage in more dialogic reading behaviors than children who read a print book with a parent because the child could respond to the parent or the device. This hypothesis was not supported; in fact, the opposite was found. Although parent, device, and child dialogic reading behaviors were significantly correlated in both groups, children who read the print book with a parent engaged in significantly more dialogic reading behaviors than children using the interactive book. This suggests that interactions around the print book are more conducive to evoking children's dialogic reading behaviors. Most of the differences in children's dialogic reading behaviors stemmed from children attending to specific aspects of print, such as reading a letter or word, and from commenting on book structure, such as noting the title or demonstrating an awareness of story order (i.e. beginning, middle, or end). The implication of this finding is that print books may be more useful for parents who want to encourage their child to participate in reading.

A final point of interest relates to the social nature of the interactive book. The interactive features allowed for some social contingency, in the form of children being able to respond to prompts by pressing buttons on the controller. However, children who read the interactive book by themselves displayed the fewest number of dialogic reading behaviors. On average, they displayed under three observable dialogic reading behaviors

when using the device. This does not necessarily mean that children were not responding socially to interactive media, but they were not displaying observable or verbal behaviors at the same levels as children who read with a parent. The results provide a reminder that although interactive media may be able to provide some aspects of reading scaffolding functionality, they may not elicit the same level of verbal or observable dialogic reading behaviors in children as parents. This may be expected considering that most current interactive media is not responsive to vocal input, so there is less incentive for children to verbally respond to an interactive book. Pressing a button on the device in response to an interactive feature could be considered a non-verbal social response, since the child is responding to a direct prompt. A future analysis of the data could more closely examine each interactive feature that children responded to in order to understand other non-verbal reading behaviors.

Affective Qualities of Interactive Book Reading

Although it was hypothesized that the affective qualities of the book reading activity would impact learning, no relationship was found between parent or child engagement, enjoyment, or frustration and story comprehension variables. Levels of engagement and enjoyment were generally high in all groups. However, parents using the interactive book with their children had higher levels of frustration, driven at least partly by the increased time it took to read the interactive book. Thus, although parents might be engaged in and enjoying the interactive reading, increased frustration could lead parents to avoid using interactive books in their homes, especially when other forms of reading are less stressful.

Children in all groups enjoyed and were engaged in the story in all reading conditions. However, children using the interactive book by themselves showed more frustration than children in other reading groups. The frustration was related to the increased amount of time it took children in the interactive alone group to complete the story. As the length of time reading the story was significantly correlated with the number of interactive features children accessed, the implication is that children might prefer to read a book with a parent, on-screen or off, because it would be a less frustrating experience.

Limitations and Future Research

Children in the current study only experienced one book at one time point. It is possible that the novelty and unfamiliarity of using the Read With Me DVD device consumed cognitive resources that otherwise could have been used processing story content. With more practice and exposures, children's performance after reading an interactive book could improve. Additionally, it is possible that the story used in the current study was too easy, making it more likely that only minimal support was necessary to achieve comparable levels of story understanding across groups. However, this seems unlikely given that no child scored at ceiling on the story understanding measure and there was substantial variance among children's story understanding scores. There may have also been a novelty effect such that children in the interactive book conditions improved their scores because of interest in a new technology, as compared to the more familiar parent-child print book reading. A future study could tease out these issues by having children use several storybooks over multiple exposures.

Another line of follow-up research could more closely examine the social nature of onscreen characters. Preschool children's learning from screen media is likely influenced by their parasocial relationships with on-screen characters (Richert et al., in press). Parasocial relationships describe the ways in which users of media respond to on-screen figures as they would to live partners in typical social interactions, such as through identification with characters or empathizing with characters' situations or feelings, even though there is no social contingency. Although the book used in the current study involved a popular children's character, Curious George, all interactive prompts were given by an unknown narrator who was never seen. Children had no prior relationship with the narrator, unlike when reading print books with parents. Since children are disposed to interact with media in social ways (Reeves & Nass, 1996; Richert et al., in press), future research should examine children's learning of story content when they have the opportunity to interact with a known character. In other words, if Curious George was asking children about what happened on a page or asked children about their own experiences as they related to the story, would children be more attentive and retain central story content more effectively?

Future research should also follow-up on findings that parents and children experience increased frustration when using interactive books. One appeal of interactive books is that they are an additional tool that can be used in informal learning environments that children enjoy using. If children have multiple frustrating experiences with interactive books, it could dissuade children from wanting to use them as a learning tool. If used too frequently, it could also lead children to develop negative associations

with reading, a result that could harm children's long term reading development. Children in this study were only able to read a single interactive story, so frustration might have been related to the unfamiliarity of the device. However, a future study could examine children's reading preferences after multiple exposures to interactive books to see if the pattern remains.

One final concern involves observing naturalistic reading behaviors in a laboratory setting. Although care was taken to make parents and children feel comfortable in an unfamiliar setting, behaviors observed in the lab may not be reflective of what occurs in the home. Unlike laboratory settings in which adults are more likely to lead interactions, children in home environments initiate more than 75% of the interactions that lead to scaffolding (Carew, 1980, cited in Gauvain, 2005). Thus parents' and children's observed behaviors in the current study may not be reflective of their home dialogic reading behaviors. Examining reading interactions in the home environment would be an ideal next step.

CHAPTER 5 – CONCLUSIONS

This study was one of a limited number of published experimental studies to test the impact of interactive books on story comprehension outcomes (Bus et al., 2009; de Jong & Bus, 2002, 2003, 2004; Ricci & Beal, 2002). It was also the first to closely examine parent-child interactions around interactive books. New technologies progress rapidly, often beyond the capabilities of research to study their impact on child outcomes. However, electronic books continue to be a popular format, available on stand-alone devices such as the one used in this study, on the web, and increasingly on mobile platforms such as the iPhone and iPad. This study illuminates the potential and limitations of interactive books to develop emergent literacy skills, such as story comprehension. Although interactivity was not related to increased performance on child reading outcomes, it was at least as effective as other groups when a parent was present.

Although this study was not intended to make a case for choosing one form of reading over another, it does suggest that there are multiple ways to encourage children's interest in reading. For families who enjoy using new technologies, this study suggests that interactive books are a useful tool to complement traditional print book reading. Importantly, however, this study provides evidence that interactive books do not replace parents as reading scaffolding partners. Parents wanting to promote emergent literacy skills should not rely on marketing claims of the educational value of an interactive book and should remain actively involved in all reading scenarios, interactive or not.

A major appeal of interactive books is a perception that they can support and promote similar to a live teacher, by providing scaffolding assistance through modeling,

providing contingent assistance based on the reader's needs, and making difficult aspects of reading more accessible by providing assistance when necessary (Gauvain, 2005). Interactive books can only provide limited scaffolding at this point, by motivating children's interest in the activity and providing a limited set of prompts that support story comprehension, vocabulary development, personal reflection, and other reading skills. Like an experienced tutor, an ideal interactive book would adapt to children of different ages and abilities by adjusting to different developmental levels, reading abilities, or interests (Gauvain, 2005; Wood et al., 1976). An interactive book could monitor a child's abilities to read independently or understand story content, and reduce the amount of support provided or increase difficulty as children developed their reading skills. As new technologies gain increased functionality and become more sensitive to children's development and changing capabilities, they could become important agents of socialization, like teachers, parents, peers, siblings, and other social partners who help children learn the skills of a culture.

Table 1

Characteristics of Sample

	Total Sample (n = 90)		Interactive Reading with Parent (n = 23)		Interactive Reading Alone (n = 21)		Non-interactive with Parent (n = 22)		Print Book Reading with Parent (n = 24)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Child's age (months)	59.23	6.01	60.35	5.60	58.29	5.10	58.00	5.05	60.13	7.70
Income (per year)	64,962	46,047	71,500	39,142	76,437	48,022	62,320	60,596	51,444	32,000
Parent educational level*	2.45	1.04	2.52	1.08	2.81	.93	2.43	1.16	2.08	.93
Child gender (0=male, 1=female)	.46	1.04	.39	.50	.52	.51	.45	.51	.46	.51
Total minutes watching TV on typical day	80.13	51.39	80.00	66.52	62.31	47.77	88.42	41.50	68.20	52.98
Total minutes being read to on typical day	30.19	18.90	32.27	27.63	26.79	12.03	33.00	15.08	27.73	15.02
Total minutes playing with electronic educational toys on typical day	30.94	30.97	29.78	34.45	32.14	39.14	31.17	33.30	38.13	37.79
Length of time reading target story	11.44	7.33	18.78[a]	7.73	12.08[ab]	7.33	5.50[ab]	0	8.98[a]	5.19
PPVT-IV (Scaled)	105.59	14.54	103.43	11.38	105.43	13.82	108.32	15.25	105.29	17.42
Parental Reading Belief Inventory	145.88	9.96	145.83	9.71	145.86	8.66	147.86	8.56	144.09	12.53
CBCL Total Problems Scale	43.36	9.42	42.48	6.06	44.50	9.89	44.60	11.67	42.05	9.72

Note. [ab]Matching superscript within rows denote values that are significantly different at $p < .05$

*0=did not complete high school, 1=High school diploma/GED, 2=Some college/vocational school, 3=Bachelor's degree, 4=Advanced degree

Table 2

Story Comprehension Scores by Condition

	Story Understanding (out of 15)[a]		Free Recall (out of 47)[b]		Story Sequencing (out of 5)[c]	
Condition	*M*	*SD*	*M*	*SD*	*M*	*SD*
Interactive reading with parent	9.48	2.31	3.41	2.38	3.77	.922
Interactive reading alone	7.48	3.30	4.24	5.16	3.45	1.23
Non-interactive with parent	9.45	3.47	4.14	3.59	3.50	1.01
Print book reading with parent	8.58	2.72	3.33	2.63	3.50	1.25
Total	8.77	3.03	3.76	3.53	3.56	1.10

[a]Minimum = 0, Maximum = 14, Range = 14
[b]Minimum = 0, Maximum = 22, Range = 22
[c]Minimum = 0, Maximum = 4, Range = 4

Table 3

Correlation Coefficients for Observed Variables

	Story understanding	Free Recall	Sequence	Female	Months old	Annual salary	Parent education	Time reading Curious George story	PPVT scale score	PRB scale total
Story understanding										
Free recall	.299**									
Sequence	.532**	.250*								
Female	.019	.117	-.059							
Months old	.355**	.289**	.410**	.084						
Annual salary	.153	.198	.196	-.114	.172					
Parent education	.149	.185	.166	.022	-.010	.385**				
Time reading Curious George story	.047	.017	.077	.009	.008	.073	.071			
PPVT scale score	.467**	.224*	.345**	.077	.102	.339**	.235*	-.188		
PRB scale total	.078	.058	.062	.088	-.203	.040	.178	-.029	.212*	

Table continues

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

Table 3 Continued

Correlation Coefficients for Observed Variables

	Story understanding	Free Recall	Sequence	Female	Months old	Annual salary	Parent education	Time reading Curious George story	PPVT scale score	PRB scale total
CBCL total problems	-.259*	-.076	-.184	-.086	-.114	-.426**	-.227*	-.101	-.235*	-.298**
Parent and device combined dialogic reading behaviors	.124	-.066	.052	-.083	-.031	.035	.059	.765**	-.202	-.013
Device dialogic reading behaviors	.229	-.045	.016	-.145	-.192	.070	.064	.888**	-.368*	.012
Parent dialogic reading behaviors	.130	-.101	-.011	-.061	-.029	-.155	-.063	.395**	-.160	-.057
Child dialogic reading behaviors	.134	.014	.005	.056	.100	-.046	-.007	.274*	-.131	-.069
Child engagement - average	-.023	.037	.113	.043	.167	.213	.136	-.115	.049	-.152
Child enjoyment - average	.065	-.017	.025	.056	.161	-.012	-.045	-.102	.086	-.114
Child frustration - average	-.005	-.022	-.038	-.054	-.052	.013	-.006	.574**	-.251*	-.005
Parent engagement - average	-.060	.106	.056	-.081	-.107	.131	.025	-.046	-.013	.008
Parent enjoyment - average	-.043	.003	.082	-.048	-.111	.087	.042	-.122	.042	-.020
Parent frustration - average	-.026	-.077	-.089	-.078	-.039	.174	.347**	.523**	-.097	-.023

Table continues

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

Table 3 Continued

Correlation Coefficients for Observed Variables

	CBCL total problems	Parent and device combined dialogic reading behaviors	Device dialogic reading behaviors	Parent dialogic reading behaviors	Child dialogic reading behaviors	Child engagement - average	Child enjoyment - average	Child frustration - average
CBCL total problems								
Parent and device combined dialogic reading behaviors	-.061							
Device dialogic reading behaviors	-.102	.876**						
Parent dialogic reading behaviors	-.033	.773**	.497**					
Child dialogic reading behaviors	-.162	.536**	.579**	.776**				
Child engagement - average	-.119	-.136	-.322	-.041	.026			
Child enjoyment - average	-.055	-.059	-.009	.124	.266*	.547**		
Child frustration - average	-.041	.579**	.463**	.305**	.166	-.414**	-.440**	
Parent engagement - average	-.001	.025	-.540*	.210	.120	.388**	.308*	-.116
Parent enjoyment - average	-.005	.005	-.474*	.244	.182	.424**	.336**	-.212
Parent frustration - average	-.112	.461**	.608**	.081	.067	-.089	-.098	.208

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

Table 4

t-tests – Differences in Children's Story Understanding

Comparisons	*n*	*M*	*SD*	*t*	*df*	*p*	*d*
Device interactivity allowed	44	8.52	2.97	-1.14	64	.26	.30
No device interactivity allowed	22	9.45	3.47				
Parental support provided	69	9.16	2.85	2.28	88	.02*	.57
No parental support provided	21	7.48	3.30				
Book viewed on screen	66	8.83	3.15	.345	88	.73	.08
Print book	24	8.58	2.72				
Interactive with parent	23	9.48	2.31	2.35	42	.02*	.73
Interactive alone	21	7.48	3.30				
Interactive with parent	23	9.48	2.31	1.21	45	.23	.36
Print book with parent	24	8.58	2.72				
Interactive with parent	23	9.48	2.31	.03	43	.98	.01
Non-interactive with parent	22	9.45	3.47				
Print book with parent	24	8.58	2.71	1.24	43	.22	.38
Interactive alone	21	7.48	3.30				

Table 5

t-tests – Differences in Children's Free Recall

Comparisons	*n*	*M*	*SD*	*t*	*df*	*p*	*d*
Device interactivity allowed	43	3.81	3.96	-.32	63	.75	.09
No device interactivity allowed	22	4.14	3.59				
Parental support provided	68	3.62	2.89	-.70	87	.48	.18
No parental support provided	21	4.24	5.16				
Book viewed on screen	65	3.92	3.81	.70	87	.49	.17
Print book	24	3.33	2.62				
Interactive with parent	22	3.41	2.38	-.68	41	.50	.21
Interactive alone	21	4.24	5.16				
Interactive with parent	22	3.41	2.38	.10	44	.91	.03
Print book with parent	24	3.33	2.63				
Interactive with parent	22	3.41	2.38	-.79	42	.43	.24
Non-interactive with parent	22	4.14	3.59				
Print book with parent	24	3.33	2.63	-.75	43	.45	.23
Interactive alone	21	4.24	5.16				

Table 6

t-tests – Differences in Children's Story Sequencing

Comparisons	*n*	*M*	*SD*	*t*	*df*	*p*	*d*
Device interactivity allowed	42	3.62	1.08	.43	62	.67	.11
No device interactivity allowed	22	3.50	1.01				
Parental support provided	68	3.59	1.07	.49	86	.62	.13
No parental support provided	20	3.45	1.23				
Book viewed on screen	64	3.58	1.05	.30	86	.77	.07
Print book	24	3.50	1.25				
Interactive with parent	22	3.77	.92	.97	40	.34	.31
Interactive alone	20	3.45	1.23				
Interactive with parent	22	3.77	.92	.84	44	.41	.25
Print book with parent	24	3.50	1.25				
Interactive with parent	22	3.77	.92	.93	42	.35	.29
Non-interactive with parent	22	3.50	1.01				
Print book with parent	24	3.50	1.25	.13	42	.90	.04
Interactive alone	21	3.45	1.23				

Table 7

Correlation Coefficients for Story Comprehension Variables and Device Prompt Activation

Correlations

		1	2	3	4	5	6
1	Story Understanding						
2	Free recall	.299**					
3	Sequence	.532**	.250*				
4	Seductive details activated	.135	-.018	.148			
5	Total prompts activated	.124	-.106	-.014	.871**		
6	Total unique prompts activated	.244	-.091	.092	.838**	.956**	

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

Table 8

Mean Frequencies and Standard Deviations of Parental Dialogic Reading Behaviors[A]

	Total Sample (n = 66)		Interactive Reading with Parent (n = 23)		Non-interactive with Parent (n = 22)		Print Book Reading with Parent (n = 24)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Labeling / Vocabulary Development	2.71	2.79	3.38[a]	3.34	1.09[ab]	1.23	3.65[b]	2.73
Verbal Expression	4.51	2.95	6.52[ab]	2.87	2.68[a]	2.36	4.43[b]	2.39
Prior Knowledge	2.43	2.84	2.00[a]	2.17	.71[b]	1.42	4.39[ab]	3.22
Book Structure	3.75	3.63	3.90[a]	4.47	1.48[ab]	1.63	5.70[b]	2.98
Print Awareness	2.39	2.62	2.29[ab]	2.81	.54[ac]	.91	4.26[bc]	2.30
Reinforcement	1.36	2.25	2.85[ab]	3.06	.05[a]	.218	1.26[b]	1.63
Device-related Helping Behaviors			7.38	5.13				
Total Parent Dialogic Reading Behaviors	19.38	14.94	28.19[a]	16.79	6.45[ab]	5.53	23.70[b]	10.64

Note. [ab]Matching superscript within rows denote values that are significantly different at $p < .05$

[A]The *interactive alone* condition is not included because it did not involve parental participation.

Table 9

Mean Frequencies and Standard Deviations of Device-Initiated Dialogic Reading Behaviors[A]

	Total Sample (n = 44)		Interactive Reading with Parent (n = 23)		Interactive Reading Alone (n = 21)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Labeling / Vocabulary Development	8.35	6.06	10.23[a]	6.54	5.87[a]	4.42
Verbal Expression	.27	.61	.33	.73	.19	.40
Prior Knowledge	2.80	2.52	3.65[a]	2.78	1.75[a]	1.69
Book Structure	4.17	4.47	4.63	4.58	3.62	4.42
Print Awareness	1.67	1.71	2.15	1.93	1.06	1.18
Reinforcement	8.33	6.80	11.05[a]	6.67	4.94[a]	5.42
Device-related Helping Behaviors	1.67	2.59	2.24	3.16	.94	1.34
Total Device Dialogic Reading Behaviors	26.70	20.12	33.05[a]	21.43	18.38[a]	15.14

Note. [abc]Matching superscript within rows denote values that are significantly different at $p < .05$

[A]The *print book reading with parent* and *non-interactive with parent* conditions are not included because they did not involve use of the interactive device.

Table 10

Mean Frequencies and Standard Deviations of Child Dialogic Reading Behaviors[A]

	Total Sample (n = 90)		Interactive Reading with Parent (n = 23)		Interactive Reading Alone (n = 21)		Non-interactive with Parent (n = 22)		Print Book Reading with Parent (n = 24)	
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Labeling / Vocabulary Development	.81	1.20	1.43[ab]	1.43	.11[bc]	.32	.38[ad]	.74	1.21[cd]	1.35
Verbal Expression	5.47	4.52	7.90[ab]	4.10	2.16[bd]	3.06	2.34[ac]	1.99	8.96[cd]	3.70
Prior Knowledge	1.73	1.96	2.85[a]	2.30	1.31	1.63	1.04[a]	1.24	1.74	2.09
Book Structure	1.72	2.71	1.95[a]	2.74	.10[c]	.32	.52[b]	.75	3.96[abc]	3.36
Print Awareness	.93	1.90	.65[a]	.88	.05[c]	.23	.38[b]	.97	2.39[abc]	2.93
Total Child Dialogic Reading Behaviors	8.86	7.89	11.81[abc]	6.16	2.42[ae]	3.62	3.59[bd]	2.70	16.52[cde]	7.24

Note. [abcde]Matching superscript within rows denote values that are significantly different at $p < .05$

Table 11

Average Engagement, Enjoyment, and Frustration Scores by Condition

	Parent Engagement (out of 5)		Parent Enjoyment (out of 5)		Parent Frustration (out of 5)		Child Engagement (out of 5)		Child Enjoyment (out of 5)		Child Frustration (out of 5)	
Condition	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Interactive reading with parent	4.79	.51	4.53	.59	1.12	.277	4.70	.46	4.33	.68	1.61	.76
Interactive reading alone							4.94	.17	4.04	.74	1.26	.45
Non-interactive with parent	4.53	.97	4.29	.75	1	0	4.73	.60	4.38	.68	1.13	.14
Print book reading with parent	4.88	.17	4.87	.22	1	0	4.92	.22	4.64	.56	1.09	.18
Total	4.77	.66	4.59	.70	1.04	.16	4.83	.41	4.36	.68	1.23	.48

Figure 1

Mean number of prompts activated over time.

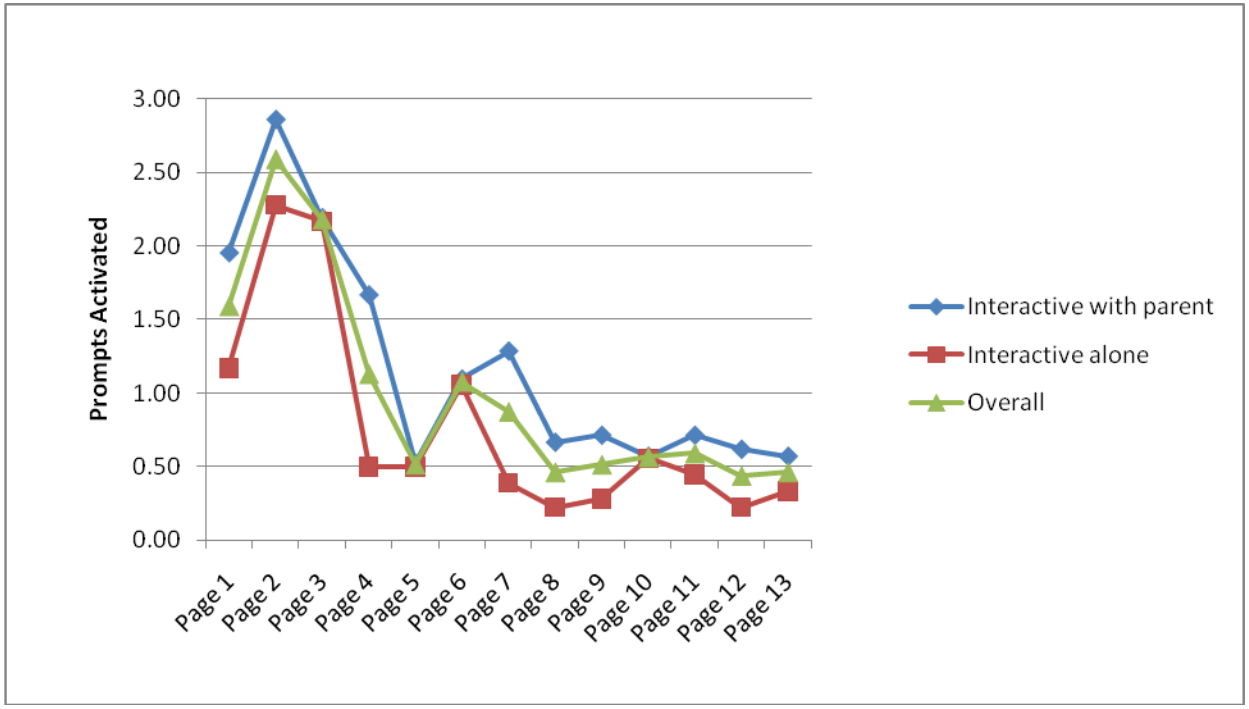


Figure 2

Total Supportive Reading Behaviors (Parent and Device Combined)

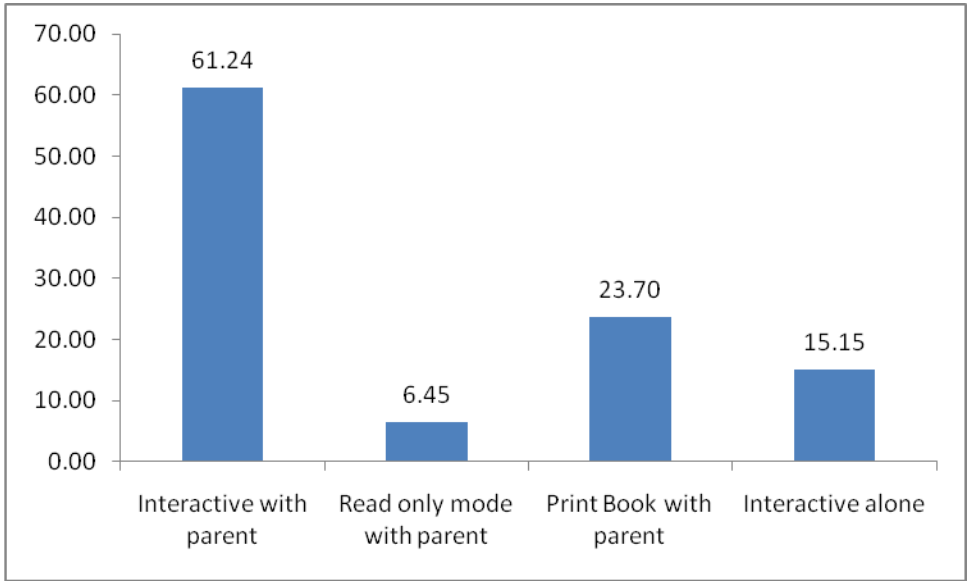
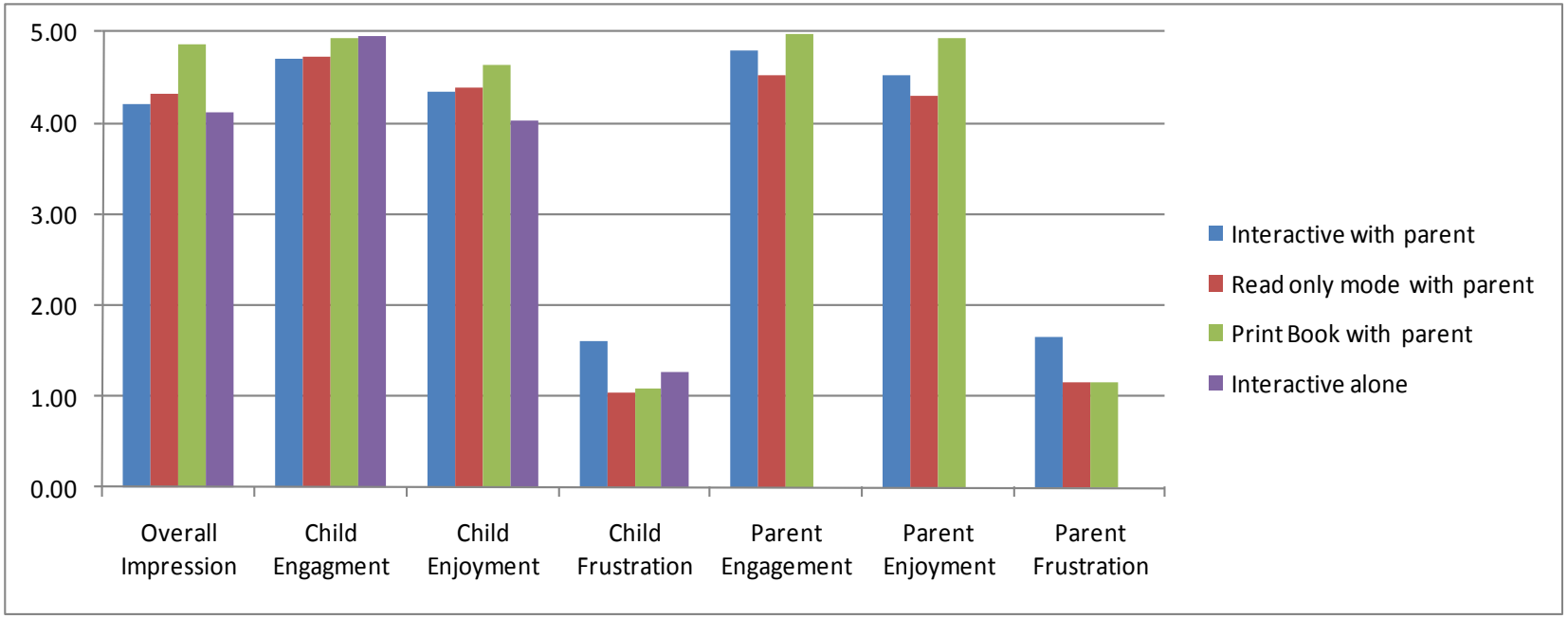


Figure 3

Average Ratings of Parent and Child Engagement, Enjoyment, and Frustration



REFERENCES

Ainsworth, M. D. S., Waters, E., & Wall, S. (1978). *Patterns of attachment: A psychological study of the strange situation*. Hillsdale, NJ: Routledge.

Anderson, D. R., & Lorch, E. P. (1983). Looking at television: Action or reaction. In J. Bryant & D. R. Anderson (Eds.), *Children's understanding of television: Research on attention and comprehension* (pp. 1–33). New York: Academic Press.

Ball, S., & Bogatz, G. (1970). *A summary of the major findings in the first year of Sesame Street: An evaluation*. Princeton, NJ: Educational Testing Service.

Beagles-Roos, J., & Gat, I. (1983). Specific impact of radio and television on children's story comprehension. *Journal of Educational Psychology*, *75*(1), 128-137. doi:10.1037/0022-0663.75.1.128

Bogatz, G., & Ball, S. (1971). *The second year of Sesame Street: A continuing evaluation*. Princeton, NJ: Educational Testing Service.

Bus, A. G. (2001a). Parent-child book reading through the lens of attachment theory. In *Literacy and Motivation*. Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Bus, A. G. (2001b). Joint caregiver-child storybook reading: A route to literacy development. In *Handbook of Early Literacy Research*. New York: The Guilford Press.

Bus, A. G., & van Ijzendoorn, M. H. (1988). Mother-child interactions, attachment, and emergent literacy: A cross-sectional study. *Child Development*, *59*, 1262-1273.

Bus, A. G., & van Ijzendoorn, M. H. (1995). Mothers reading to their 3-year-olds: The

role of mother-child attachment security in becoming literate. *Reading Research Quarterly*, *30*(4), 998-1015.

Bus, A. G., & van Ijzendoorn, M. H. (1997). Affective dimension of mother-infant picturebook reading. *Journal of School Psychology*, *35*, 47-60.

Bus, A. G., Verhallen, M., & de Jong, M. T. (2009). How onscreen storybooks contribute to early literacy. In A. G. Bus & S. B. Neuman (Eds.), *Multimedia and literacy development: Improving achievement for young learners*. New York, NY: Routledge.

Bus, A., van IJzendoorn, M. H., & Pellegrini, A. D. (1995). Joint book reading makes for success in learning to read: a meta-analysis on intergenerational transmission of literacy. *Review of Educational Research*, *65*(1), 1-21. doi:10.3102/00346543065001001

Calvert, S. L. (1999). *Children's journeys through the information age*. McGraw-Hill series in developmental psychology (Vol. 1). Boston: McGraw-Hill College.

Calvert, S. L. (2004). Media forms for children's learning. In *The design of instruction and evaluation: Affordances of using media and technology*. Mahwah, NJ: Lawrence Erlbaum.

Calvert, S. L. (2006). Media and early development. In *Blackwell Handbook of Early Childhood Development* (pp. 843-879). Boston, MA: Blackwell.

Calvert, S. L., Strong, B. L., & Gallagher, L. (2005). Control as an engagement feature for young children's attention to and learning of computer content. *American Behavioral Scientist*, *48*(5), 578-589.

Collins, W. A. (1983). Interpretation and inference in children's television viewing. In J. Bryant & D. R. Anderson (Eds.), *Children's understanding of television: Research on attention and comprehension*. New York: Academic Press.

Comstock, G., & Scharrer, E. (2007). *Media and the American child*. Burlington, MA: Academic Press and Elsevier Inc.

Cordes, C., & Miller, E. (2000). *Fool's gold: A critical look at children and computers*. College Park, MD: Alliance for Childhood.

Crijnen, A. A. M., Feehan, M., & Kellam, S. G. (1998). The course and malleability of reading achievement in elementary school: The application of growth curve modeling in the evaluation of a mastery learning intervention. *Learning and Individual Differences*, *10*(2), 137-157.

DeBaryshe, B. D., & Binder, J. C. (1994). Development of an instrument for measuring parental beliefs about reading aloud to young children. *Perceptual and Motor Skills*, *78*(3), 1303–1311.

DeBruin-Parecki, A. (1999). *Assessing adult/child storybook reading practices* (Center for the Improvement of Early Reading Achievement, University of Michigan). Ann Arbor, MI.

Desmond, R. J., Singer, J. L., Singer, D. G., Calam, R., & Colimore, K. (1985). Family mediation patterns and television viewing: Young children's use and grasp of the medium. *Human Communications Research*, *11*(4), 461-480.

Dorr, A., Kovaric, P., & Doubleday, C. (1989). Parent-child coviewing of television. *Journal of Broadcasting and Electronic Media*, *33*(1), 33-51.

Fisch, S. M. (2004a). *Children's learning from educational television: Sesame Street and beyond*. Mahwah, NJ: Lawrence Erlbaum.

Fisch, S. M. (2004b). What's so "new" about "new media?": comparing effective features of children's educational software, television, and magazines. Proceedings of the 2004 Conference on Interaction Design and Children: Building a Community. doi:http://doi.acm.org/10.1145/1017833.1017847

Fisch, S. M. (2004c). Characteristics of effective materials for informal education: A cross-media comparison of television, magazines, and interactive media. In *The design of instruction and evaluation: Affordances of using media and technology*. Mahwah, NJ: Lawrence Erlbaum.

Fisch, S. M., & Truglio, R. T. (2001a). *"G" if for growing: Thirty years of research on children and Sesame Street*. Mahwah, NJ: Lawrence Erlbaum.

Fisch, S. M., & Truglio, R. T. (2001b). Why children learn from Sesame Street. In *"G" If for growing: Thirty years of research on children and Sesame Street*. Mahwah, NJ: Lawrence Erlbaum.

Friedrich, L. K., & Stein, A. H. (1973). Aggressive and Prosocial Television Programs and the Natural Behavior of Preschool Children. *Monographs of the Society for Research in Child Development, 38*(4), 1-64.

Garner, R., Brown, R., Sanders, S., & Menke, D. J. (1992). "Seductive details" and learning from text. In *The role of interest in learning and development* (pp. 239-254). Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.

Gauvain, M. (2001). *The social context of cognitive development*. New York: Guilford.

Gauvain, M. (2005). Scaffolding in socialization. *New Ideas in Psychology*, *23*(3), 129-139. doi:doi: DOI: 10.1016/j.newideapsych.2006.05.004

Gauvain, M., Savage, S., & McCollum, D. (2000). Reading at Home and at School in the Primary Grades: Cultural and Social Influences. *Early Education & Development*, *11*(4), 447 - 463.

Glasgow, J. (1996). Motivating young readers using CD-ROM storybooks. *Learning and Leading With Technology*, *24*(4), 17-22.

Greenfield, P., Farrar, D., & Beagles-Roos, J. Is the medium the message?: An experimental comparison of the effects of radio and television on imagination. *Journal of Applied Developmental Psychology*, *7*(3), 201-218.

Gudmundsen, J. (2005, August 29). 'Read With Me DVD!' makes learning interactive! *USA Today*. Retrieved from http://www.usatoday.com/tech/columnist/jinnygudmundsen/2005-08-29-read-dvd_x.htm

Harp, S. F., & Mayer, R. E. (1998). How seductive details do their damage: A theory of cognitive interest in science learning. *Journal of Educational Psychology*, *90*(3), 414-434.

Huston, A. C., Anderson, D. R., Wright, J. C., Linebarger, D. L., & Schmitt, K. L. (2001). Sesame Street viewers as adolescents: The recontact study. In *"G" is for "growing": Thirty years of research on children and Sesame Street*. Mahwah, NJ: Lawrence Erlbaum Associates.

Huston, A. C., Bickham, D. S., Lee, J. H., & Wright, J. C. (2007). From Attention to

Comprehension: How Children Watch and Learn From Television. In *Children and television: Fifty years of research*. Mahwah, NJ: Lawrence Erlbuam Associates.

Huston, A. C., & Wright, J. C. (1983). Children's processing of television: The informative functions of formal features. In J. Bryant & D. R. Anderson (Eds.), *Children's understanding of television: Research on attention and comprehension* (pp. 35-68). New York: Academic Press.

de Jong, M. T., & Bus, A. G. (2002). Quality of book-reading matters for emergent readers: An experiment with the same book in a regular or electronic format. *Journal of Educational Psychology*, *94*(1), 145-155.

de Jong, M. T., & Bus, A. G. (2003). How well suited are electronic books to supporting literacy? *Journal of Early Childhood Literacy*, *3*(2), 147-164.

de Jong, M. T., & Bus, A. G. (2004). The efficacy of electronic books in fostering kindergarten children's emergent story understanding. *Reading Research Quaterly*, *39*(4), 378-393.

Juel, C. (1988). Learning to read and write: A longitudinal study of 54 children from first through fourth grades. *Journal of Educational Psychology*, *80*(4), 437-447.

Kaderavek, J. N., & Sulzby, E. (1998). Parent-child joint book reading: An observational protocol for young children. *American Journal of Speech-Language Pathology*, *7*(1), 33-47.

Kirkorian, H. L., Wartella, E. A., & Anderson, D. R. (2008). Media and young children's learning. *The Future of Children*, *18*(1), 39-61.

Korat, O., & Shamir, A. (2004). Do Hebrew electronic books differ from Dutch electronic books? A replication of a Dutch content analysis. *Journal of Computer Assisted Learning*, *20*(4), 257-268.

Korat, O., & Shamir, A. (2008). The educational electronic book as a tool for supporting children's emergent literacy in low versus middle SES groups. *Computers & Education*, *50*(1), 110-124.

Labbo, L. D., & Kuhn, M. R. (2000). Weaving chains of affect and cognition: A young child's understanding of CD-ROM talking books. *Journal of Literacy Research*, *32*(2), 187 - 210.

Leapfrog: Tag reading system. (n.d.). . Retrieved from http://www.leapfrog.com/en/families/tag/tag_system/tag_reading_system.html

Lemish, D., & Rice, M. (1986). Television as a talking picture book: a prop for language acquisition. *Journal of Child Language*, *13*(2), 251-274.

Levin, D. E., & Rosenquest, B. (2001). The increasing role of electronic toys in the lives of infants and toddlers: Should we be concerned? *Contemporary Issues in Early Childhood*, *2*(2), 242-247.

Linebarger, D. L. (2006). *Teaching language and literacy on television. A literature review prepared for the Corporation for Public Broadcasting.* Philadelphia, PA: Annenberg School for Communication, University of Pennsylvania.

Linebarger, D. L., Kosanic, A. Z., Greenwood, C. R., & Doku, N. (2004). Effects of viewing the television program Between the Lions on emergent literacy skills of young children. *Journal of Educational Psychology*, *96*(2), 297-308.

Linebarger, D. L., & Wainwright, D. K. (2007). American Indian children, their home media and literacy environments, and their literacy abilities in relation to participation in a Between the Lions literacy intervention. In *Society for Research in Child Development*. Boston, MA.

Luckin, R., & du Boulay, B. (1999). Ecolab: The development and evaluation of a Vygotskian design framework. *International Journal of Artificial Intelligence in Education*, *10*(2), 198-220.

Luckin, R., Connolly, D., Plowman, L., & Airey, S. (2003). Children's interactions with interactive toy technology. *Journal of Computer Assisted Learning*, *19*(2), 165-176.

McLuhan, M. (1964). *Understanding media: The extensions of man*. New York: Penguin.

National Reading Panel. (2000). Teaching children to read: An evidence-based assessment of the scientific research literature on reading and its implications for reading instruction. Retrieved from http://www.nichd.nih.gov/publications/nrp/smallbook.cfm

National Research Council. (1998). *Preventing reading difficulties in young children.* Washington, DC: National Academy Press.

Ninio, A. (1983). Joint book reading as a multiple vocabulary acquisition device. *Developmental Psychology, 19*(3), 445–451.

Palmer, E. L., & Fisch, S. M. (2001). The beginnings of Sesame Street research. In *"G" is for growing: Thirty years of research on children and Sesame Street* (pp. 3-23). Mahwah, NJ: Lawrence Erlbaum Associates.

Pecora, N. (2007). The changing nature of children's television: Fifty years of research. In *Children and television: Fifty years of research*. Mahwaj, NJ: Lawrence Erlbaum Associates.

Reeves, B., & Nass, C. (1996). *The media equation: how people treat computers, television, and new media like real people and places*. New York, NY: Cambridge University Press.

Reiser, R. A., Tessmer, M., & Phelps, P. (1984). Adult-child interaction in children's learning from "Sesame Street". *Educational Technology Research and Development*, *32*(4), 217-223.

Reiser, R. A., Williamson, N., & Suzuki, K. (1988). Using "Sesame Street" to facilitate children's recognition of letters and numbers. *Educational Technology Research and Development*, *36*(1), 15-21.

Revelle, G. L. (2003). Educating via entertainment media: the Sesame Workshop approach. *Computers in Entertainment (CIE)*, *1*(1), 1-9.

Revelle, G. L., & Medoff, L. (2002). Interface design and research process for studying the usability of interactive home-entertainment systems by young children. *Early Education & Development*, *13*(4), 423-434.

Revelle, G. L., Medoff, L., & Strommen, E. F. (2001). Interactive technologies research at Children's Television Workshop. In *"G" If for growing: Thirty years of research on children and Sesame Street*. Mahwah, NJ: Lawrence Erlbaum.

Ricci, C. M., & Beal, C. R. (2002). The effect of interactive media on children's story memory. *Journal of Educational Psychology*, *94*(1), 138-144.

Rice, M., Huston, A. C., Truglio, R., & Wright, J. C. (1990). Words from Sesame Street: Learning vocabulary while viewing. *Developmental Psychology*, *26*, 421-428.

Richert, R., Robb, M. B., & Smith, E. Media as social partners: The social nature of young children's learning from screen media. *Child Development*.

Rideout, V. J., Hamel, E., & Kaiser Family Foundation. (2006). *The media family: Electronic media in the lives of infants, toddlers, preschoolers and their parents*. Menlo Park, CA: Henry J. Kaiser Family Foundation.

Rideout, V. J., Vandewater, E. A., Wartella, E., & Kaiser Family Foundation. (2003). *Zero to six: electronic media in the lives of infants, toddlers and preschoolers*. Menlo Park, CA: Henry J. Kaiser Family Foundation.

Rodgers, E. M. (2005). Interactions that Scaffold Reading Performance. *Journal of Literacy Research*, *36*(4), 501-532.

Rogoff, B. (1998). Cognition as a collaborative process. In D. Kuhn & R. S. Siegler (Eds.), *Handbook of child psychology* (5th ed., Vol. 2, pp. 679–744). New York: Wiley.

Rosenthal, R., & Rosnow, R. L. (1991). *Essentials of Behavioral Research: Methods and Data Analysis*. McGraw-Hill.

Sherin, B., Reiser, B. J., & Edelson, D. (2004). Scaffolding Analysis: Extending the Scaffolding Metaphor to Learning Artifacts. *Journal of the Learning Sciences*, *13*(3), 387 - 421.

Shore, R. (2008). *The power of Pow! Wham!: Children, digital media & our nation's future. Three challenges for the coming decade*. New York: The Joan Ganz

Cooney Center at Sesame Workshop.

Shuler, C. (2007). *D is for digital: An analysis of the children's interactive media environment with a focus on mass marketed products that promote learning*. New York, NY: The Joan Ganz Cooney Center at Sesame Workshop.

Silvern, S. B., & Williamson, P. A.The effects of video game play on young children's aggression, fantasy, and prosocial behavior. *Journal of Applied Developmental Psychology*, *8*(4), 453-462.

Singer, J. L. (1980). The power and limitations of television: A cognitive-affective analysis. In P. Tannenbaum (Ed.), *The entertainment functions of television* (pp. 31–65). Hillsdale, NJ.

Stanovich, K. E. (1986). Matthew Effects in Reading: Some Consequences of Individual Differences in the Acquisition of Literacy. *Reading Research Quarterly*, *21*(4), 360-407.

Strommen, E. F. (1993). Is it easier to hop or walk? Development issues in interface design. *Human-Computer Interaction*, *8*(4), 337-352.

Strommen, E. F. (2000). Interactive toy characters as interfaces for children. In *Information appliances and beyond: Interactive design for consumer products* (pp. 257–298). New York: Morgan Kaufmann Publishers.

Strommen, E. F. (2003). Interacting with people versus interacting with machines: Is there a meaningful difference from the point of view of theory? Society for Reserach in Child Development, Tampa, FL.

Strommen, E. F., Revelle, G. L., Medoff, L. M., & Razavi, S. (1996). Slow and steady

wins the race? Three-year-old children and pointing device use. *Behaviour & Information Technology*, *15*(1), 57-64.

Sulzby, E. (1985). Children's emergent reading of favorite storybooks: A developmental study. *Reading Research Quarterly*, *20*(4), 458–481.

Taverne, A., & Sheridan, S. M. (1995). Parent training in interactive book reading: An investigation of its effects with families at risk. *School Psychology Quarterly*, *10*(1), 41–64.

Valkenburg, P. M., Krcmar, M., Peeters, A. L., & Marseille, N. M. (1999). Developing a scale to assess three styles of television mediation: "Instructive mediation," "restrictive mediation," and "social coviewing". *Journal of Broadcasting and Electronic Media*, *43*, 52-66.

Vogel, C., Uhl, S., & Boller, K. (2002). *Implementing Ready To Learn Outreach: Lessons from 20 Public Television Stations*. Mathematica Policy Research, Inc.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard Univ. Press.

Wartella, E. A., & Jennings, N. (2000). Children and Computers: New Technology, Old Concerns. *The Future of Children*, *10*(2), 31-43.

Wartella, E., Keefe, B., & Scantlin, R. (2000). *Children and interactive media - A compendium of current research and directions for the future*. New York, NY: Markle Foundation.

Wartella, E., Lee, J. H., & Caplovitz, A. (2002). *Children and interactive media: An updated research compendium*. New York, NY: Markle Foundation.

Wells, G. (1985). Preschool literacy-related activities and success in school. In D. R. Olson, N. Torrance, & A. Hildyard (Eds.), *Literacy, language, and learning: The nature and consequences of reading and writing* (pp. 229–255). New York: Cambridge University Press.

Whitehurst, G. J., Falco, F. L., Lonigan, C. J., Fischel, J. E., DeBaryshe, B. D., Valdez-Menchaca, M. C., & Caulfield, M. (1988). Accelerating language development through picture book reading. *Developmental Psychology*, *24*(4), 552–559.

Whitehurst, G. J., Arnold, D., Epstein, J., Angell, A., Smith, M., & Fischel, J. (1994). A picture book reading intervention in day care and home for children from low-income families. *Developmental Psychology*, *30*(5), 679-689.

Whitehurst, G. J., & Lonigan, C. J. (1998). Child development and emergent literacy. *Child Development*, *69*(3), 848-872.

Whitehurst, G. J., & Lonigan, C. J. (2001). Emergent literacy: Development from prereaders to readers. In *Handbook of early literacy research* (pp. 11–29). New York, NY: The Guilford Press.

Wood, D., Bruner, J. S., & Ross, G. (1976). The Role of Tutoring in Problem Solving. *Journal of Child Psychology and Psychiatry*, *17*(2), 89-100.

Wright, J. C., Huston, A. C., Murphy, K., Peters, M. S., Pinon, M., Scantlin, R., & Kotler, J. (2001). The relations of early television viewing to school readiness and vocabulary of children from low income families: The Early Window Project. *Child Development*, *72*, 1347-1366.

Zill, N., Davies, E., & Daly, M. (1994a). *Public television children's programs: Are they*

helping young children get ready for school? Rockville, MD: Westat.

Zill, N., Davies, E., & Daly, M. (1994b). *Viewing of Sesame Street by preschool children in the United States and its relationship to school readiness*. Rockville, MD: Westat.

APPENDIX A

Participant #_____ Date_____

Media Questionnaire

This survey is part of a research study about the effects of media on children under the age of two. Television programs and DVDs are often targeted at this age group, but very little is known about the effects of these products.

Please complete this survey as accurately and honestly as possible. **Remember you always have the option to choose not to answer a question; just check "don't know" or "decline to answer".**

1. Is your child a boy or a girl? ___Boy ___Girl ___Decline to answer

2. What is your child's birthday? (MMDDYYYY) ____/_____/_____ (____ years ____ months)

3. How many total children do you have? _____

a. what are the ages of your other children? Please fill them in below and CIRCLE the child participating in the study.

1st	2nd	3rd	4th	5th	6th	7th or higher

4. We're interested in what kinds of things your child did on the last day you followed your TYPICAL routine. As best you can recall, please answer the following questions regarding the activities your child did on that day.

If yes, please also check the amount of time your child engaged in that activity. If it is longer than 3 ½ hrs, please fill in the time in the space provided.

	Yes	**No**	5 min	15 min	30 min	45 min	1 hr	1 ½ hr	2 hr	2 ½ hr	3 hr	3 ½ hr	Other	Don't know	Decline to answer
a. Did your child spend any time watching TV programming on that day?															
b. Did your child spend any time watching a video or DVD on that day?															
c. Did your child spend any time playing outside on that day?															

d. Did your child spend any time being read to on that day?															
e. Did your child "read" or look at books by him/herself?															
f. Did your child spend any time playing inside with non-electronic toys on that day?															
g. Did your child spend any time playing with electronic educational toys (such as Leapfrog products or talking books) on that day?															

5. Do you have cable or satellite TV?

___Yes ___No ___Don't know ___Decline to answer

6. Do you have a TV/DVD player in your car?

___Yes ___No ___Don't know ___Decline to answer

	0	1	2	3	4	5	6 or more	Don't know	Decline to answer
How many televisions, if any, do you have in your household? (Please don't count anything that is not hooked up or is put away in storage)									
How many VCRs or DVD players, if any, do you have in your household?									
How many video game players like Xbox, Playstation, Wii, or Nintendo DS, if any, do you have in your household?									
How many electronic educational toys, like LeapFrog, if any, do you have in your household?									
How many radios, if any, do you have in your household?									

How many music CD, MP3, ipod audiocassette, or other music players, if any, do you have in your household?									

7. How many children's books do you have in your home?

___None
___1-10
___11-20
___21-30
___31-40
___more, please estimate: _____

8. How many books for adults do you have in your home?

___None
___1-10
___11-20
___21-30
___31-40
___more, please estimate: _____

9. How often do you, or other members of the family, read to your child in a typical week?

At bedtime:
___never ___once ___2 ____3 ____4 ____5 ____6 ___7 times ____more, please estimate: _____
Other times:
___never ___once ___2 ____3 ____4 ____5 ____6 ___7 times ____more, please estimate: _____

10. How often does your child "read" or look at a book by him/herself in a typical week?

At bedtime:
___never ___once ___2 ____3 ____4 ____5 ____6 ___7 times ____more, please estimate: _____
Other times:
___never ___once ___2 ____3 ____4 ____5 ____6 ___7 times ____more, please estimate: _____

11. How much does your child *enjoy* being read to?

Doesn't like to be read to Likes to be read to a little Likes to be read to somewhat Loves to be read to

12. During a typical week, how often does your child *ask* to be read to? (Please circle)

Never Seldom Sometimes Often Very often

13. Please check which of the following you have in your home:

___ Magazines
___ Newspapers
___ Non-electronic toys (blocks, dolls, etc.)
___ Electronic educational media (Leapfrog, talking books, etc.)
___ Computer
___ Dial-up Internet Access
___ Hi-speed Internet Access

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

___Always
___Most of the time

___About half of the time
___Less than half of the time
___Hardly ever
___Never
___No TV in household
___DON'T KNOW
___Decline to answer

15. Sometimes children are exposed to television even when they are not viewing a show for themselves. For example, children may be playing or sleeping in an area where they can see or hear the television, even though it's only in the background. How long, on a typical day, is your child exposed to television or a DVD that is on in the background?

___0 min/Not at all
___5 min
___15 min
___30 min
___45 min
___1 hr
___1 ½ hr
___2 hr
___2 ½ hr
___3 hr
___3 ½ hr
___4 hr
___4 ½ hr
___5 hr
___5 ½ hr
___6 hr
___6 ½ hr
___7 hr
___7 ½ hr
___8 hrs or more

16. How often is the TV on when your family is eating meals?

___Always
___Most of the time
___About half of the time
___Less than half of the time
___Hardly ever
___Never
___No TV in household
___DON'T KNOW
___Decline to answer

17. How often, if ever, does your child do each of the following things:

	Every Day	Several Times a Week	Several Times a Month	Less Often	Never	Don't know	Decline to Answer
a. How often does your child watch television?							
c. How often does your child "read" or look at a book by him/herself?							
d. How often does your child play with literacy-related electronic educational toys, like LeapFrog or talking books?							
e. How often does your child play computer games?							
f. How often does your child watch videos or DVDs?							

18. To the nearest month, at what age did your child FIRST do each of the following things?

	Younger than 3 months	3 mo.	6 mo.	12 mo.	18 mo.	24 mo.	2½ yrs	3 yrs	Not Yet	Don't know	Decline to Answer
a. Watch television											
c. Watch a video or DVD											
f. Watch a video or DVD specifically for babies (i.e. Baby Einstein)											
h. Use a computer *while* sitting on a parent's lap											
i. Use a computer *without* sitting on a parent's lap											
j. Play computer games, even if on a parent's lap											
k. Play electronic educational toys like Leapfrog or talking books											

19. How old was your child when you started reading picture books to him or her? (please estimate age to nearest year and month): _____

20. In general, do you think watching TV mostly helps or mostly hurts children's learning, or doesn't have much effect either way?

___Mostly helps ___Mostly hurts ___Not much effect ___Don't know
___Decline

21. In general, do you think playing electronic educational toys such as Leapfrog products, talking books, etc. mostly helps or mostly hurts children's learning, or doesn't have much effect either way?

___Mostly helps ___Mostly hurts ___Not much effect ___Don't know
___Decline to answer

22. Please tell how important, if at all, you think each of the following is in helping the **intellectual development** of children the same age as your child.

	Very important	Somewhat important	Not too important	Not important at all	Don't know	Decline to Answer
a. Reading books						
b. Building toys like blocks or Legos						
c. Using electronic educational toys like Leapfrog or talking books						
d. Watching educational TV shows like *Sesame Street*						
e. Watching educational videos or DVDs, like *Baby Einstein*						
f. Playing educational computer games						

23. What TV programs does your child watch on a regular basis?

24. What DVDs/movies does your child watch on a regular basis?

25. Please list any electronic interactive toys you own (i.e. Read With Me DVD System, Leapster, Leappad, My First Computer, V.Smile TV Learning System, etc.).

26. How many books do you own that include the character, *Curious George?* _____

27. How often does your child watch programs or videos/DVDs that feature *Curious George*?

____Every day
____Several times a week
____Several times a month
____Once a month or less
____Never
____Don't know

____Decline to answer

28. Compared to other stories, how much does your child **enjoy** Curious George stories? (Please check one).

____Much less than other stories
____A little less than other stories
____About the same as other stories
____A little more than other stories
____Much more than other stories
____Don't know
____Decline to answer

DEMOGRAPHIC QUESTIONS

We'd also like to know a little bit about you and your family so we can describe the people who responded to our survey.

1. What is your relationship to the child in this survey?

___Mother
___Father
___Grandmother
___Grandfather
___Aunt
___Uncle
___Other (please specify):

2. What is your gender? ___Male ___Female

3. Are you currently employed full-time, part-time, are you retired or are you not employed for pay?

___Full time
___Part time
___Retired
___Not employed
___Student
___Homemaker
___Disabled
___Decline to answer

4. Are you married, divorced, separated, widowed or have you never been married?

___Married
___Unmarried/Living with partner
___Divorced
___Separated
___Widowed
___Single
___Decline to answer

5. Is your husband/wife or partner currently employed full-time, part-time, retired or not employed for pay?

___Full time
___Part time
___Retired
___Not employed
___Student
___Homemaker
___Disabled
___Decline to answer

6. What is the last grade or class that you completed in school?

___Did not complete High School
___High School diploma/GED
___Some college/vocational school
___Bachelor's degree
___Advanced degree
___Decline to answer

7. What is the last grade or class that your husband/wife/partner completed in school?

___Did not complete High School
___High School diploma/GED
___Some college/vocational school
___Bachelor's degree
___Advanced degree
___Decline to answer

8. What is your age? _____

9. What is your annual yearly income?

$_____ ___Don't know ___Decline to answer

10. How would you describe your ethnic background or race? Please check all that apply.

___White/Caucasian
___Hispanic/Latino
___Black/African-American
___Asian/Asian-American
___Native American

___Other:_____
___Decline to answer

11. What is the PRIMARY language spoken in your household? _____

12. Are there other languages spoken in your household? ___Yes ___No

13. What other language(s)_____

END OF SURVEY. Thank you very much for taking the time to complete the survey.

APPENDIX B

Participant # _____

Story Understanding, Free Recall, and Sequencing Post-Reading Interview

"I'd like you to watch and listen carefully to this story that will be read to you over the television. After you finish the story, I'm going to ask you to tell me what the story was about. I'd like you to try to remember what the people did and what they said so you can tell me afterward. Listen very carefully."

Likeability –
I want to ask you about Curious George. How much do you like Curious George? Do you like him a lot? A little bit? Or do you not like Curious George at all?

Free-Recall Question – TURN ON CAMERA
I'd like you to tell me about the story you just heard. Can you tell me everything that happened in the story? Start by telling me what happened at the beginning of the story. Anything else? Tell me some more from the story. Think real hard and tell me something else from the story.

Picture-Sequencing Task
Place 6 pictures in front of child in random order. Ask, "Which of these happened first in the story?" Then, "Which one happened next?" "What happened after that?" "What happened last?"

Picture Order (i.e. 1, 2, 4, 3, 6, 5): ____, ____, ____, ____, _____, _____

Story Questions
1. Who is this story about?

2. Where does this story take place?

3. In the story, George loves to eat something. What is it?

4. The man with the yellow hat told George to "stay out of trouble". What does that mean?

5. In the story, a tour guide tells how a group of visitors how to tell what is inside the chocolates. What does she say to do?

6. Where do the workers put the chocolates from the machines?

7. Why did the chocolates start to come out faster and faster from the machine?

8. How did George save the chocolates?

9. Did George mean to save the chocolates?

10. How do you think the workers felt when they saw George putting the chocolates in boxes?

11. Did George get in trouble for eating the chocolates?

12. Why do you think George did not take the chocolates from the man at the end of the story?

APPENDIX C

Parent	Behaviors	Device
	Labeling / Vocabulary Development Assists child in developing new use of vocabulary words. Says or provides a label for (1) an object, (2) a person, (3) a place, (4) a qualifier, or (5) an action word. Asks a why, what, where, or how question. Says or provides a word or phrase close in meaning to another word already used. **Verbal Expression (parent)** Models verbal fluency. Expands upon child's utterance, providing a more complete sentence structure. Validates child's utterance by repeating the child's word or saying "yes,," "oh,," or "uh huh." Comments on the story as she reads. **Prior Knowledge** Questions or comments so as to encourage child to recall a previous experience or prior knowledge. Encourages child to make judgments about the story (based on prior knowledge). Helps child to recall a previous experience related to the story. **Book Structure** Assists child in developing awareness of the book's physical organization or story narrative. Calls attention to parts of the book such as author, illustrator, and cover pages. Identifies cause and effect relations or chains of events that relate to the main narrative. Leads a summary of story events. (Tangential or merely descriptive comments should be ruled out.) Encourages child's retelling of parts of the story. **Print Awareness** Encourages child's attending to print characteristics of the book, such as letters or sounds. **Reinforcement** Gives positive or negative reinforcement (i.e. "Good job!" or "Try again" or "That's not right") **Device-related helping behaviors** Guides or assists child in how to use device (e.g. "what happens when you press the button?" or "Press the circle button."	
Child	_____	
	Labeling / Vocabulary Development (child) Child labels for the first time in the reading session a noun, descriptor, or descriptive verb. Child asks a what, where, or how question. **Verbal Expression (child)** Child repeats all or part of parent expansion, making at least a three word utterance. Child uses language to recall memorized story fragments, to relate her or his prior experience, or to express new ideas. Child practices concepts learned or asks for a clarification of a concept. Child responds to parent's prompt with a "yes" or a "no" answer. **Book Structure (child)** Child identifies a cause and effect sequence associated with the story narrative. Child recalls the story name, its author or illustrator, or notes cover characteristics. Child notes parts of the narrative such as what comes first, second, and last. Child recalls a common refrain. **Print Awareness (child)** Child attends to aspects of the book's print. Child asks about or reads a number, word, letter, or letter sound. **Other** This code includes statements that are not coded according to the other criteria. An example is "Take your fingers out of your mouth."	

APPENDIX D

Instructions: At the conclusion of each **section** of the book, please answer the questions below with the following scales.

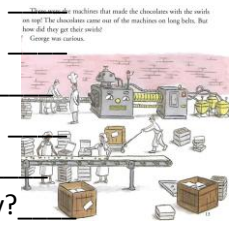
←1----------2----------3----------4----------5→

Not Engaged	Moderately Engaged	Very Engaged
No Enjoyment	Moderate Enjoyment	Enjoyed it Greatly
No Frustration	Moderate Frustration	Very Frustrating

←1----------2----------3----------4----------5→

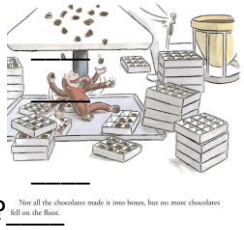
Engagement: Was the child focused on the activity? Did the child seem to be paying attention to the activity?
Enjoyment: Did the child seem to be enjoying herself? Did the child give physical indications that they were enjoying the activity (smiles, laughter, not physically pulling away from the activity)

Beginning of the book (pp. 5-13)



For the beginning of the book, how engaged was the **child** in the activity? ____
For the beginning of the book, how much was the **child** enjoying the activity? ____
For the beginning of the book, how frustrated was the **child** during the activity? ____
For the beginning of the book, how engaged was the **parent** in the activity? ____
For the beginning of the book, how much was the **parent** enjoying the activity? ____
For the beginning of the book, how frustrated was the **parent** during the activity? ____
For the beginning of the book, who generally led the interaction? Circle one. Parent / Child / Mutual

Middle of the book (pp. 14-21)



For the middle of the book, how engaged was the **child** in the activity? ____
For the middle of the book, how much was the **child** enjoying the activity? ____
For the middle of the book, how frustrated was the **child** during the activity? ____
For the middle of the book, how engaged was the **parent** in the activity? ____
For the middle of the book, how much was the **parent** enjoying the activity? ____
For the middle of the book, how frustrated was the **parent** during the activity? ____
For the middle of the book, who generally led the interaction? Circle one. Parent / Child / Mutual

End of the book (pp. 22-24)

For the end of the book, how engaged was the **child** in the activity? ____
For the end of the book, how much was the **child** enjoying the activity? ____
For the end of the book, how frustrated was the **child** during the activity? ____
For the end of the book, how engaged was the **parent** in the activity? ____

For the end of the book, how much was the **parent** enjoying the activity? ____
For the end of the book, how frustrated was the **parent** during the activity? ____
For the end of the book, who generally led the interaction? Circle one. Parent / Child / Mutual