

# **Preschoolers' Listening Comprehension of Digital Storybooks**

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To Charlie, Annie, and children growing up digital everywhere.

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**LIST OF ABBREVIATIONS**

|         |   |
|---------|---|
| ATK     | Assessment of Topic Knowledge                         |
| CD-ROMa | Living Books CD-ROM “read to me” presentation format  |
| CD-ROMb | Living Books CD-ROM “let me play” presentation format |
| CIS     | Children’s Interest Survey                            |
| COS     | Concepts of Screen                                    |
| ECP     | Explicit Comprehension Probe                          |
| ICP     | Implicit Comprehension Probe                          |
| OMS     | One More Story presentation format                    |
| PKIS    | Pre-Kindergarten Interest Survey                      |
| PPVT SS | Standard Score on the Peabody Picture Vocabulary Test |
| SO      | Storyline Online presentation format                  |
| SST     | Story Sequencing Task                                 |
| STR     | Story Retelling Task                                  |

## SUMMARY

Research has demonstrated the efficacy of storybook reading as an instructional context supporting young children's developing comprehension processes. The research base directly investigating preschool and kindergarten children's listening comprehension, however, has largely neglected the role individual differences play in comprehension processes. Concomitant with the aforementioned gap in the read aloud research base is a societal shift toward the increasing use of digital books as a text base for reading. Therefore, what we know about young children's comprehension of paper texts cannot be directly translated to electronic texts.

This experimental study sought to determine (1) whether the presentation format of digital storybooks impacts young children's listening comprehension and (2) whether individual differences in knowledge and interest predict young children's listening comprehension and recall of a digital storybook. One hundred fifty-two at-risk preschool students participated in the study. Each student was pretested for receptive vocabulary, knowledge (domain knowledge about computers and topic knowledge about bats and birds), and interest. Next, each participant was randomly assigned to one of four possible different digital presentation formats of *Stellaluna*. After listening to the digital storybook, each child completed four measures of listening comprehension.

Analyses indicated that three- and four-year-old children had a difficult time freely recalling the events of *Stellaluna* no matter the story listening condition—they fared better sequencing story events on picture cards and responding to open-ended probes for comprehension. Scores on the open-ended probes indicated that very few children fully comprehended the story as presented on the computer. Moreover, children who exhibited higher explicit comprehension of *Stellaluna* also tended to exhibit higher implicit



### SUMMARY (continued)

comprehension. There was no significant univariate effect of story listening condition on the measures of listening comprehension employed in this study, likely because the differences among the four presentation formats of *Stellaluna* were not dramatic enough, or too many of the presentation features overlapped from one condition to another.

Multiple regression analyses determined the predictive value of knowledge and interest with respect to listening comprehension of digital storybooks. Analyses indicated that quantitative, Likert-based methods of inquiry *exclusive of* qualitative triangulation are insufficient measures of preschoolers' emergent interests. These measures yielded ceiling effects and little variability—nearly all children were interested in everything. Moreover, receptive vocabulary, domain knowledge and topic knowledge were not significant predictors of story sequencing for any age group participating in this study. Receptive vocabulary, domain knowledge and topic knowledge were significant predictors of both explicit and implicit comprehension. These predictors were significant for both three- and four-year-old participants. The majority of the variance in outcome measures of story listening comprehension was shared among the predictor variables, with topic knowledge accounting for the largest amount of unique variance in both explicit and implicit comprehension. The measure of computer skill accounted for larger amounts of unique variance in the three-year-old sample than in the four-year-old sample. In other words, the younger participants who were also less skilled in the domain of computers tended to exhibit lower scores on measures of explicit and implicit comprehension than those with better scores on the measure of computer knowledge.

According to Informal Reading Inventory scoring criteria of 70% for Instructional Level or 90% for Independent Level it can be concluded that very few children were able to

**SUMMARY (continued)**

comprehend the digital story. No presentation format was more supportive than another regarding listening comprehension. Because of the constraints of the commercial digital storybook products available at the time of this study, it was impossible to determine whether any particular features of a given presentation format were more or less supportive of listening comprehension; there was substantial overlap in the presentation features across the four story formats. Individual differences in background knowledge did play a substantive role in preschoolers' story listening comprehension; it is likely that at-risk populations require substantially more support and scaffolding for listening comprehension than current digital storybook presentation formats provide. Future refinement in the design of these digital environments and additional research are required to determine better ways to support listening comprehension in at-risk learners when they engage in digital storybook activities.



## CHAPTER I: INTRODUCTION

Text comprehension is of crucial importance in a democracy. Comprehension is a foundational skill that is necessary for civic participation; yet some populations continually demonstrate difficulties comprehending text and have been classified “at-risk” for reading failure. Because of the widespread belief that most reading difficulties can be prevented by promoting early childhood language and literacy, the importance of storybook reading has been emphasized, especially for populations considered to be at-risk for reading failure, by educators, policymakers, and even physicians (Diener, Wright, Julian, & Byington, 2003; Russ, et al., 2007). Educators and researchers believe that two inextricable foundational skills—excellent listening comprehension and vocabulary knowledge—are associated with better reading comprehension in later grades (Neuman, 2010; Paris, 2005, 2009; Schickedanz & McGee, 2010). Read alouds have served to stimulate children’s text understanding and vocabulary development for a long time. It is well-documented that traditional parent-child book reading contexts get children off to a good start (Bus, Van IJzendoorn, & Pellegrini, 1995) and that teacher-student read alouds can likewise have significant beneficial effects for listening comprehension (Van Kleeck, Stahl, & Bauer, 2003; Whitehurst, et al., 1988).

Building listening comprehension typically involves texts presented in bound paper format with static images and interaction between the reader, the listener, and the text; but texts are changing—with the advent of the computer, and, more importantly, the Internet, visual, audio and written text components are being combined in new ways and are being presented to children in new formats in which the adult-child interaction is altered or, in some instances, omitted. It is now much more common for young children to read texts in electronic format than it was 20 years ago. Information and communication technologies (ICT) have the potential to

expose young children to the rich language of books in digital form, without adult assistance. Nearly all schools have computers in their early childhood classrooms capable of presenting digital storybooks and, in some homes, electronic books have become an integral part of the day. But, are children understanding the digital texts they experience? How supportive are these texts of young children's comprehension?

Children are motivated by technology—they are exposed to, seek out, and navigate electronic texts for entertainment and enjoyment; and mobile devices like iPods, laptop computers, and personal gaming devices are making texts available in different ways than many adults are familiar with. The 2006 report by Scholastic Inc. and Yankelovich indicated that four of every ten children read on a technological device, most often the computer, and that the children who use ICT for reading are *more* frequent and *more* engaged readers than those children who do not read on computers, mobile phones, or other devices. It is likely that that percentage is even higher today. So it appears that technology can motivate children to engage in literate activity, which could be particularly beneficial for children classified as at-risk for reading failure; but we need to understand better the salient features of digital storybooks that contribute to young children's learning.

The purpose of this study was twofold: (1) to study young children's listening comprehension of digital storybooks and (2) to investigate how individual differences in children's interest, background knowledge, and computer skill relate to their story understanding.

### **Reading, Writing, Thinking: Literacy in the 21<sup>st</sup> Century**

Today, there are changing notions of what it means to be literate—we have moved from definitions of literacy focused largely at the code level (i.e., simply decoding and encoding) to definitions of literacy that recognize the role of the code in reading and writing, but emphasize

the meaning behind the language and images used to convey literate messages (The New London Group, 1996). Presently, literacy requires one to approach a wide variety of traditional and electronic texts with an eye for evaluation, critique, synthesis, and seeing multiple perspectives.

There is widespread belief among educators and parents that children will require technological competencies to succeed in school and, later, in the workplace (Council of Chief State School Offices & National Governors Association, 2010; DfES, 2002; Plowman & Stephen, 2003). Traditional notions of literacy are rapidly giving way to multiple ideas of what constitutes literate activity. Some scholars refer to the *new literacies* (plural) of the Internet and other digital environments (Lankshear & Knobel, 2003). Literacy is no longer a static construct; it has now come to mean a rapid and continuous change in the ways in which we “read, write, view, listen, compose, and communicate information” (Coiro, Knobel, Lankshear, & Leu, 2008, p. 5).

There is no doubt that conventional, established and traditional forms literacy are required to engage in the new literacies, but the social and cultural ways of doing ‘literacy’ have changed: email, text messaging, and Twitter are used to send messages to a friends or colleagues; paper and pencils, while they are still available, are no longer needed; digital indexing systems and Boolean searches have taken the place of traditional card catalogs in the libraries; traditional editing and revising have been modified with computer functions such as Track Changes; and our traditional ways of reading paper bound texts are giving way to new patterns of text navigation in the World-Wide-Web and on e-book readers.

Despite the ubiquity of technology outside of school walls, ICT have made very little impact on the everyday lives of students, particularly those in Pre-K to 3<sup>rd</sup> grade classrooms. Cuban (2001) reports that “teachers have been infrequent and limited users of the new

technologies for classroom instruction” (p.178), which implies that young children are not often exposed to the multitude of ways people engage in literate activity with ICT. A more recent survey of literacy teachers K-12 found that, despite access to ICT hardware and software, barriers still exist to technology integration in elementary schools (Hutchinson, 2009). Thus, children may be missing out on (1) motivating contexts for literacy activities and (2) additional support in comprehending new kinds of text that are presented electronically.

### **The State of Reading Achievement in the United States**

The political landscape of the past 20 years in America has been colored with a recurring emphasis on improving education to enhance overall literacy achievement, closing the achievement gap and eliminating the fourth-grade slump. The achievement gap (Foster & Miller, 2007; Stanovich, 1986) draws attention to differences in the literacy achievement of different groups of children (e.g., race, gender, language, socio-economic status) as evidenced data from the National Assessment of Educational Progress [NAEP] (<http://www.nces.ed.gov/nationsreportcard/pdf/main2005/2006451.pdf>). Research also suggests that a large number of children, starting as early as the age of nine years, tend to experience a decline in motivation for and engagement with reading and a parallel leveling-off, or even decline, of academic achievement (Chall & Jacobs, 1983; Scholastic Inc. & Yankelovich, 2006, 2008; Tyre & Springen, 2007). This phenomenon is often referred to as the fourth-grade slump.

The most recent NAEP data reveal a narrowing of the overall achievement gap over a period of the past 35 years between both White and Black and White and Hispanic populations ([http://nationsreportcard.gov/ltt\\_2008/media/pdf/ltt\\_news\\_release\\_2008.PDF](http://nationsreportcard.gov/ltt_2008/media/pdf/ltt_news_release_2008.PDF)), but there have been no significant changes at grade four in the last two reporting cycles (i.e., 2008 and 2009, see [http://nationsreportcard.gov/reading\\_2009/](http://nationsreportcard.gov/reading_2009/)), and researchers therefore surmise that the gains

earned in the wake of the early years of No Child Left Behind will not be maintained as the cohorts of students mature into middle school and junior high, particularly with respect to comprehension (Foster & Miller, 2007). More emphasis on supporting young children's text comprehension is needed (RAND Reading Study Group, 2002; Snow, Burns, & Griffin, 1998), and comprehension instruction in early childhood classrooms can help alleviate some of what some have called the "comprehension instruction gap" (Teale, Paciga, & Hoffman, 2007). However, focused research is needed to test whether ICT can play a role in alleviating this gap.

### **The Importance of Early Intervention**

Despite the efforts of Presidents Clinton, Bush and Obama to provide more educational funding and promote higher standards of student achievement, neither the achievement gap nor the fourth-grade slump has been eliminated. In order to address these educational dilemmas, it is important to continue to target the ages immediately preceding them, focusing on constructs connected to the achievement gap and the fourth-grade slump—comprehension and motivation. Currently, work in early intervention, targeting the Pre-K to 3<sup>rd</sup> grade age range, is not addressing comprehension or motivation to a sufficient degree.

Because we know that literacy learning begins very early in a child's life (Teale & Sulzby, 1986), federal and state governments, parents, and educators have seen the need to intervene early to help prevent reading difficulties. Early intervention, particularly in the forms of Reading First (RF) and Early Reading First (ERF), were developed as avenues to minimize the number of children affected by the achievement gap and to have "No Child Left Behind." RF, guided by the findings of the National Reading Panel (2000), provided additional funding to primary grade classrooms so that the students were taught by high-quality teachers who teach content identified as leading to later reading achievement—phonological awareness, phonics, vocabulary, fluency,



and comprehension. ERF provides similar benefits to preschool-aged children, with content focusing on phonological awareness, oral language and vocabulary, listening comprehension, letter knowledge, phonics, and print awareness. Progress monitoring assessments are required in all RF and ERF classrooms, and schools are required to report their progress to the federal government each year. In doing so, these schools have become apprenticed into a culture driven by accountability.

Most recently, this accountability model has impacted school curriculum in that we have come to rely on instructional approaches emerging from scientifically based reading research (Shavelson & Towne, 2002) as the foundational pedagogical principles of early literacy education. The What Works Clearinghouse (WWC, see <http://ies.ed.gov/ncee/wwc/>) was established in 2002 by the Institute of Education Sciences at the U.S. Department of Education to provide educators, policymakers, researchers, and the public with a central and trusted source of scientific evidence about "what works" in education. Teachers, researchers, policy makers, and parents can search the WWC for instructional techniques and programs for effects on particular outcome measures. Among the instructional techniques are dialogic reading, shared reading, interactive shared reading – all forms of reading aloud to children – and two computer based intervention programs (Waterford Early Reading Program and Daisy Quest). Although there are at least three read aloud interventions and two interventions based on electronic texts, none of this research has specifically investigated the efficacy of digital read alouds with respect to listening comprehension; the WWC outcome measures for early childhood education only include oral language, phonological processing, cognition, print knowledge, early reading/writing, and math.

Because skills like phonological awareness, print knowledge, letter identification, fluency and phonics are more easily measured than vocabulary or comprehension (Hoffman, 2008), they are more frequently measured (one only need look at WWC results or DIBELS/TPRI/ PALS tests which include no measures of story comprehension for our youngest students). Thus, although policies like RF and ERF and teachers' curriculum guides give equal importance to the easy-to-measure and difficult-to-measure skills, teachers in practice are more likely to emphasize the skills for which they are held immediately accountable (Teale, et al., 2007). As Paris (2005) stated, "There has been relatively less research and classroom emphasis on vocabulary and comprehension to date, perhaps because of the difficulty assessing and teaching these skills to children who are beginning to read" (p.187). In early childhood (i.e., Pre-K-3) this means the easy-to-measure skills—phonological awareness, print knowledge, letter identification, fluency, and phonics—are more evidently attended to in teacher's enactment of the curriculum.

Also complicating this matter is that there are clear ceilings and benchmarks for these easy-to-measure skills. Paris (2005, 2009) has referred to these kinds of skills as 'constrained.' Over-emphasis on constrained skills can possibly lead to negative effects on engagement and interest in reading, and a lack of attention to building early comprehension skills, thus contributing to the fourth-grade slump. Instructional emphasis on unconstrained skills (i.e., vocabulary and comprehension), in addition to appropriate teaching of constrained skills, however, leads children to understand the text and apply the message in texts.

Because instructional emphasis is already being placed on constrained skills in early childhood classrooms, also teaching the unconstrained skills early in a child's educational experience could potentially positively affect the achievement gap. Moreover, teaching strategies that "promote meaningful participation...as well as instructional approaches that are flexible

enough to appeal to individual students' interests and abilities" are suggested as ways to help increase student motivation for literacy (from <http://www.ers.org/otsp/otsp3.htm>) and thus can help address the fourth-grade slump. This research carefully examines the often-neglected unconstrained skill of comprehension in its earliest stages, emergent literacy.

### **Comprehension in Emergent Literacy**

Both lower- and higher- level processing skills contribute to a child's reading comprehension (Palincsar & Brown, 1984). For example, word recognition skills and identification of a main character are considered a lower level processing skill. In contrast, inference making is considered a higher level processing skill because it aids the construction of the meaning-based representation of the text (Pressley, 2000).

Because preschool children typically do not decode texts independently, they act as listeners and viewers, attending to the oral language presented by a skilled reader and to the illustrations in the text to build story understanding. A young child's comprehension of the text, therefore, is not dependent on the ability to cipher the encoded language in print. His/her text understanding depends, rather, on the complex interaction of text, individual, and task variables in listening situations (RAND Reading Study Group, 2002). The task variables are a function of the ways the text is presented to the child; what is emphasized by the reader and how the child is supported in his or her efforts to understand the complexities of the text (i.e., its characters and plot) and vocabulary. Also important in the task strand is the child's engagement in the story listening activity (Bus & van IJzendoorn, 1995; Paciga, Lisy, & Teale, 2009). The text factors largely depend on the language complexity of the text (Price, Kleeck, & Huberty, 2009), the role of the illustrations in the text (Sipe, 2008), and the genre of the text (Duke & Kays, 1998; Pappas, 1993; Pappas & Pettegrew, 1998). Research on young children's listening

comprehension has more often focused on the task and the text factors of story understanding, thereby comparatively neglecting the contributions of the individual in the comprehension process.

We know that contributions of the individual do matter in conventional reading comprehension. Existing research has shown that individual differences, including situational and individual interests and domain knowledge, are significant and long-term predictors of reading comprehension in mature independent readers—in both paper formats (Alexander, 1992; Alexander, Jetton, & Kulikowich, 1995; Alexander, Kulikowich, & Schulze, 1994; Alexander & Murphy, 1999; Braten & Olaussen, 2005) and electronic formats (Lawless, 1996; Lawless & Kulikowich, 2006; Lawless & Schrader, 2008; Schrader, Lawless, & Mayall, 2008). But how these variables develop from a young age and change throughout the early and elementary years of education is largely unknown. Theories of interest development do exist (Hidi & Renninger, 2006; Krapp, Hidi, & Renninger, 1992) and propose that interest in a given domain begins with situational interest and that maintained situational interest can lead into personal interest. The Model of Domain Learning (Alexander, 2003) suggests that the interplay of several linguistic, cognitive, and motivational constructs contribute to the development of proficient and strategic adult readers. But what is the relationship among these variables with younger populations? This research begins to address this gap in the field's understanding about listening comprehension in young children.

### **Teaching Listening Comprehension: Storybook Reading as Recommended Practice**

Reading aloud has received much research and practical attention since the advent of an emergent literacy perspective (Teale & Sulzby, 1986; Yaden, Rowe, & MacGillivray, 2000) and more recently has been featured as a desirable, research-based instructional practice in federal

policy documents (e.g., National Early Literacy Panel), federally funded professional development efforts (e.g., Early Reading First and Reading First), and initiatives of the Institute of Education Sciences (e.g., What Works Clearinghouse). This instructional practice is valuable for several reasons. First, reading aloud to children demonstrates the authentic purpose for reading—through read aloud experiences, young children come to understand that real reading is rooted in meaning making and can accomplish the goals of entertainment, acquiring information (Yaden, Smolin, & Conlon, 1989), or connecting with ideas presented in stories to develop their understandings of the world and its people. Moreover, children's understandings of how we read are developed through this activity; they come to understand that the adult is reading the print on the page, making connections between the alphabetic principle and phonological awareness in ciphering the text.

Second, children are invited into the decontextualized language of text when they listen to stories read aloud. This is significant primarily because of the connections between text comprehension and understanding of decontextualized language (Dickinson & Snow, 1987; Tabors, 2001). While young children tend to readily understand the contextualized language of conversation that integrates supports like facial expressions and gestures, the language of stories is removed from young children's experiential background knowledge and knowledge of people, objects and actions in their immediate surroundings. Written texts contain more decontextualized language; including more abstract vocabulary and complex language structures. Children's listening comprehension is fostered through the addition of visual (e.g., gestures and explicit reference to the illustrations) and auditory supports (e.g., intonation, characterization, and pacing) and discussion of the decontextualized language present in storybooks. These kinds of

early experiences with decontextualized language may support future reading comprehension when independently accessing text.

Third, complex cognitive processes, like comprehension strategies, are easily modeled for young children in storybook reading contexts. Research has shown that story reading contributes to children's later abilities to make sense of text on their own because these activities introduce children to new language strategies (Cochran-Smith, 1984). In her investigations of "ways of taking meaning" from text, Heath (1982, 1983) concluded that children from communities where adults continually mediated the connection between meaning from text and knowledge from the environment achieved much higher levels of literacy than those with adults who did not. Through observation of an adult "thinking aloud" the meaning making process within the context of a read aloud, children begin to make sense of the balance and interplay of the information gleaned from the text, background knowledge, and discussion with others that results in story understanding. Furthermore, they begin to understand this process as the goal of reading and also apply and practice strategies modeled by the adults: asking questions, making comments, and engaging with the text and others to actively create meaning.

### **Fostering Comprehension Vis-à-Vis Storybook Reading: Research and Practice**

Storybook reading can play an integral role in supporting early literacy development in general, and listening comprehension in particular. Current recommendations for reading aloud are based on research (Van Kleeck, et al., 2003) and indicate that some children have higher levels of story understanding after they have practiced retelling the story's main events and following repeated readings of the same texts (Karweit, 1989; Morrow, 1985, 1988). Research has also concluded that maintaining story-directed, rather than word-focused talk, and focus on important information integral to understanding the story also contributes to higher levels of

student text comprehension (Brabham & Lynch-Brown, 2002; Dickinson & Smith, 1994; Teale & Martinez, 1996). Furthermore, research investigating the relationship between the structure and content of conversations in the read aloud and resultant story understanding indicate that when an adult explicitly refers to the illustrations in text, students exhibit higher levels of complex text comprehension (i.e., connections and inferences) (Paciga, Hoffman, Teale, & Garrette, 2008). In order to maximize text comprehension, teachers engage in read alouds that utilize illustrations to support complex comprehension (Sipe, 2008), focus on the important information of the text, are interactive to maintain student engagement and interest, and are presented multiple times to children (McGee & Schickedanz, 2007).

In the years spent developing these understandings about traditional text read alouds, society has experienced a concomitant shift in the common text base for many children. A recent report found that children ages 8 to 18 spend only six percent of their time beyond school walls interacting with print-based media compared to 45 percent on computers or mobile devices (Rideout, Foehr, & Roberts, 2010). In other words, there has been a dramatic reduction in children's interaction with paper-based texts. In addition, children in this study were more likely to go online. Now, many children access stories on computers over the Internet, mobile devices, or on CD-ROMs. Our understanding of what makes storybook reading effective in supporting young children's listening comprehension of paper-bound text has come a long way, but all that is recommended practice is not applied in every read aloud context, particularly in instances where children are accessing digital storybooks on computers. This is not to suggest that traditional read alouds will ultimately give way to digital stories presented on computers or handheld devices, but the technology exists and there are remarkable differences among the

presentation features of digital storybooks that are associated with particular websites. Because of this, research investigating the nuances of the digital storybook read aloud is needed.

### **Listening to Digital Storybooks: Additional Benefits for Young Children**

Emergent literacy research has demonstrated the educational benefits of reading aloud to children (Bus, et al., 1995; Scarborough & Dobrich, 1994) as well as the efficacy of CD-ROM storybooks for supporting children's emerging literacy skills (de Jong & Bus, 2004; Korat & Shamir, 2007). Furthermore, research has indicated that reading aloud to children and computers (i.e., as an activity separate from read alouds) can motivate children to engage in literacy.

Additional exposures to the rich language of storybooks in digital forms can provide all children with access to high-quality text and competent readers. These additional exposures to and interactions with text could result in possible effects on traditional measures of constrained skill development (e.g., print awareness and word identification) and could also help develop unconstrained skills (e.g., vocabulary and comprehension). In addition, listening to digital storybooks could be a developmentally appropriate way for children to begin to use ICT for authentic purposes—as tools designed for literate activity.

Incorporating developmentally appropriate uses of ICT into early childhood education is important for at least four reasons. First, a preponderance of research evidence indicates that early experiences with traditional literacy are predictive of later achievement in traditional literacy measures (e.g., Durkin, 1966; Ferreiro & Teberosky, 1982; National Reading Panel, 2000; Teale & Sulzby, 1986), and therefore additional exposures to forms of literacy activities that are effective for supporting literacy such as ICT for digital storybooks will benefit young children, particularly those from at-risk backgrounds where parents either have limited literacy



skills or with children from second language backgrounds where parents with limited proficiency in the English language are not able to read aloud to their children in English.

The second reason developmentally appropriate uses of ICT in early childhood are important relates to our understandings of traditional emergent literacy: because of the differences in the social nature of literacy experienced through ICT, the integral role of images in texts, and the non-linearity of text structures on the Internet, it is likely that emergent literacy manifests itself in different ways in a digital environment than in a traditional literacy environment. Furthermore, it is likely that young children's listening comprehension is supported in different ways than in traditional storybook listening contexts.

Third, research has also suggested that work on computers and with other forms of ICT requires some foundational technological skills only likely to develop through experiential learning with computers and other forms of ICT. Children need to know how to power-on and use component parts of the computer, control a mouse to accomplish their goals, recognize icons, print, and open and close programs (Turbill, 2001a; Zevenbergen & Logan, 2008). Digital storybooks can provide children with the experience requisite to form the foundational skills for literacy learning with technology.

Finally, ICT provide motivating contexts for literacy. We know that young children who use information and communication technologies for reading are *more* frequent and *more* engaged readers than those children who do not read on computers, mobile phones, or other devices (Scholastic Inc. & Yankelovich, 2006). If we provide authentic and intriguing contexts and literacy tasks for children, the fourth-grade slump could be lessened considerably (Gambrell, 2006).

It is important to build on what is already known about the ways in which the format of the electronic texts and their presentation support or interfere with text comprehension. Labbo and Kuhn (2000) used a single case study to illustrate that incongruent hotspots (i.e., places where children could activate animations that were entirely unrelated to the story's plot) in CD-ROM technology interfered with one student's text understanding. Other research has experimentally investigated the effects of these hotspots on children's literacy outcomes (Bus, Verhallen, & de Jong, 2009; de Jong & Bus, 2004), but existing digital read alouds available through digital libraries, like One More Story (<http://www.onemorestory.com>), on websites like Story Line Online (<http://www.storyonline.net>), or on CD-ROMs vary in presentation format. The level of animation (static to fully animated production), presentation of text (text captions that track print, no text, etc.), extra-textual supports (e.g., character dialogue or semiotic support like gestures, intonation) and the degree of interactivity (passive viewing, hotspots, turning pages only) can have significant effects on a child's story understanding. How do these variations in presentation format affect children's listening comprehension?

### **Purpose of the Study**

Research has demonstrated the efficacy storybook reading as an instructional context supporting young children's developing comprehension processes. Furthermore, storybook reading is recommended and common practice in early childhood classrooms (Teale, Hoffman, & Paciga, 2010; Van Kleeck, et al., 2003) and can be very interactive and engaging for young children (McGee & Schickedanz, 2007; Paciga, et al., 2009). The research base directly investigating preschool and kindergarten children's listening comprehension, however, has largely neglected the role of individual differences play in comprehension processes and so this research serves to fill that gap.

Concomitant with the aforementioned gap in the read aloud research base, we are experiencing a societal shift in the main text base for reading and what we know about young children's comprehension of paper texts cannot be directly translated to electronic texts. This study builds on the accomplishments in the lines of listening comprehension research focused on the effects of (a) storybook reading and (b) CD-ROM storybooks, examining the affordances of digital storybooks as a support for young children's developing story understanding.

More research is needed to investigate the ways in which the variations in presentation format of digital storybooks affect young children's listening comprehension. This question is not simply answered, as text alone does not determine what/how a child will comprehend (RAND Reading Study Group, 2002). We need a more complete understanding of how individual differences contribute to listening comprehension. To be relevant to today's youth, the research community needs to embrace ICT as a potential source for early text exposure. Computer technology can serve as an integral support for young children's developing story understanding, providing visual and auditory supports for comprehension, but the efficacy of these texts and supports likely vary with respect to individual differences. We know that successful listening comprehension is related to several key variables including the text, the activity, and the contributions of the child (e.g., vocabulary knowledge, background knowledge, and their interests).

An experimental design explored the following questions related to young children's listening comprehension of digital storybooks:

1. Does the presentation format of digital storybooks impact young children's story understanding in a digital environment?

- a. To what degree do the various presentation formats support young children's recall of the text?
  - b. To what degree do the various presentation formats support young children's abilities to order, or sequence, pictures from the text?
  - c. To what degree do the various presentation formats support young children's understanding of elements explicitly presented in the text?
  - d. To what degree do the various presentation formats support young children's higher-level comprehension of the text?
2. Do individual differences in knowledge and interest predict young children's listening comprehension and recall of a digital storybook?

Together, these research questions will help develop understandings about the nature of young children's comprehension of digital storybooks.

## CHAPTER II: LITERATURE REVIEW

Emergent readers are young children who are not yet reading conventionally, but are developing understandings of literacy and building content knowledge through interactions with picture books. For more than three decades, research has emphasized the relationship between exposure to books during the preschool years and learning to read. Exposure to read alouds of books in both the home and school environment is now considered to be a major source for developing vocabulary (e.g., Bus, et al., 1995; Juel, 2006; Mol, Bus, & de Jong, 2009; Scarborough & Dobrich, 1994; Senechal & LeFevre, 2002) and skill in story comprehension (Brabham & Lynch-Brown, 2002; Collins, 2004; Dickinson & Smith, 1994; Karweit, 1989; Morrow, 1985; Reese & Cox, 1999; Sipe, 2000; Teale & Martinez, 1996), both of which are key components of reading success in later grades (National Early Literacy Panel, 2008; National Reading Panel, 2000). This empirical evidence clearly indicates that young children who are read to regularly are more likely to be better readers than those who do not have these experiences. Policy documents have concluded that “the single most important activity for building the knowledge required for eventual success in reading is reading aloud to children” (Anderson, Hiebert, Scott, & Wilkinson, 1985, p. 23). These kinds of recommendations have spurred the wide-scale adoption of storybook reading as a common early childhood practice, both in the home and in schools.

In the school setting, adoption of technology has increasingly brought digital storybooks into the preschool classroom. This new context for children’s experiencing the rich language of storybooks has resulted in significant changes to both the nature of texts being read (de Jong & Bus, 2003; Korat & Shamir, 2004; Shamir & Korat, 2009) and the kinds of interactions the child experiences while listening to a story (Paciga, 2009). Each of these changes has the potential to

affect how young children comprehend a particular story they are exposed to and, in the long run, their story comprehension skill, or, as Heath (1983) called it, their “ways of taking” from text.

Because this is a study of emergent readers’ story comprehension (situated within a cognitive framework), the issues it addresses cut across three areas of research: the use of digital storybooks with young children, reading with young children, and the larger body of research on comprehension. Accordingly, this chapter presents a theoretical frame for the study and situates this work within the fields of research focused on listening comprehension, digital storybooks, and the larger body of literature on storybook reading with young children. It employs the RAND framework (RAND Reading Study Group, 2002) for comprehension to structure the review of key studies shedding light on emergent readers’ story comprehension of digital storybook read alouds.

### **Theoretical Perspective**

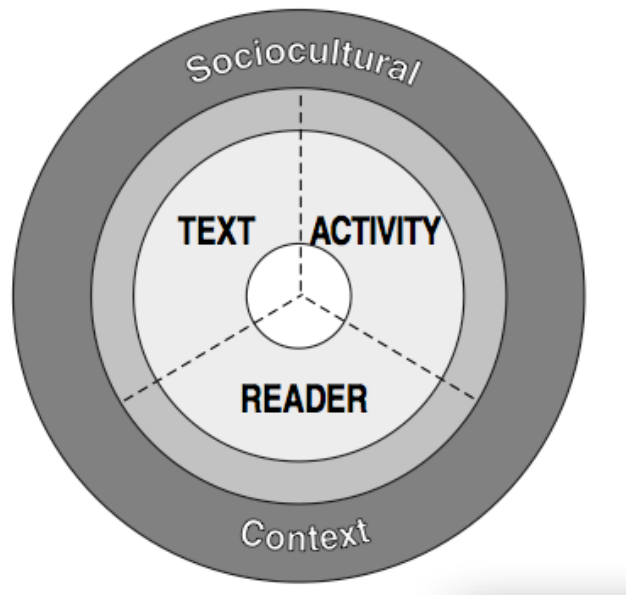
According to Neisser (1967), “‘cognition’ refers to all the processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used” (p. 4). Cognitive theories propose that humans have limited attention capacity or working memory (Engle, 2002) and that the ways we process information affect our memory and recall. In the case of a storybook read aloud, the sensory input consists of visual and auditory input from a book and a reader, sent to a young listener who, in an ideal world, attempts to make sense of the input, or story.

Research about text comprehension rooted in a cognitive perspective is primarily concerned with the mental representation of textual information by the reader (Kintsch & van Dijk, 1978). The most widely accepted cognitive theories of reading comprehension suggest that the reader combines the various pieces of information in the text with relevant information from

the reader's background knowledge. These representations build and connect to form a network of schema in the reader's mind (Rumelhart, 1978). Thus, theories of text understanding are largely based on the more general principles of schema theory (Anderson & Pearson, 1984), which posits that cognitive structures, called schemata, process and organize information and, in doing so, are themselves modified and refined by new information. This perspective holds that what the individual brings with him/her to a text is an extremely important factor in understanding that text. In other words, new information presented by a text is filtered through the individual's prior knowledge. The reading process is a "balancing act, in which the reader tries to find a compromise between limited attentional capacity and his/her standards for coherence" (Van den Broek, Kendeou, & White, 2009, p. 66).

Given that cognitive theories historically examine the (1) input and (2) individual and that learning occurs as consequence of an (3) an activity in which the individual is exposed to a particular input, the RAND framework for comprehension (Figure 2.1) serves as an appropriate model for examining young children's story comprehension from a cognitive perspective, where the input is the text, the individual is the reader and the activity is the read aloud. There is, however, one component of the RAND model that remains unaddressed by a strictly cognitive perspective—the sociocultural context in which the activity is carried out. Reading, in general, takes place within a specific social, geographical, and historical context. These factors have an influence on the "funds of knowledge" (Gonzalez, et al., 1995), or schema, that help children process and organize new information. So, by adopting the RAND model as a framework for examining story comprehension, it is necessary to be mindful of the fact that the sociocultural context can impact the inputs and outputs associated with a read aloud activity and young

children's story comprehension consequent from that activity. This study does not, however, examine variables associated with the sociocultural context.



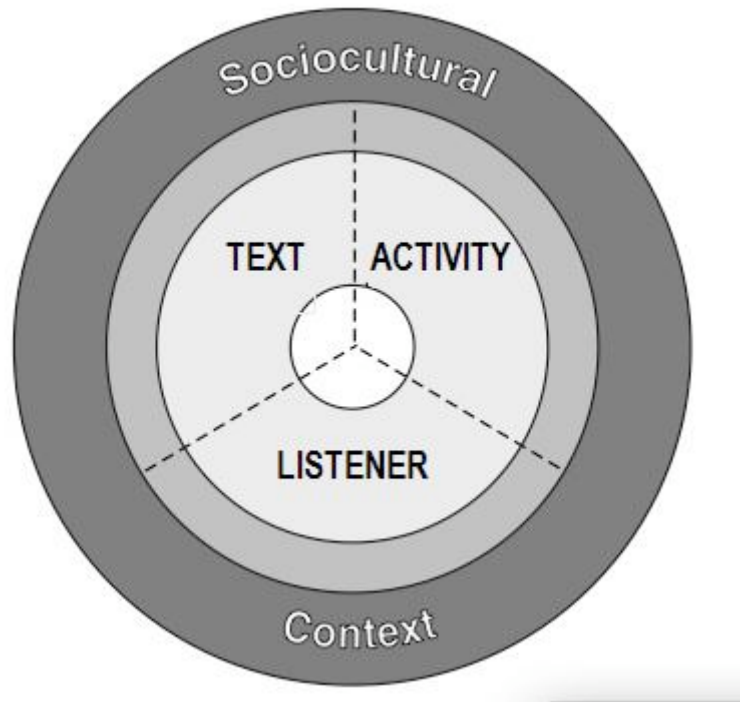
**Figure 2.1. RAND Framework for Text Comprehension** (RAND Reading Study Group, 2002). This figure provides a visual representation of the factors associated with the framework.

While the RAND framework has helped us understand reading comprehension in general, it can also help us understand emergent readers' story comprehension, with two caveats. The first is that we distinguish between what the reader does in a traditional reading task versus what the young child does while listening to a story read aloud—reading comprehension in older readers is explicitly tied to their decoding ability and fluency (skills situated at the reader level of the RAND framework) whereas emergent readers do not independently decode texts; their story understanding is closely tied to the ways texts are presented, or read aloud, to them (situated at the activity level of the RAND framework) and their ability to understand oral language (a skill situated at the reader level of the RAND framework), rather than on their independent ability to



cipher written texts. So, if a new rendition of the RAND framework was created specifically for comprehension of read aloud, it would read “listener” rather than “reader” to avoid confusion, as the “reader” in a read aloud is actually the narrator. Figure 2.2 (p. 23) makes this adjustment to the RAND framework for text comprehension.

Secondly, as this is a study of storybook comprehension consequent from hearing a story read aloud, research in this field typically situates the reader’s narration of the text as a feature of the activity because, in a school setting, the teacher is the orchestrator of the activity and mindfully (or un-mindfully) adopts a particular style of reading (Dickinson & Smith, 1994; Martinez & Teale, 1993). In this way, there are many potential presentations of the same text that depend on the teacher’s orchestration of the read aloud activity. This study, however, situates the text narration in the text portion of the RAND framework, thus aligning with a New London Group (1996) conception of text. In this conception, the narration of the text, the discussion surrounding the read aloud and the corresponding book selected for the reading become data sources for the text portion of the research. The activity, then, becomes the description of the task, as described by the teacher and researcher, and the other factors associated with the activity of electronic storybook read alouds that are elucidated in the paragraphs that follow.



**Figure 2.2. Framework for Storybook Comprehension.** This framework replaces the RAND framework's 'reader' with 'listener.'

### Defining Listening Comprehension

Because this research is primarily concerned with a young child's story, or narrative, and with listening comprehension, and not reading comprehension, it is important to illustrate the situations in which story comprehension can be measured. Story listening comprehension, in particular, is measured during or following an individual's exposure to narrative texts accompanied by illustrations. The text is read aloud by a competent reader and the individual listens to the story (i.e., is not actively engaged in decoding the words). Story listening comprehension requires grasping information explicitly presented in the text—the characters, setting, problem, resolution, and sequence of events. In addition, it also requires higher-order thinking including inferencing, making connections, and predicting. Attention to and

interpretation of information presented in storybook illustrations often facilitates this kind of inferential thinking.

The body of literature explicitly related to preschool children's story listening comprehension of digital storybooks has significant gaps, which will be explored in the paragraphs to come. Specifically, the body of research on young children's electronic storybook comprehension (1) neglects to simultaneously investigate variables from three of the factors associated with RAND framework for comprehension—the activity, the text, the reader—and (2) does not encompass younger preschoolers (i.e., younger than four years old) as a part of their examination of this construct. A wealth of research from other fields offer some additional insight into the complex of variables associated with listening comprehension and so, when they are related to the construct being reviewed, studies from traditional reading comprehension research, semiotics, and visual design are also reviewed.

### **The Activity: Listening to Digital Storybooks**

This study is focused on preschool children's listening comprehension of digital storybooks. Digital storybooks are onscreen versions of children's picture books. They are also commonly referred to as e-books, CD-ROM storybooks, talking books, living books, interactive books or electronic books. These storybooks have been available on CD-ROMs for at least a decade (de Jong & Bus, 2003; Korat & Shamir, 2004; Unsworth, 2003) and, more recently, have become available through paid-membership to electronic libraries housed on the Internet (e.g., <http://www.onemorestory.com>; <http://www.etumblebooks.com>; <http://auth.grolier.com/login/bookflix/login.php>) or as single book downloads for iPhones and iPads (e.g., <http://istorytimeapp.com/>) or on the Barnes and Noble "Nook", and on children's websites (e.g., <http://www.kideos.com/category/characters/book-characters>; <http://www.scholastic.com>; <http://www.pbskids.org>). Audiobooks downloadable from Amazon

(<http://www.amazon.com>) and Audible (<http://www.audible.com>) are different from digital storybooks, because in these latter sources the visual images are not presented along with the oral reading of text. When a child independently activates the pages of an electronic storybook and selects a “read to me” function he or she becomes a participant in a digital storybook read aloud, viewing the onscreen images and listening to the oral presentation of written text.

Duration is an activity-level variable that, in some electronic storybooks, is controlled by the student (Calvert, Strong, & Gallagher, 2005). This variable remains unexamined in the extant body of literature on digital storybook comprehension. Traditional read aloud research with preschool students in urban settings has noted a remarkable decrease in the engagement levels of students as the duration of the read aloud activity approaches 20 minutes (Paciga, et al., 2009). The majority of digital read alouds endure longer than this 20-minute threshold, likely an effect of the integration of reader-controlled hotspots and musical accompaniment. While it is likely that these features are included to pique students’ interest and maintain their engagement with the activity, their effects remain largely unexplored with respect to story comprehension. Although the evidence from the Paciga, et al. (2009) study does not suggest that exceeding 20 minutes has an adverse effect on story comprehension, further investigation of the relationship between the duration of a read aloud and resultant story comprehension could provide more clear directives for those designing and marketing digital storybooks.

### **Comprehension of electronic storybooks.**

Activities presented in the existing research that employ electronic storybooks have wide variation in what the students do with the electronic storybook. There is a range of ways young children interact with the media in studies examining electronic storybook activities when emergent readers are instructed to listen to the digital read aloud—listen only; listen and view;

and listen, view and click. Experimental research has determined that, in general, children exposed to the visual and audio components of a digital read aloud result in better story comprehension than those who experience only one of those components (e.g., Calvert, et al 2005; Ricci & Beal, 2002). Descriptive research indicates that, when engaged with digital read alouds, young children (1) advance page turns and activate hotspots embedded within the illustrations and text of the electronic storybook, (2) express affective reactions to the text and (3) engage in cognitive and metacognitive thinking about the text (e.g., Labbo & Kuhn, 2000).

There are several studies examining how electronic storybooks facilitate kindergarten and first-grade children's efforts to decode text. Doty, Popplewell and Byers (2001) randomly assigned first-grade classrooms to one of two conditions—reading a CD-ROM storybook or reading the same story in a printed text—and followed-up by gathering oral retellings and responses to six comprehension questions. Their measures of reading comprehension indicate that there were no significant differences in oral retelling, but that differences in comprehension measured by the six questions existed; students who read the electronic storybook achieved higher story comprehension than those who read the printed version of the text.

In a similar vein, Matthew (1996) matched pairs of students on gender and scores on the Primary 2, Reading Comprehension Subtest of the Metropolitan Achievement Test. One student in each pair was randomly assigned to either the experimental (CD-ROM story) or the control group (paperback of the same text). Matthew's measures also included oral retelling and comprehension questions eliciting students' understanding of both textually explicit and inferred information. Findings for this study are opposite those of the Doty, et al. (2001) study; comprehension measured by open-ended comprehension questions yielded no significant

differences. In this experiment, measures of story retelling yielded significant differences in reading comprehension.

Although these studies do include measures of *reading* comprehension that focus on explicit and implicit information presented in the text, they have conflicting outcomes and the tasks differ from those proposed for this study. Students in the Doty, et al. (2001) and Matthew (1996) studies were not listening to the entire story; rather, they were actively decoding and clicking on text-based hotspots to help them decode challenging words. Moreover, these studies are not focused on emergent readers and so the results from the measures of reading comprehension do not translate well either to populations of emergent readers or to a study of story comprehension as defined earlier in this chapter.

The digital storybook research that has assigned students the task of *listening* to the story is largely deficient in measures of story comprehension. For example, of six studies that assign the task of listening to the digital read aloud (de Jong & Bus, 2002, 2004; Korat & Shamir, 2007, 2008; Labbo & Kuhn, 2000; Ricci & Beal, 2002), only two contain measures of story comprehension that probe on children's ability to take information that was both explicitly and implicitly presented in the text (Korat & Shamir, 2007; Ricci & Beal, 2002). The other studies include retelling and free-recall measures (Labbo & Kuhn, 2000), emergent readings (de Jong & Bus, 2002, 2004) or do not measure any kind of comprehension (Korat & Shamir, 2008). While retelling and emergent readings are indicative of what a child has taken from the read aloud activity, these measures typically do not spontaneously produce information relevant to what a child infers about character emotions or how they connect that information to other themselves, other texts, and the world.

Korat and Shamir's (2007) study of compared kindergarten students' literacy outcomes consequent from digital read alouds of electronic storybooks to those consequent from traditional storybook read alouds. All students listened to the story three times and then participated in post-activity assessments. Korat and Shamir's measure of story comprehension consisted of seven open-ended questions; four of these questions prompted children to identify information that was explicitly presented in the story (e.g., what did the character do at the beginning of the story?) and three of these questions were centered on information that was implied by the story (e.g., why do you think the character was sad?). They found high levels of story comprehension in both experimental conditions with no significant comprehension differences between SES groups and no significant interaction between intervention group and SES, indicating that CD-ROM storybooks were just as effective as adult readers in supporting young children's story comprehension. It is important to note that the electronic storybook employed in this study had three main functions—read only, read with dictionary, and read and play—and all students interacted with all three modes of the storybook. In other words, every participant in either condition listened to the story at least three times. Read aloud research recommends multiple readings of the same text to better support story comprehension and vocabulary development (McGee & Schickedanz, 2007; Van Kleeck, et al., 2003), so it is possible that the dosage in this experiment could account for the high levels of story comprehension. Also, Korat and Shamir trained all of the students how to use the CD-ROM before they began their experiment, ensuring that computer skill would not intervene in attending to the task and affect outcome measures of story comprehension.

The studies by Doty, et al. (2001), Matthew (1996) and Korat and Shamir (2007) include questioning measures of story comprehension that address both explicit and implicit story

understanding, but the analyses do not distinguish between these two kinds of “taking from text” (Heath, 1983). Ricci and Beal (2002) do just that in their study: they assigned first-grade students to one of four experimental story conditions—listen only; listen and view (i.e., like a TV presentation); listen, view and interact with the storybook media; listen, view and observe someone else interact with the storybook media. Each child engaged in interaction with the storybook media one time only, but the authors did not provide students with training to ensure that they knew how to work with the technology. Here, Ricci and Beal found a main effect of question type; children performed better on the inference questions than on the explicit questions. This contradicts findings from studies of traditional listening comprehension which indicate that young children exhibit greater difficulty in appropriately responding to inference-type questions (Paris & Paris, 2003), particularly in the absence of targeted support provided by a more knowledgeable reader (e.g., Collins, 2004; Hoffman, 2009; Sipe, 2008).

So, the review of the activity of digital storybooks leads to three important conclusions. First, very few studies investigating the efficacy of digital storybooks have included measures of story comprehension and those that do present conflicting results with respect to explicit and implicit, or higher-level, story comprehension. Second, variations in the dosage of the interventions may affect story comprehension. Third, students’ previous experience or degree of comfort with using the technology has been inconsistently measured, and computer training before interacting with the technology is not consistently completed. These variations associated with the activity warrant further exploration of digital storybook listening and consequent story comprehension. Thus, the activity structure of digital storybook listening can potentially affect story comprehension, but the RAND framework for comprehension also posits that the features associated with a text and the individual will also impact one’s comprehension.



### **The Text: Variations in the Design and Presentation of Electronic Storybooks**

Fifty years ago, children's first medium was print; and although print media is still a part of American children's typical day, it is giving way to screen media. Given the wide-spread availability of information and communication technologies (ICT) in schools and at home, multimedia approaches are more and more frequently proposed as effective means to promote comprehension (Van den Broek, et al., 2009), but multimedia approaches (1) differ from print-based texts and print-based read alouds and (2) research suggest that multimedia approaches may interfere with comprehension by increasing the attention load for the comprehenders.

No matter the presentation mode (i.e., print or onscreen) of the text, Paivio's dual-coding theory (1986) can be employed to help make sense of the text's effects on one's story comprehension. This theory postulates that two different classes of information, one specialized for information concerning nonverbal objects and events (i.e., visual) and the other for dealing with language (i.e., auditory), are handled cognitively by separate systems of representation that are structurally and functionally distinct but that may support and expand each other in conveying the same content. Teale (2003) points out the importance of illustrations in traditional story books, "In the best of these [picture books] the illustrations and text complement each other to create a work which offers far more than either the pictures or words, no matter how good, could provide by themselves" (p. 126). Despite the complementarities of text and image, empirical research has not addressed the role of images in story comprehension. Although research has documented the differences in the visual images across genres (Kress & Van Leeuwen, 1996; Pappas, 2006), there is little in the way of systematic, empirical research applying dual-coding theory to the role of images in print-based storybook comprehension. Given the recent shift from print to electronic text, the application of Pavio's (1986) theory in the

information age becomes even more important than before. Electronic texts include audio, in the form of musical tracks and sound effects, and animation in addition to the static images and text found in print-based storybook. These multiple channels of information trigger the auditory and visual input systems independently but interconnections between the two systems trigger activity in the other, thus promoting the creation of coherent mental images of the story (Mayer, 2005). There is much research describing the visual images presented in electronic storybooks and documenting the differences between print and electronic versions of a text, but the majority of the research on digital read alouds have employed interactive CD-ROM storybook software (e.g., de Jong & Bus, 2002; Korat & Shamir, 2007, 2008). These typically include an oral rendition of the text (Reinking, Labbo, & McKenna, 1997) instead of, or in addition to, printed text (de Jong & Bus, 2003). Feature analyses have examined the features of interactive CD-ROM software and identified hotspots and filmic effects as common features of this kind of electronic storybook (de Jong & Bus, 2003; Korat & Shamir, 2004; Labbo & Kuhn, 2000).

CD-ROM technology was the only market for electronic storybooks in the 1990s, but web-based electronic storybooks have become more common in the 21<sup>st</sup> century. Recent work has compared the features of interactive CD-ROM storybook software with web-based electronic storybooks (Paciga, 2009). This feature analysis pointed to the difference in the auditory and visual content across presentation formats of the same text. Web-based electronic storybooks employed text-based factors that were characteristically different from those identified in CD-ROM storybooks. These text-based factors—hotspots, filmic features, and the differences in language content across presentation formats—have the potential to dramatically impact young children's story comprehension. Literature from other fields of research support this hypothesis, but the body of research focused on storybook read alouds with preschoolers does not consider

these variables when investigating story comprehension.

### **Hotspots.**

As previously mentioned, many digital storybooks contain hotspots—places in the onscreen illustrations or text that become active after the text has been narrated and only when a student points and clicks on these particular spots. Some of the hotspot animations have been classified as integral, or comprehension-supportive, and others have been classified as incidental, or not contributing to a child's understanding of the story's plot (Labbo & Kuhn, 2000; Turbill, 2001a). The interactive book format offers many more potential detours and distractions away from the main story line than other forms of storybook media. On each screen, the child can click on nearly any object in the text or illustrations to see an animation with accompanying sound effect (a 'hotspot'). In her description of Kindergarten students interacting with an interactive storybook, Turbill (2001a) suggested:

My field notes reveal that there has been little that fits within the teacher's view of 'beginning reading' practices even though the boys have been at the computer for some 15 minutes. While it is hoped that they are reading the print, they seem to enjoy mostly playing with the visually attractive animations. The many animations on each page seem to have little to do with the overall storyline of each page. When the boys were asked to retell the story of Grandma and her trip to the beach, they had little idea of the overall story but could tell which animation they liked the most, what happened when they clicked on it and in which scene it could be found. (p. 267)

Others agree that interacting with these animated areas on the screen might disrupt children's attention and interfere with their ability to connect scenes, make inferences, and follow the story line (e.g., Labbo, 2009; Unsworth, 2003) particularly as each page can have dozens of hotspots (de Jong & Bus, 2003).

Support for the possibility that interaction with hotspots might disrupt learning is found in research with adult learners—this body of research has found that the addition of interesting

but irrelevant information to a passage ('seductive details') can significantly impede learning (Lehman, Schraw, McCrudden, & Hartley, 2007; Renninger, Hidi, & Krapp, 1992), but similar results have not been found in digital storybook comprehension research with preschool children. Three studies have investigated these "gratuitous intrusions into the story" (Unsworth, 2003, p.5) that do not appear in the printed version in any format. In the first, Labbo and Kuhn (2000) found that the seductive details present in *Arthur's Teacher Trouble* (Brown, 1994) did interfere with one Kindergarten child's coherence in retelling the story. The second study, however, found that children frequently interacted with the animations often embedded in electronic stories, but did not find any evidence to support that the animations distracted children from listening to the text, nor that the animation interfered with story understanding measured by an emergent reading of the text (de Jong & Bus, 2004). Also, another de Jong and Bus study (2002) provided children with multiple exposures to the electronic storybooks with incidental hotspots and found that given a choice between interactive animations hidden in the illustrations and text read orally, none of the participants read the story multiple times, illustrating the attractiveness of incidental hotspots. Neither the Labbo and Kuhn (2000) nor the de Jong and Bus (2002, 2004) study employed measures of story comprehension, as defined previously in this chapter. Moreover, these studies were conducted with kindergarten children who typically have better attention spans than preschoolers. Further research is needed to (1) better understand the effects of hotspots on measures of story comprehension, rather than on story retelling or emergent reading, (2) to untangle the effects of dosage (i.e., multiple storybook exposures) found in the de Jong and Bus studies and (3) to compare the effects of electronic text that does contain hotspots with one that presents the same story without hotspots.

**Filmic effects.**

Filmic effects include musical accompaniment, animation, cuts, pans, and dissolves. These effects add to the text and blur the boundaries between viewing a storybook read aloud and viewing a fully animated feature presented on-screen. Bus, Verhallen and de Jong explain, “visual features include cuts, pans, dissolves, and special effects; auditory effects include music and sound effects; and more holistic characteristics include pacing (rates of scene and character change), physical movement (action), and variation” (2009, p. 154). Work in film studies indicates that music and sound effects play an important role in conveying the meaning of a story. These auditory inputs were originally used as mood enhancers and narrative aids for the cinema audience and they gradually became an essential part of the film itself, “to colour a scene, to suggest a general mood, to intensify a narrative or emotional tension” (Larsen, 2005, p. 145). The interpretation of film music and sound effects depends on the listener and his or her prior experiences with music and sound effects, in general, and music and sound effects in combination with film. De Jong and Bus (2003) and Korat and Shamir (2004) agree that music and sound effects are common in CD-ROM storybooks. Paciga (2009) suggests that digital storybooks employ musical accompaniment for a variety of purposes—as a filler between page turns, as a means to convey emotion, associated with particular hotspots, and as additional tracks of music that support the theme or plot of the story. She compared four presentation formats of *Stellaluna* (Cannon, 1993, 1996) and found that each of the four formats employed musical accompaniment and sound effects in different parts of the story and to varying degrees. The ramifications of these differences on story comprehension, however, have not been untangled in the extant body of research.

Another affordance of including filmic effects in digital storybook read alouds is that the participants in these activities are exposed to gestural forms of meaning-making, which may have implications for story understanding. Work in the fields of semiotics and linguistics indicates that people who have access to gestures in both demonstrations and conversations exhibit better comprehension of oral language than comparison groups not exposed to gestures. Gestures are the movements we make with our hands, arms, body, head or face. Deictics are pointing gestures that may refer to specific objects or may be more abstract in reference to a nonspecific time or location. Cuts and zooms in electronic storybooks mimic deictic gestures, drawing one's attention to a particular part of an illustration. Trushell and colleagues (2001) hypothesized that zoom shots and other visual and auditory effects help focus attention on significant visual details (Calvert, Huston, Watkins, & Wright, 1982), suggesting that animations selectively draw viewers' attention to contiguous content, thereby helping them to select content for processing the story (James, 1999; Kamil, Intrator, & Kim, 2000).

Gestures can also display affect. For example, a person may cover his or her eyes upon seeing something unpleasant or may clench a fist when angry. A child often rubs his eyes to show he is fatigued. Various studies with native speakers have shown that the presence of gestures with a verbal message brings a positive outcome to both speakers and listeners. Some have argued that gestures communicate vital aspects of meaning (Church, Ayman-Nolley, & Mahootian, 2004; Hadar & Pinchas-Zamir, 2004; Sueyoshi & Hardison, 2005) and, moreover, that the gestural and speech channels are so highly intertwined that each channel informs the other, and to remove gestures is to remove information.

Gestures are particularly effective for listeners when the intelligibility of the speech is reduced, as in noisy conditions. Such conditions are present in preschool classrooms during

center times and small group activities, which represent typical times students are invited or directed to engage in digital read aloud activities. Riseborough (1981) examined the interaction of available visual cues in a story-retelling task with native speakers of English. A story was told to middle school participants in four conditions, all with audio but varying in visual cues: no visual cues, a speaker with no movement, a speaker with vague body movement, and a speaker with gestures. These conditions were presented in the clear and in two different levels of noise. Results indicated the group that saw the speaker's gestures recalled more story information. There was no significant difference in mean scores across the other three groups. The noise factor had a significant effect; the higher levels of noise, the amount of the story participants could recall decreased, but only for those who had not seen the speaker's gestures.

Church and colleagues conducted an experiment with first grade Spanish and English speakers (Church, et al., 2004). Half of the English-speaking and half of Spanish-speaking students viewed a 'speech only' math instructional tape (i.e., instruction was not accompanied by gesture), while the other half of the English-speaking and Spanish-speaking students viewed a 'speech and gesture' instructional tape focused on conservation of volume and length. Student knowledge of conservation was assessed before and after viewing the instructional tape in the experimental room. The same questions were used in the pre- and post-test. Results indicated learning increased two-fold for all students (English- and Spanish-speakers) when gesture accompanied speech instruction.

These results from research on the effects of gestural stimuli on oral language comprehension indicate that gestures likely affect students' story comprehension, which is partially based on auditory input and partially based on visual input from the text (Paivio, 1986). The images of electronic storybooks tend to incorporate filmic features that provide students

with gestural stimuli. De Jong and Bus (2003) found that the majority of Living Books and interactive books in the Netherlands had animated part of or the entire scene in a given page. Korat and Shamir (2004) found similar results in their replication of CD-ROM storybooks available in Israel. Given the prominence of these features in electronic storybooks, their effect on story comprehension is grossly under-represented in the story comprehension literature.

One experimental study (Verhallen, Bus, & de Jong, 2006) compared the effects of static and filmic images in electronic storybooks with kindergarten-aged second language learners. After multiple exposures to the static image digital read aloud, participants improved their story understanding to some extent, but more so after repeated exposures to the filmic version including music, sounds and animation. While this study clearly supports the hypothesis that filmic story presentations improve young children's explicit story comprehension, it leaves two gaps. First, Verhallen, Bus and de Jong (2006) used retelling with visual prompts from the electronic storybook to test explicit and implicit story understanding where *explicit* referred to actions based on verbs and *implicit* are "states of mind, mainly referring to goals or motives of main characters [and are] expressed with verbs such as 'see,' 'decide,' 'think' or 'is furious'" (p. 414). This operationalization is partially incongruent with *implicit*, or higher-level, story comprehension as previously defined in this chapter; Verhallen and colleagues did not prompt participants to infer, predict, or analyze in their retellings. They simply were asked to tell what was happening while looking at the images (static or animated minus the oral reading). When a child indicated that that was "all they had to tell" the research moved on to the next screen to continue the retelling. This is problematic when working with young children from at-risk backgrounds because they often lack experience in retelling a story and so children with less story retelling experience are less likely to make higher-order inferences about story characters.



The second gap in this literature is that the sample was comprised second language learners in the Netherlands. Findings from one population cannot be directly translated or generalized to other populations (Cronbach, Gleser, Nanda, & Rajaratnam, 1972; Cronbach, Nageswari, & Gleser, 1963). Additional research is needed to see whether similar effects are observed in at-risk African-American populations whose primary language is English.

A third gap in this literature base lies in the fact that animation and music found in illustration-based hotspots are common in CD-ROM technology (de Jong & Bus, 2003; Korat & Shamir, 2004; Labbo & Kuhn, 2000), but electronic storybooks housed on the Internet typically do not include these hotspots and differ in the degrees to which they employ (1) filmic features and (2) musical accompaniment (Paciga, 2009) and so the results from studies examining story comprehension of fully animated texts, like those in interactive CD-ROM storybooks, cannot be generalized to texts employing less animation or different musical accompaniment.

### **Language.**

Pavio's dual coding theory (1986) suggests that verbal (i.e. auditory input) coordinates and with nonverbal (i.e., visual) information, integrates and connects to one's existing schema and results in story comprehension. In the context of storybook read alouds, the auditory component of the input consists of the readers' oral rendition of the printed text. Variation in the abstraction or contextualization of language, the employment of extra-textual supports for comprehension, the reader's tone of voice, and the words read per minute certainly have potential to impact the listeners' story comprehension, but there is a dearth of research investigating the relationship among these components of read aloud texts and subsequent story comprehension.

***Contextualization of language.***

The research on oral language indicates that understanding storybooks is highly related to one's ability to understand decontextualized language (Dickinson & Snow, 1987; Tabors, 2001), which is characterized by abstract vocabulary, complex language structures that include dialogue carriers, and events removed from the present time and space. As Nagy and Scott (2000) suggest, "what contextualized language accomplishes through gesture, intonation and allusions to shared knowledge and experiences, decontextualized language must accomplish through precision in choice of words" (p.279).

Fully animated filmic presentations of digital storybooks blur the boundaries between decontextualized and contextualized language. By enacting the story and eliminating some of the dialogue carriers, such as 'he said' or 'she exclaimed,' presented in the printed text, the language of the storybook becomes less abstract and the gestures and intonation associated with the animation facilitate understanding. Children immediately know who 'he' is or which 'she' exclaimed because the characters on screen have moving mouths and body parts while speaking and the child only need identify which character is moving to understand who is speaking as opposed to having to recall the pronoun's referent from short-term memory.

***Extra-textual discourse associated with reading aloud.***

When reading aloud to a class of students, teachers often adopt a particular read aloud style in which they employ extra-textual comments and story-related conversation to varying degrees. The content of the discussions before, during, or after a storybook reading exposes children to types of thinking that are valued by the reader and gives license to the active pursuit of knowledge from stories.

Dickinson and Smith (1994) examined correlations for 25 preschool teachers' reading styles and their students' scores on story retelling and the Peabody Picture Vocabulary Test-

Revised (PPVT-R). The researchers analyzed one videotaped read aloud session from each classroom and found that at least 10 of the observed teachers used a *performance style* of reading, incorporating little discussion during the reading and following up with extended discussion following the reading performance. Fifteen teachers read with interactional styles, but exhibited two different approaches. Dickinson and Smith identified ten of these teachers as *didactic interactional*, asking students to respond to questions, repeat factual information, and recite parts of the text in chorus during the reading. The other five of these teachers were identified as reading in a *co-constructive* style because they had children predict, analyze, generate word meanings, and draw conclusions as they read. Students of performance-style teachers performed significantly better on the PPVT-R than students who had been in the didactic interactional classrooms” (Dickinson & Smith, 1994, p.115), but showed no differences on measures of story retelling. A co-constructive style was found to predict both vocabulary development and story retelling.

Several notable studies have manipulated the read aloud style in experimental research designs. Reese and Cox (1999) randomly assigned 48 four-year olds to a *performance* style or one of two interactional styles in which readers provided either descriptions and labels for pictures (*describer* style) or comments and inferential questions about the story meanings (*comprehender* style). Vocabulary (measured by the PPVT-R) but not comprehension (measured by comprehension questions focused on plot, inferences, and background knowledge) was significantly greater for children with readers who used the describer style. In other words, after controlling for pre-test differences, reading style had no effect on story comprehension, although the performance-oriented style of reading approached significance for story comprehension. In

their discussion of this study, Reese and Cox indicate a need for more suitable (i.e., valid and reliable) measures of story comprehension than were currently available.

In a similar vein, Brabham and Lynch-Brown (2002) designed an experimental study with first- and third-grade students to examine whether repeated readings in a *performance* approach, *just reading*, or *interactional* styles were more supportive of comprehension and vocabulary learning. The researchers found significant effects of style for both vocabulary (measured by a researcher-created 40 item multiple choice test) and comprehension (measured by a researcher-created 17 item, multiple choice test including items measuring literal and inferential understandings) and showed that the presence of a discussion is more beneficial to story comprehension than just repeated readings.

In contrast to traditional read alouds, digital storybooks often omit any extra-textual discourse or discussion of the text pre- or post-reading. In general, most digital storybook read alouds mimic a performance read aloud style in that there are relatively few interruptions into the presentation of the story (Paciga, 2009). However, digital interactive storybooks containing hotspots can contain extra-textual discourse that may support story comprehension. The effects of the omission of extra-textual scaffolds or cues to prompt comprehension remain to be discovered.

### ***Linguistic differences in reading aloud to children.***

The linguistic component of reading aloud includes meaning conveyed by features of the reader's pitch, intonation, stress, rhythm, and accent. There is an abundance of research indicating that, when learning to read, children who do so with prosody have better story comprehension than those who do not read in such a way (National Reading Panel, 2000) and so experts in read aloud research commonly recommend that teachers read expressively to better support students' story understanding. Teale (2003) recommends that teachers and parents "read

in a lively, engaging way,” and continues, “creating character voices and reading expressively help maintain children’s engagement” (p.132), but there is relatively little research documenting the effects of neglecting to read in such a way. A significant amount of descriptive and correlational research within the context of teacher-led print-based read alouds has documented at least three primary read aloud styles, or ways of interacting with children during a read aloud, but generally neglects to fully document and isolate the effects of linguistic components of meaning making including pitch, intonation, stress, accent, and rhythm.

Early descriptive work by Dickinson and Keebler (1989) observed preschool teachers’ read alouds and resulting speech events to 3- and 4-year olds in daycare settings. In this study, the authors identified three read aloud styles. In the first style, the reader’s voice was rather quick (i.e., quick-paced) and devoid of affective qualities (i.e., no variation in pitch), given that their voices emphasized isolated words to convey meaning rather than using prosody to imply meaning. Dickinson and Keebler noted that reader’s voice in the second style conveyed meaning through changes in speed (i.e., pace), register (i.e., pitch), and volume. Moreover, readers in this style exhibited distinct changes in voice when reading emotive or informative parts of text. Qualities of the reader’s voice in the third style included a distinctive “story reading” pitch while reading. This study is particularly important because it suggests that readers’ use of voice can convey meaning in sophisticated ways that are helpful to children’s language use outside of the story reading experience.

From this research, it seems that the linguistic components of meaning-making within a read aloud context can be placed on a continuum with dull, monotone reading largely absent of variation in pitch or pace on one end and full dramatization including distinct character voices and variations in pace and pitch appropriate to convey meaning on the other end. Research in

traditional linguistics suggest that spectral analyses can provide visual maps of the intensity of changes in pitch and intonation (Bolinger, 1986; Cruttenden, 1986) and that variations in the intensity of the rises and falls of intonation can convey different meanings. For example, Bolinger (1986) suggests a deep fall conveys finality or assertiveness and more truncated falls convey a sense of offhandedness or tentativeness. These analytic techniques, however, have not yet been applied to read aloud research focused on story comprehension. Collectively, the work on read aloud style tends to focus more on the documentation of the readers' styles and resultant effects from combining linguistic features and story discussion patterns, rather than on the isolated effects of differences in linguistic features on story comprehension.

Pulling from this research base is important when considering the effects of digital storybooks on story comprehension for at least two reasons. First, with the exception of interactive CD-ROM storybooks, electronic stories online seldom include discussion or interruptions in the story reading. In this way, the performance-oriented style of reading (Brabham & Lynch-Brown, 2002; Dickinson & Keebler, 1989; Dickinson & Smith, 1994; Reese & Cox, 1999) is the dominant approach for digital storybook presentation, but there are clear variations in the pace and pitch of the oral readings across digital presentations. Secondly, the measures used to examine story comprehension in this body of literature vary. Story retelling, multiple choice questions, and story-specific questions have been employed and reveal that researcher-designed, story-specific methods like those developed by Reese and Cox (1999) had larger effect sizes than the general measures of listening comprehension (e.g., Woodcock-Johnson III) but smaller effect sizes than researcher-designed multiple choice comprehension questions like those used by Brabham and Lynch-Brown (2002) and so they may represent a

moderate approach to detecting differences in story comprehension for young children (Paciga, 2007).

### **The Listener: Individual Differences in Story Comprehension**

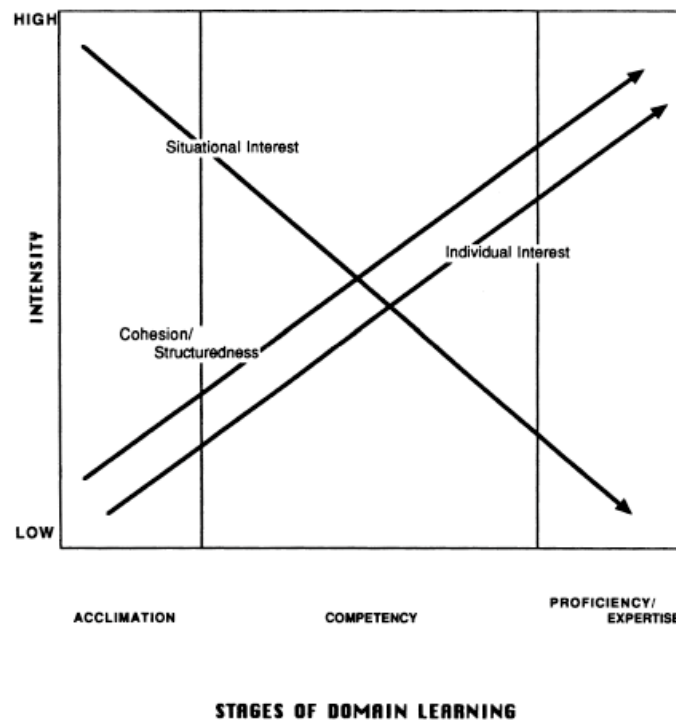
Children from different backgrounds come to school-based story comprehension activities with unique prior storybook reading experiences, background knowledge and varying affective dispositions toward these types of activities. Some children have had very positive experiences bonding with parents over stories and have read many books before preschool. Others may have had limited exposure to book reading and may lack any interest in book reading as an activity. Given these differences in prior experiences with book reading, children vary, in terms of cognitive and affective aspects, on what they bring to story comprehension activities. Age often serves as a correlate for many of the cognitive aspects associated with story comprehension; it is a significant predictor of background knowledge, vocabulary, and reading skill.

Socio-economic status (SES) and minority status also frequently serve as grouping variables for, covariates for, or predictors of comprehension. Much research has documented the differences in the academic achievement between lower income and middle-class students, as well as between racial and ethnic groups (e.g., NAEP; Stanovich, 1986) in the elementary grades and beyond. This gap is mirrored in emergent literacy achievement and vocabulary knowledge in children prior to entering elementary school (Hart & Risley, 1995, 2003) The vocabulary knowledge disparity between poor and middle-income children amounts to as much as 15,000 words upon entry to first grade (Hart & Risley, 1995; Moats, 1999). Hart and Risley (2003) argue that the accumulated experiences with words for children who come from poor circumstances compared with children who come from professional families may constitute a 30-

million word gap. Several studies have examined the important role of vocabulary knowledge in text comprehension and have concluded that knowing word meanings enables reading comprehension in a causal way (Anderson & Freebody, 1981; Baumann, 2009). Accordingly, this population requires substantial support and scaffolding to comprehend grade-level texts. Listening to stories read aloud and independent reading are the most common means through which vocabulary knowledge is developed (NRP, 2000; NELP, 2008).

One perspective that attempts to understand the impact of both the cognitive and affective aspects of learners and interactive effects of these on comprehension of text-based material is offered by the Model of Domain Learning (MDL) (Alexander, et al., 1995; Lawless & Kulikowich, 1998). The MDL is an empirically based theoretical model that posits that a reader's prior knowledge (both domain and topic) and interest (both individual and situational) influence what the reader recalls from text-based information. This model proposes that readers progress through three stages of reading proficiency in a given domain—acclimation, competency, and expertise. Differential relationships between knowledge, interest, and strategic processing are present at each stage of this theoretical model. The relationships among these factors are illustrated in Figure 2.3, below.





**Figure 2.3. Relationship Between Subject-matter Knowledge and Interest at Stages of Domain Learning** (from Alexander, et al., 1994).

The period of acclimation is marked by very high, or intense, situational interest (e.g., (Alexander, 1992, 1997, 2003, 2005; Alexander, et al., 1994; Lawless & Kulikowich, 2006). In the stage of acclimation, one's knowledge is rather fragmented and is made up of bits of declarative knowledge and procedures that are inconsistently applied. The information these learners are likely to recall is more apt to be less important and verbatim in nature. With continued exposure to the domain the individual typically progresses to a stage of competency, wherein the individual's knowledge structure is more coherent. Domain procedures become more complex and more routinely applied. There are relatively few who do progress to a more sophisticated level of domain learning, proficiency. These individuals are rarely drawn to the tangential aspects of the situation or text and they possess highly structured, coherent bodies of domain knowledge.

Although this model specifically relates to reading comprehension, it can also provide a framework for exploring the impact of knowledge and interest with emergent readers in story listening contexts. In the sections that follow, knowledge and interest are defined, and evidence linking these constructs to reading comprehension in older populations is presented. In addition, where possible, literature that relates to these variables and their potential impact with emergent readers in story comprehension is discussed.

## **Knowledge**

### **Prior knowledge.**

A common generalization in cognition and instruction research states that what an individual knows (i.e., prior knowledge) and her/his interest in a particular domain or about a given topic bears on what the individual will come to know. Prior knowledge is best defined as knowledge the reader has prior to engaging in an activity. It is sometimes referred to as schema, or memory structures that represent “our knowledge about all concepts: those underlying objects, situations, events, sequences of events, actions and sequences of actions” (Rumelhart, 1981, p. 34) and is comprised of domain, topic, and strategy forms of knowledge.

### **Domain knowledge.**

Domain knowledge is information related to a broad field of study (e.g., literature, physics, psychology) (Alexander, 1992). In literature, for example, one’s domain knowledge may encompass factual information about the history of children’s storybooks and styles of literary criticism, as well as procedural information about how to read and interpret a children’s book from a particular style of literary criticism. The digital read aloud activity with electronic storybooks involves an individual student engaged with narrative text about a given subject

matter/topic that is presented in a computerized environment. So, there are two forms of domain knowledge that impact digital storybook read alouds—the actual domain of the text and the knowledge of computers.

One consistent finding from the literature is that a strong and positive correlation exists between domain knowledge and one's ability to competently process, or understand, text related to that domain (Alexander & Judy, 1988; Garner, Alexander, Gillingham, Kulikowich, & Brown, 1991). This research has been primarily conducted with adult populations, typically with college students and/or university professors. In one study, Alexander, Kulikowich and Schulze (1994) measured pre-reading domain knowledge and post-reading recall of two physics-related text passages in more than 200 college students. The students were classified as acclimated, competent, or proficient based on the domain knowledge pretest that consisted of 25 multiple-choice items assessing students' knowledge of key concepts and principles in the domain of physics. The students read each passage and then completed a 13-item recall test with fill-in-the-blank response formats. The recall items either addressed ideas that were (1) trivial or tangential to the main ideas in the passage or those answerable by verbatim recall (8 items) or (2) important or linked to the main idea or those requiring more than verbatim recall (5 items).

Regression analysis indicated that for both passages and all levels of proficiency, domain knowledge significantly influenced recall. In fact, domain knowledge explained over one fifth of the variance on the first recall measure. Moreover, correlational analyses between domain knowledge and recall improved with domain learning. That is, for those in the acclimation state, there was almost no correspondence between student performance on the recall measures and their initial performance on the measure of domain knowledge. Higher correlations between

domain knowledge and recall variables were observed in competent and proficient/expert groups than the acclimation group (see Figure 2.3, above).

In an effort to expand on these findings, Alexander, Kulikowich and Jetton (1995) conducted two experiments to assess the relationship among (1) individuals' knowledge of human immunology/biology, (2) their related interest in two topics associated with human immunology, and (3) their recall of information presented in the two passages. In the first experiment, a 25-item multiple choice measure was employed to measure domain knowledge of immunology. Cluster analyses indicated that of the 30 premedical and 17 graduate educational psychology students, there were three distinct clusters of students. High levels of interest and recall for both of the immunology passages characterized the first cluster. Students in cluster 2 reported lower levels of interest and achieved lower recall scores than those students in cluster 1, but exhibited comparable levels of pre-reading knowledge (domain and topic) as the students in cluster 1. Students in the third cluster reported lower levels of interest for both reading passages, had lower levels of pre-reading knowledge and did not recall as much information from the passage as those students in clusters 1 and 2. Significance testing indicated that domain knowledge and recall were significantly different across all three clusters.

As would be predicted from the MDL, knowledge was generally positively associated with recall in the Alexander, Kulikowich and Schulze (1994) and the Alexander Kulokowich and Jetton (1995) studies. Many other studies indicate similar relationships between domain knowledge and recall as well, although recent work indicates differential relationships across different domains of knowledge (e.g., (Lawless & Kulikowich, 2006). Taken together, these studies provide compelling evidence of the presence of a strong and positive relationship between knowledge associated with a particular domain of study and a reader's ability to recall

information from reading passages of text presenting topics associated with that particular domain.

A second finding from research employing the MDL is that an adult's knowledge of computers influences the learning outcomes when the learning task (i.e., reading passage) is presented on a computer (Lawless & Kulikowich, 1998). This research has also concluded that adults who have more knowledge of computer software have higher grade-point averages than peers who have less computer software knowledge (Tien & Fu, 2008). With methods replicating those employed by Alexander, Kulikowich and Jetton (1995), Lawless and Kulikowich (1998) identified similar trends in their study focused on hypertext navigation. Here, primary cluster analyses were used to identify three types of hypertext users and then secondary non-parametric cluster analyses identified striking differences in the domain knowledge, computer knowledge, recall and interest of each primary-level cluster. High amounts of domain knowledge and high levels of recall characterized the first primary-level cluster, which the authors classified as "apathetic hypertext users." These participants did not engage the features of the hypertext (e.g., hot words) while reading, an observation the authors attribute to decreased motivation to navigate and explore a document with information that is already familiar to them. Recall in the second primary-level cluster, which the authors classified as "knowledge seekers," was closely related to domain knowledge and computer knowledge. The third primary-level cluster, or "feature explorers," spent the greatest amount of time exploring the interactive features of the hypertext and the results from the non-parametric cluster analyses indicate that recall was more highly associated with interest than to knowledge of computers or domain knowledge, but this group did exhibit high levels of computer knowledge.

While not specifically related to outcome measures of comprehension, the Tein and Fu (2008) study explored the relationship between computer knowledge and general learning measured by GPA. The authors found that students who devoted a greater proportion of their computer time to academic work tended to obtain higher academic grades after controlling for the effects of gender, SES and ethnicity. The largest effects were attributable to differences in various kinds of software knowledge.

Thus, the literature base appears to provide the field with limited conclusions regarding whether these forms of domain knowledge (i.e., computer knowledge and knowledge of a particular domain) influence learning with preschool populations. The Lawless and Kulikowich (1998) and Tein and Fu (2008) studies are indicative of a relationship between computer knowledge and learning with adults, but additional work is needed to examine the relationship between computer knowledge and learning with younger populations. The research base connecting oral language and vocabulary development to later literacy achievement suggests that measures of receptive vocabulary could serve as valuable proxies for domain knowledge. Children who are read to from young ages perform better on measures of receptive and expressive vocabularies than those who are not (Hart & Risley, 1995). Moreover, it is likely that children who are particularly interested in dinosaurs, for example, know more dinosaur-specific vocabulary because they have read or have listened to countless books associated with the domain. Measuring the effect that reading aloud has on a child's general vocabulary growth has been valuable because it has provided evidence of a connection between reading aloud and the kind of widespread vocabulary outcomes that are correlated with reading achievement in the later elementary grades and beyond. In this way, vocabulary is predictive of success in later reading comprehension. Many read aloud studies also illustrate the effect of reading aloud on

vocabulary development (e.g. Collins, 2004; Dickinson & Smith, 1994; Schwanenflugel, et al., 2006), but this is a study about story comprehension and so it is not particularly concerned with the effects of reading aloud on vocabulary development. What is of interest, however, is the relationship between pre-existing differences in vocabulary and resultant measures of story comprehension.

While the body of research focused on story comprehension involves a listener, rather than a reader, there is still some evidence that individual differences in vocabulary may affect story comprehension. As previously discussed, prior experience with traditional storybook reading is typically correlated to higher levels of receptive vocabulary (Bus, et al., 1995). The chain of effect can be then connected to better story comprehension because the listener can understand more of the words presented in the text (Dickinson & Tabors, 2001).

Evidence also exists that gestures are beneficial to varying degrees based on individual differences in language proficiency of which receptive vocabulary is an important factor. Again, this is relevant when considering digital read alouds from a cognitive perspective because children pull meaning from both visual and auditory inputs in read alouds. In their investigation of the effects of gestures on ESL students' listening comprehension Suyeoshi and Hardison (2005) assigned 42 Korean and Japanese ESL students, ranging in age from 18 to 27 years and varying in their English-competency, to one of the following stimulus conditions: audiovisual including gestures and face, audiovisual without gestures, or audio only. After viewing/listening to each stimulus clip (five total), each student responded to a four question multiple choice comprehension test. Results of this task revealed significantly better scores with visual cues for both English-proficiency levels. For the higher level, the audiovisual without gestures condition produced the highest scores; for the lower level, the audiovisual including gestures and face

yielded the highest levels of text comprehension. This research indicates that the incorporation of gestures matters for students with lower levels of language proficiency, but once students are more proficient the gestural component did not matter. From this, one can hypothesize that digital storybook read alouds containing filmic or gestural components may result in higher levels of story comprehension for students with lower levels of receptive vocabulary. This hypothesis, however, has not been tested in research with preschool populations.

Although vocabulary was measured pre-and post-intervention in the one digital read aloud study focused on kindergarteners' story comprehension (Korat & Shamir, 2007), the research did not use pre-test vocabulary as a covariate for story comprehension outcomes. Rather, vocabulary was examined as an outcome produced from engaging with a digital read aloud with supports for unknown words so this study did not factor individual differences into children's ability to comprehend the electronic stories. The same trend appears in the story comprehension research with traditional read alouds. Drawing a connection between these two variables that are inextricably intertwined (Nagy & Scott, 2000) could be one piece of the explanation of differences in comprehension exist when very young students hear the same story. In a similar vein, descriptive research with Kindergarteners has documented that children with more experience using computers and other technological devices have higher levels of skill and are better able to complete tasks on the computer (Turbill, 2001a). In this ethnography, Turbill spent a full academic year in the computer center of a Kindergarten classroom. One of her emerging research questions focused on why the teachers in her study found it so difficult to implement technology in their classroom. One of her conclusions was that children had varying levels of competence with using the hardware, software, and knowledge of the Internet. These variations led her to create a "concepts of screen" checklist so she would know how to work with



children to help them become independent computer users.

Here, Turbill (2001a) suggests a child's computer skills could possibly interfere with the ability to attend to the story content in digital read alouds on CD-ROMs:

They love playing with these talking books, but what are they engaged in? Are they taking in the storyline, hearing the book language, developing their vocabulary from being immersed in the oral telling of the story? Are they seeing the print text and following along with it as the story is read for them? Or are they only focusing on the visual images and animation and the 'story' each one creates when clicked on? The children, it would seem, are highly involved in 'visual literacy' activities and are certainly learning 'screen literacy' evidenced by the increasing control with the mouse and the cursor that is demonstrated as they click on the visual images on the page. I am becoming more convinced that I need to identify the 'concepts of screen' that the children need in order to manage the technology. With such a set of concepts, we could use these to 'screen' the children in the early days of their Kindergarten year... (p. 268)

Although measurement of computer skill is not common in the body of research on story comprehension from digital read alouds, it could account for additional variance in story comprehension. Korat and Shamir (2007) did train all students in how to use the CD-ROM software prior to engaging in the experiment, and they found no significant differences in post-listening measures story comprehension. These results could be attributed to dosage, as previously discussed, or from familiarity with how to use the computer. In other words, because all children were equally skilled at maneuvering a computer to listen to a digital storybook, they were all equally able to attend to the story content. The task of listening to a story did not interfere with children's ability to receive the visual and auditory inputs from the story and so their story comprehension was remarkably high and resulted in no differences.

The evidence from research with adult populations that illustrates the strong relationship between domain knowledge and comprehension compels one to wonder whether the same relationship is present with our youngest students. But, with the exception of the body of research that employs measures of general oral language as a form of prior knowledge in read

aloud research, few empirical studies explicitly make the connection between domain-specific forms of prior knowledge and comprehension outcomes with populations of emergent readers. This gap warrants further research on the role of domain-specific knowledge, such as a young child's knowledge of computers, in story listening comprehension.

**Topic knowledge.**

In contrast to the breadth of domain knowledge, topic knowledge represents a narrower, more specific niche of knowledge (Alexander, et al., 1994). For example, a component of topic knowledge positioned within the real of literature may be the case of a particular lecture about postmodern literary criticism. This topic falls within the larger domain of literature, but it addresses only one kind of literary criticism. If students are reading a passage about postmodern literary analysis, for example, their topic knowledge is represented by the intersection between what is talked about the passage and what the readers already know about postmodern literary criticism.

The study by Alexander, Kulikowich and Schulze (1994) also included measures of topic knowledge in their study examining the relationships among subject-matter knowledge, recall, and interest. Here, the research team and experts in the field of physics read the passages and came to consensus on the main topics for each paragraph of the passage (e.g., black holes, leptons). Participants were asked to jot down words, phrases, or sentences that tell what they knew about each term. Responses to the pretest measure were scored 0, 1, or 2, with two points awarded only in instances where all of the information on participant response sheets was correct. In instances where the distribution of topic knowledge was normally distributed, pretest topic knowledge scores for individual items were then used as predictor variables in regression analysis with recall as the criterion variable. One form of topic knowledge, knowledge about

black holes, was found to predict recall. The combination of this topic knowledge and domain knowledge together accounted for 32 % of the variance in the observed recall scores.

In a second experiment, Alexander, Kulikowich and Jetton (1995) found four distinct clusters of students from the 78 undergraduate educational psychology participants. Parametric significance testing indicated significant differences in post-reading measures of recall and pre-reading measures of topic knowledge. The most evident differences were present between clusters 1 and 4. Cluster 1 students exhibited high levels of domain and topic knowledge, high levels of interest in the reading passages and high levels of recall. Cluster 4 students, in contrast, exhibited low levels of domain and topic knowledge, low levels of interest and poor passage recall.

While the findings from the adult comprehension literature strongly support the relationship between topic knowledge and comprehension, there is a dearth of research examining the relationship among these variables with very young children or emergent readers. Evidence supporting the relationship between topic knowledge and comprehension does exist, however, at the junior high, middle school, and primary grade levels. Junior high students exhibited better verbal and nonverbal recall of a passage about a baseball game when they had higher prior knowledge of baseball (Recht & Leslie, 1988). Similarly, fourth-grade middle school students participating in the Marr and Gomerly (1982) study read six passages with structurally equivalent text and then recalled information explicitly presented in the text and answered probe questions, or higher-level questions reliant on prior knowledge, about the text. Prior knowledge was used to predict comprehension performance. Marr and Gomerly found that general prior knowledge was a strong predictor of comprehension ability.

With regard to younger readers, Townsend and Clarihew's (1989) study documents the relationship between topic knowledge and comprehension with students in second and third grade students. This study found that students with strong prior knowledge had better comprehension of both science and prose passages. Furthermore, Pearson, Hansen and Gordon (1979) found significant main effects for question type (explicit or inferential) and prior knowledge on measures of comprehension in slightly above-average 2nd-grade readers with strong and weak schemata for knowledge about spiders, the topic of the reading passage. Simple effects tests indicated a significant prior knowledge effect on the inferrable knowledge but not on explicit information. In other words, this study indicates differential effects of prior knowledge based on comprehension question type, a finding that has not yet been supported in the research with emergent story comprehension.

When we apply these findings to the investigation of knowledge in storybook reading, two forms of topic knowledge are particularly relevant. First, knowledge associated with the particular story elements (i.e., the characters, setting and action) can impact story comprehension. In the case of stories that employ personified animals, situated in naturalistic settings, participating in actions that are not unlike what one would expect to see in a live version of that animal (i.e., what they eat, their dwelling, how they move etc.), it becomes arguable that one's topic knowledge about that species of animal and perhaps even one's knowledge about the larger domain of animal behavior could predict their comprehension of the text. Familiarity with the narrative text genre is a second kind of topic knowledge that could potentially facilitate explicit and higher-level forms of story comprehension.

**Measuring domain and topic knowledge with young children.**

Because this is a study of preschool students' story listening comprehension, there are several issues related to measuring domain and topic knowledge that need to be explored. First, measures of general receptive vocabulary are insufficient measures of domain knowledge, which includes domain-specific vocabularies. Most read aloud studies measuring general vocabulary are larger correlational or experimental studies [e.g., the 19 studies reviewed by (National Early Literacy Panel, 2008) and others (Dickinson & Smith, 1994; Reese & Cox, 1999; Schwanenflugel, et al., 2005)], and most use the *Peabody Picture Vocabulary Test* (PPVT). In this test the researcher shows 4 pictures (1 correct and 3 distracters) for each of the target words, and the child is asked to "Point to the picture that shows [target word]." This type of measure has been used with both preschool children (e.g., Ard & Beverly, 2004; Collins, 2005; Justice, 2002; Walsh & Blewitt, 2006; Wasik & Bond, 2001), and kindergartners (e.g. Sénéchal & Cornell, 1993; Silverman, 2007). Because the PPVT assesses an individual's general vocabulary, rather than a specific vocabulary associated with a particular domain, these measures only provide information about the extent to which the individual has a normally developing general receptive vocabulary.

The response format for domain knowledge employed in the Alexander, Kulikowich and Schulze (1994) study and topic knowledge in the Alexander, Kulokowich and Jetton (1995) study could be of use with young children, but the use of written language in the stem and responses would be impossible, as these children are not yet reading independently. Oral narration of the stem and response choices is an alternative to entirely text-based questions, but the young child's ability to distinguish between four orally presented choices might inhibit his or her ability between the correct response and distracters. The use of pictorial cues, such as those

associated with the PPVT, as visual stimuli to reference the orally presentation of response choices could be more reliable than simple auditory questioning and choices.

Secondly, differences in computer knowledge could account for additional variance in young children's story comprehension, but none of the work in digital read aloud story comprehension has addressed this matter. The measurements used to assess computer knowledge in the Turbill (2001b) study and the description of the training experiences in the Korat and Shamir (2007) study indicate that it is possible to observe and measure this construct with very young children, but the formal measures employed with adult populations (e.g., Tien & Fu, 2008) are not age-appropriate for preschool children. These formal measures, however, can validate the content of the observational measures employed by Turbill (2001b).

Tien and Fu (2008) employed a multiple-choice test with their adult students to measure computer knowledge. In it, students were asked to report their knowledge in three areas, namely, computer hardware, computer software, and the Internet. The computer hardware section asked troubleshooting-type questions (e.g., The reason my computer always takes longer to load images than my neighbor's computer is...) and the software section asked students to identify icons to complete particular tasks with specific software programs (e.g., which icon makes a chart in excel?). The Internet questions asked students to respond to questions related to the function of Internet-specific vocabulary (e.g., RSS, hypertext, etc.). In addition to these multiple-choice items, college students also reported self-efficacy values for the three related scale dimensions. Tien and Fu's analyses indicate that self-efficacy had a strong and positive relationship with computer knowledge and their test of concurrent validity found that computer engineering students performed significantly better on these measures than literature students.

In her study, Turbill (2001a) documented differences in Kindergarten students' ability to work with computer hardware, software, and the Internet. This study led her to develop a Concepts of Screen Checklist (Turbill, 2001b) for teachers to use with parent volunteers to determine areas of computer knowledge in which individuals required additional support and guidance. The checklist, however, was not validated and Turbill has not yet provided reliability statistics for the checklist; but observers are instructed to report children's ability in the same areas Tien and Fu found to be valid and reliable measures of computer knowledge.

## **Interest**

Interest is a motivational variable that refers to the psychological state of engaging, or the predisposition to reengage with particular classes of objects, events, or ideas over time. There are both affective and cognitive components to interest as separate but interacting systems (Hidi & Renninger, 2006). The affective component of interest describes the positive emotions accompanying engagement whereas the cognitive component refers to perceptual and representational activities related to engagement. Two forms of interest have been identified in the research—individual and situational interest. Hidi and Renninger (2006) propose a four-phase model of interest development in which interest begins by triggering situational interest. This phase is followed by maintained situational interest in an activity. Individual interest begins to emerge in the third phase of interest development and becomes well developed in phase four of this model. In general, the literature has shown strong relationships between one's interest (both individual and situational) and the reader's investment in learning from a related text.

### **Individual interest.**

Individual interest refers to a person's relatively enduring predisposition to reengage in particular content over time as well as to the immediate psychological state when this

predisposition has been activated. The distinction between situational and individual interest has been verified empirically (e.g., Ainley, Hillman, & Hidi, 2002; Renninger, Ewen, & Lasher, 2002), and many propose that individual interests become more intense as one becomes a more competent reader in a particular domain. Hidi (1990) summarized the literature on the effect of interest on academic learning. She concluded that interest has a profound effect on students' attentional and retrieval processes, their acquisition of knowledge, and their effort expenditure. Hidi and her colleagues documented that students who score high on interest do not necessarily spend more time on tasks and activities for which they show interest. They want to become involved in a subject domain for its own sake and the quality of their interaction with the material is superior, reflected in using less rehearsal and more elaboration strategies, seeking more information and also reflecting more on the material.

Durik and Matarazzo (2009) measured 45 undergraduate students' individual interests in biology and their knowledge of biology before the students completed a lesson in biology specifically related to the topic of fungus. After the lesson, the participants completed a quiz covering material from the lesson (fungus-related questions) and reported their interest in fungi and willingness to return for another session. With the exception of one student, no one who reported low interest in biology had high knowledge in biology and a range of biology knowledge scores emerged for students with high biology interests. Individuals in the low biology interest/low biology knowledge group performed worse on the fungus quiz than those in the high biology interest/high biology knowledge group. Regression analyses indicate that biology interest positively predicted interest on fungus and that in cases where individuals had high biology interest, this variable also served as a significant predictor of his or her willingness



to participate in additional research. This study did not include any regression analysis of the predictive potential of individual interest with respect to the measure of recall.

Similarly, Alexander, Kulikowich and Jetton (1995) found that students with low levels of interest also exhibited low levels of recall. Students with high levels of domain and topic knowledge and interest attained the highest levels of recall from the immunology texts. Results not unlike these were also found in the Lawless and Kulikowich (1998) study with respect to interest in computers and use of computers. Students who utilized hypertext features who knew a lot about computers exhibited better cognition of the text than participants who had little knowledge and interest in computers.

The study of individual interest with adults, thus, clearly indicates a relationship between measures of individual interest and participant performance on measures of learning or passage recall. There has been limited study of individual interest, however, with emergent readers in read aloud situations focused on story comprehension. Related to the affective component of interest, the studies conducted by Bus and colleagues (Bus, 2003; Bus, Belsky, van IJzendoorn, & Crnic, 1997; Bus & van IJzendoorn, 1988; Bus & van IJzendoorn, 1995) investigated the attachment quality of parent-child dyads and its association with the shared reading processes. Taken together, this body of research suggests that (a) the attachment quality when children are very young is associated with interest in later development (Bus & van IJzendoorn, 1988); (b) attachment quality influences interactional processes during reading such that mothers of insecurely attached children spend more time disciplining; and (c) in samples of low SES dyads, attachment quality was associated with the overall frequency of shared reading (Bus & van IJzendoorn, 1995). Cumulatively, the authors argue, “literacy is not the outcome of an environment enriched with written material but that it strongly depends on parental ability to

involve young children in literacy experiences” (p. 1009). While these studies do not specifically address individual interest, they do provide evidence that development of individual interest in storybook reading is at least partially reliant on the parent’s role in story reading activities and that it begins to develop at a very early age.

### **Situational interest.**

Situational interest refers to focused attention and the affective reaction that is triggered in the moment by the environmental stimuli, which may or may not endure over time. It can be sparked by environmental or text features such as incongruous, surprising information (i.e., seductive details), character identification, or personal relevance (Garner, Brown, Sanders, & Menke, 1992). Instructional conditions that include group work, puzzles and computers have been found to trigger situational interest (Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000). A triggered situational interest could be a precursor to the predisposition to reengage particular content over time and empirical research has suggested that situational interest is held and sustained through meaningful tasks or personal involvement (Harackiewicz, et al., 2000). From this, it is arguable that those who have sustained situational interest will engage in activities for longer periods of time than those whose situational interest is not sustained.

In the case of storybook reading, situational interest can be sparked either by specific components of a story (e.g., a familiar/favorite character) or the context in which the story is presented (e.g., bedtime stories or recreational reading). In the specific instance of digital storybook read alouds, situational interest can potentially be sparked by the novelty of the computer or by the content of the story presented on the computer. Features like interactive text-based, illustration-based, or page turn hotspots may serve to maintain a young child’s situational interest in the digital read aloud activity.

Results from studies of situational interest with adult populations indicate that domain knowledge and certain instances of topic knowledge are predictive of interest in a particular reading passage (Alexander, et al., 1994). Alexander, Kulikowich and Schulze (1994) collected data relevant to individuals' interest at the passage and paragraph levels of text. The research protocol asked students to rate their overall interest in each passage on a scale of 1 (least interesting) to 10 (most interesting). Similarly, students rated their interest in each paragraph on a scale from 1 to 10. They also underlined the sentences they found most interesting while reading. Regression analyses showed that domain knowledge significantly influenced interest, indicating that higher levels of domain knowledge produce higher levels of interest. Correlation analysis confirmed the relationship; the correlations between knowledge, recall and interest became stronger across the stages of learning—acclimation, competency, and proficiency.

Bray and Barron (2003) employed hierarchical linear modeling to examine the relationship between students' interest in reading passages and their performance on reading comprehension test items. Interest ratings were provided after participants read each passage. To do this, they responded to the question, “How interesting was the passage about TOPIC?” Their choices were *really interesting, a little interesting, ok, a little boring, or really boring*. The study involved nearly 20,000 participants whose ages ranged from 4<sup>th</sup> through 8<sup>th</sup> grades. A small, but significant relationship was found between interest and test performance. This relationship was stronger in instances of higher ability levels.

Studies of situational interest in book reading reveal correlations between parents' reports of frequency of shared reading and their estimation of child interest (Crain-Thoreson & Dale, 1992). In this study, Crain-Thoreson and Dale concluded that child interest in reading appears to be “an independent source of variance in literacy outcomes” (p.425), one that functions

independently from the child's general intelligence and frequency of storybook exposure. What this particular study lacks, though, was a measure of story comprehension. They looked at concepts about print, alphabet knowledge, writing, and vocabulary, but did not include any general measures of story comprehension.

Frijters, Barron and Brunello's (2000) study indicate that the combination of home literacy and interest accounted for a significant amount of the variance found in children's oral vocabulary and letter knowledge. Here, children were provided with a series of visual cues that replicated emotions, such as happy or sad or angry, and were asked to point to indicate how they felt about tasks such as reading a book or playing with blocks. This study does address the affective component of interest, but the relationship between students' story comprehension and these factors were not explored.

These few studies have examined situational interest of storybook reading with young children, but there are several studies that have examined the use of other factors, like the motivational impact of computers, that may also influence situational interest. As previously discussed, situational interest can also be sparked by features of the task or activity. It is documented that computer work is typically rated as a motivational activity for school-age students. The National Reading Panel (2000) pointed to the motivational potential of computers in its attempt to conduct a meta-analysis on the effects of computerized instructional methods on reading. The dearth of studies specifically related to the Panel's research questions did not permit meta-analysis, but they did note that "reading instruction can and should make good use of the motivational aspects of computers and software" (p. 6-7). Support for this conclusion was evidenced in Reinking and Watkin's (2000) formative experiment. In this study, the authors investigated the interventional effects of creating multimedia reviews of books on the amount

and diversity of 4<sup>th</sup> and 5<sup>th</sup> grade students' independent reading. Qualitative and quantitative data sources indicate that the success of this particular intervention hinged on the motivational affordances of technology. Similarly, McKenna and Watkins (1994, December) found that kindergarteners and first graders overwhelmingly preferred electronic storybooks equipped with digitized pronunciations but without animations to print versions of the same books; evidence of the power of computers with respect to the affective components of situational interest.

### **Measuring individual and situational interest with young children.**

Given the MDL (see Figure 2.3) and that a stage of competency is usually arrived at during the high school years (i.e., 13-18 years old), it is unlikely that preschool children will possess the types of more intense individual interests associated with competency and proficiency, so measuring this construct with these populations is unlikely to provide any fruitful contribution to the study of individual differences and story comprehension. With respect to situational interest, however, there are currently relatively few examples in the literature of direct assessment of children's interest in reading related activities. The few that have attempted to directly assess children's interest in reading have employed a range of methodologies, including measuring the child's affective response to statements about reading by asking kindergarten child to pick facial expressions that best matched their feelings about those statements (Frijters, Barron, & Brunello, 2000). The study by McKenna and Kear (1990) employed similar response format to examine reading attitude and its relationship to reading ability. The development research for the Elementary Reading Attitude Survey (or EARS) (McKenna & Kear, 1990) found that 16 of 18 dimensions on the EARS exhibited internal consistencies greater than Cronbach's alpha of .80. The same response format has also shown that a relationship exists between reading

attitude and reading ability in studies with students as young as first grade (McKenna, Kear, & Ellsworth, 1995).

A second methodology to assess a child's situational interest in book reading, direct observation of a child's engagement in book reading, has been employed by Crain-Thoreson and Dale (1992), Morrow (1985), and (Watson, 2008). These studies incorporated field notes of either live or videotaped actions and rated the child's behaviors (Crain-Thoreson & Dale, 1992; Morrow, 1985) or verbal discourse (Watson, 2008) on a scale to indicate the degree to which children were highly engaged, moderately engaged, or not engaged. This method is time consuming and obtaining consistently high levels of inter-rater reliability requires significant training for all behavioral observers.

Parent report of child interest represents a third type of method employed in the storybook reading literature to investigate the complex relationship between storybook reading and interest. These parental reports are validated, or triangulated, with direct observation of the child engaged in a storybook reading activity. At least two studies exist that document the reliability of parent reports of young children's interest in storybook reading.

In the first, Ortiz, Arnold and Stowe (1997) paired a parent completed child interest survey with direct observation and parent logs and reports of how often their child asked to be read to. This study produced measures of test-retest reliability and concurrent validity. The Brief Reading Interest Scale (BRISC) consisted of a sheet of paper with a list of 10 activities in which preschool children typically engage, including "reading a book with a parent or other person" and "playing with blocks" and "playing with dolls." Parents were asked to rank order all of the activities according to their child's preferences. Children's BRISC score consisted of the number corresponding to the rank of the "reading a book" item, with a lower number indicating a higher

level of interest. Test-retest reliability was calculated by correlating the BRISC scores at an initial visit with a visit one week later and a visit four weeks later. Validity was established by correlating the BRISC scores with video observations and parent logs and reports of requests to read at pretest and posttest. These analyses yielded significant p-values for both parent logs and reports of requests to read. Video observation and BRISC correlations were not significant but the videos were coded by undergraduate students and on a 7 point scale ranging from “uninterested” to “greatly interested.” The report contains no description about how the raters were trained nor does it include information about how the video rating scale was created and refined. A third flaw to the video rating scale is that inter-rater reliability data were not provided.

In a second study, Deckner (2002) used a parent-completed survey of home literacy practices as a means to triangulate video observations of child interest. Parental estimations of child enjoyment of book reading and the number of children’s books at home were both significantly correlated with scores on the child interest index from video observations. In this study, the report provides information about the development of the scale used for rating children’s interest from the video and also describes how inter-rater reliability was established and calculated. In this way, the Ortiz, Arnold, and Stowe (1997) and Deckner (2002) studies provide some evidence that parent reports of their child’s interest are valid and reliable estimations of their child’s interest.

### **Interaction of Knowledge and Interest Constructs**

The constructs of knowledge and interest do not, however, exist in a vacuum. Rather, they exhibit dynamic relationships with one another. Lawless and Kulikowich (1998) suggested the following:

Renninger (1992) has argued that interest cannot be separated from knowledge and value; the more knowledge a student has the greater value placed on

acquiring new information and the more strategic the reader becomes in achieving that end. Alternatively, others have proposed a curvilinear relationship between interest and knowledge (Kintsch, 1980). In other words, Kintsch suggests that when knowledge is very low or very high for a given text, readers are less likely to exhibit high levels of interest in that text. When knowledge is moderate, however, Kintsch posits that interest is more likely to peak as the reader acts on his or her desire to verify existing knowledge and integrate new knowledge forms. A third view on the relationship between knowledge and interest was put forth by Alexander (1999). She proposed that domain knowledge and individual interest share a strong positive relationship while domain knowledge and situational interest relate indirectly. (p. 3)

Empirical work illustrates these complex relationships among knowledge and interest, but most of these studies restrict their age sampling so narrowly that it is difficult to determine how these constructs are related in populations of very young children.

Given what we already know about the empirical validity of the MDL with adult readers and the presence of the constructs of knowledge and interest with young learners, more research is needed to test the utility of the MDL as a means to understand these constructs that may impinge on emergent readers' story comprehension. We need to know more, specifically, about how the individual constructs of domain and topic knowledge and individual and situational interest relate to story listening comprehension, including how to best measure these constructs with this age group. We also need to know more about how these constructs interrelate during the process of story comprehension of emergent readers in digital read aloud situations.

### **Gaps in the Literature and Research Questions**

This literature review has identified several significant gaps in the literature specifically related to young children's story comprehension of digital storybooks. It has also looked to other bodies of research from traditional reading comprehension, semiotics, and visual design for further insight on this topic. It aims specifically to examine whether individuals from at-risk backgrounds, exhibiting deficits in vocabulary knowledge, benefit from independently listening



to digital storybooks. In general, studies employing electronic storybooks lack valid and reliable measures of story comprehension and so there is an incomplete picture of emergent readers' story comprehension in the extant literature. Typical measures of story comprehension are included in studies of independent readers more often than they are included in studies of emergent readers and analyses of these outcomes tend to collapse *explicit story comprehension* and *implicit, or higher-level, story comprehension*. Listening to a digital read aloud and producing emergent readings and independent decoding of an electronic storybook followed by measures of comprehension are different activities than listening to a digital read aloud and responding to comprehension questions.

With respect to the texts employed in these studies, CD-ROM technology predominates. There is a striking difference between the filmic content of these texts and those presented in digital libraries (e.g., [www.onemorestory.com](http://www.onemorestory.com)) and available through other Internet sites (e.g., [www.storylineonline.net](http://www.storylineonline.net)) so additional research is needed to determine whether these various text presentation formats are equally as effective in supporting story comprehension. Specifically, this research began to tease out the text-level variables associated with explicit and implicit story comprehension. It asked:

1. Does the presentation format of digital storybooks impact young children's story understanding in a digital environment?
  - a. To what extent do the various presentation formats support young children's recall of the text?
  - b. To what extent do the various presentation formats support young children's abilities to order, or sequence, pictures from the text?

- c. To what extent do the various presentation formats support young children's understanding of elements explicitly presented in the text?
- d. To what extent do the various presentation formats support young children's higher-level comprehension of the text?

This review has also indicated a need for a closer examination of variables situated at the reader level of the RAND framework for reading comprehension. Research on traditional reading comprehension from a cognitive perspective indicates that variance in young children's story comprehension could be resultant from individual differences in students' knowledge and interests, but these constructs are absent from the literature on young children's storybook comprehension writ large. With respect to knowledge, a small body of descriptive research has indicated that young children who are less skilled in computer basics (i.e., mouse control, scrolling, opening/closing applications or programs) are less able to engage in meaningful independent activity in computerized environment (Turbill, 2001a; 2001b), but these findings have not been explored in larger correlational or experimental research. Moreover, although best practice comprehension instruction involves teachers building students' background knowledge, the effect of these practices remain unclear, particularly with very young students. Because the bulk of research that explores the role of knowledge and interest is conducted with older populations who are conventionally reading, more research is needed to test these constructs as they develop in our youngest populations. Accordingly, this research asked the following:

- 2. Do individual differences in knowledge and interest predict young children's listening comprehension of a digital storybook?

## **CHAPTER III: METHODOLOGY**

### **Theoretical and Methodological Approaches**

As described in the previous chapter, the cognitive perspective serves as a theoretical frame for the proposed research questions. A cognitive perspective permits the isolation of variables associated with the inputs for story comprehension (i.e., the text and the activity) and the processing variables (i.e., the listener's knowledge and interest). This perspective also permits examination of these variables separate from the sociocultural context, allowing us a more basic picture of the processes associated with story comprehension. These understandings contribute to the field's knowledge of comprehension development in general by building from what is already known about reading comprehension. The quantitative component of data collection helps begin to fill the existing gap associated with the relationship between listening and reading comprehension (Teale, Hoffman, & Paciga, 2010). Specifically, if the variables predictive of traditional reading comprehension are also found to predict outcomes of young children's story understanding, additional studies may be able to manipulate and randomize these constructs in an experimental design to test the causative nature of these predictors as has been done in many studies of adult reading comprehension.

Although this research does not address the applied processes associated with story comprehension (i.e., strategic processing), it contributes to the field's understanding of the nuances associated with applying digital storybook activities in early childhood. Also, because this is an experimental study employing regression methods, the research design helps inform early childhood teachers about the extent to which computer skill is associated with a student's ability to meaningfully engage in computerized literacy activities.

To investigate the effects of presentation format on listening comprehension, a four-group experimental design was used. Participants were randomly assigned to listen to only one presentation format of *Stellaluna*. To reduce the effect a particular teacher's instruction might have on listening comprehension outcomes, each classroom had a minimum of four participants in each experimental condition. Experimental data were collected in the context of preschool center time activity, with posttest measures completed in the hallway outside the regular classroom.

## **The Research Context**

### **The classrooms.**

This research was conducted in nine preschool classrooms in a large mid-western city. The classrooms served diverse populations of children at-risk for reading failure. The teachers and teacher assistants in four of the participating classrooms were part of a larger emergent/early literacy initiative called Early Reading First (ERF) which provided intense and on-going professional development for teachers and assistants vis-à-vis monthly large group professional development days and literacy coaching on site two days per week. The objective of ERF was to create preschool centers of language and literacy excellence, so the professional development and coaching focused on areas that are related to language and literacy learning and instruction. These included the learning environment, phonological awareness, letter identification, vocabulary listening comprehension, phonics, and print awareness. The five classrooms that were not part of the ERF project were located in similar neighborhoods and serviced similar student populations as those found in the ERF classrooms.

Each participating classroom had at least one functioning computer with a CD/DVD ROM drives and Internet connections. PCs were found in the four ERF classrooms and iMac

desktops were found in the remaining classrooms. Children listened to and interacted with the digital read alouds in their classrooms during center time and/or small group time which represent times during the normal school day when young children are typically invited to independently engage in computer-based activities.

**Participants.**

The study's sample consisted of 152 at-risk preschool students across nine classrooms in an urban city in the Midwest. All classrooms had student populations primarily of African-American or Hispanic descent and more than 90% of the children qualified for free or reduced-price lunch. Table 3.0 presents the demographic data for the participating students. Near-equal distributions of male and female participants were contained in each cell of Table 3.0.

This population of children was of particular interest for three reasons. First, at-risk preschoolers turn into at-risk middle school children who fall subject to the well-documented achievement gap (Foster & Miller, 2007; Stanovich, 1986). Research has documented the comprehension difficulties of at-risk populations and attributes these difficulties to lack of content, or background, knowledge (Berliner, 2006; Snow, et al., 1998; Teale, et al., 2007) or procedural knowledge (i.e., word-decoding). Digital storybook environments help students with the procedural aspects of story reading, but how effective are they in building and supporting young children's content knowledge for text comprehension? Secondly, research on the "digital divide" indicates that at-risk populations have less access to ICT hardware and software (Cuban, 2001; Henry, 2008; Hutchinson, 2009), yet research in learning psychology has indicated that technology represents a very motivating context for literacy, especially for at-risk populations. Little is known, however, about whether young children's inherent interest, coupled with the existing design structures of digital storybook environments, are supportive enough of young

children's listening comprehension. Thirdly, most electronic storybooks are marketed for children three- to seven-years old. There is no inherent differentiation for age embedded into existing digital storybook environments (Paciga, 2009). The sample for this study is intentionally comprised of the younger ages of this market for electronic storybooks to examine whether these storybook environments can effectively support even the youngest listeners' story understanding in the absence of an adult.

**Table 3.0. Participants: Demographic Data**

|       |       | Race             |          |           |       | Total |
|-------|-------|------------------|----------|-----------|-------|-------|
|       |       | African American | Hispanic | Caucasian | Other |       |
| Age   | Three | 53               | 7        | 2         | 0     | 62    |
|       | Four  | 62               | 18       | 2         | 8     | 90    |
| Total |       | 115              | 25       | 4         | 8     | 152   |

### The Focal Text

Children interacted with one of four different presentation formats of *Stellaluna* (Cannon, 1993). This particular text was chosen for three reasons. First, it is a commonly used text in early childhood instruction. Its theme focuses on how animals with different characteristics still have things in common and can remain friends. Friendship and interpersonal differences are common discussion topics associated with this story in preschools and kindergarten classrooms. Secondly, *Stellaluna* is a high-quality piece of children's literature. It has won numerous awards such as the ABBY Award, the Keystone to Reading Book Award, and the California Young

Reader Medal. Thirdly, *Stellaluna* was one of very few stories that were available in multiple electronic formats.

**Story summary.**

This is a tale of a baby fruit bat that gets separated from her mother when an owl attacks them. Stellaluna falls into a birds' nest and makes friends with the three baby birds that live there. Eventually, the mother bird takes in the stray bat, so long as Stellaluna leaves her bat ways behind and act like a bird—meaning that she sleep upright and eat bugs with the other birds. Concomitantly, the mother bat searches for her lost baby. One day Stellaluna and the baby birds go out flying and Stellaluna gets lost in the forest at dusk. The other birds return to their nest without their bat friend. That night, Stellaluna sleeps upright in a mango tree and is approached by several fruit bats (one is Stellaluna's mother) wondering why she is sleeping upside down. After Stellaluna tells her story, the mother realizes that the upside down bat is her lost child. The next day, Stellaluna returns to the birds' nest and invites them to fly at night to the mango tree. The birds agree only to find that they cannot find their way at night. Stellaluna guides the birds to safety and the story's ending conveys the theme— birds and bats are different and yet, alike.

**Ensuring preschoolers' listening comprehension of *Stellaluna*.**

Comprehension is the understanding and interpretation of what is read. To be able to accurately understand written material, children need to be able to (1) decode what they read (or, for young children not yet reading independently, understand the language that is read aloud); (2) make connections between what they read (or listen to) and what they already know; and (3) think deeply about what they have read (or hear). One big part of comprehension is having sufficient vocabulary. Students who have strong comprehension are able to draw conclusions about what they read (or hear) – what is important, what is a fact, what caused an event to

happen, which characters are funny or serious, and so on. Thus comprehension involves combining reading (or listening) with thinking and reasoning.

Given that the role of the text is paramount in the comprehension puzzle (RAND Reading Study Group, 2002), it is important to examine fully the features of the original version of *Stellaluna* (Canon, 1993); doing so makes clear what it takes for a preschooler to understand this challenging text. First, it is useful to present the elements of the story (i.e., story grammar or dramatic structure) (Black & Wilensky, 1979; Brewer & Lichtenstein, 1981)—characters, setting, problems, events, and solution or resolution—and simultaneously to examine the nuances of the language and images employed in the story.

There are a total of eight characters in *Stellaluna*—Stellaluna, Mother Bat, an owl, Mama Bird, three baby birds (named Pip, Flitter, and Flap), and group of other bats (without names). Stellaluna is the main character. She is present in every one of the 13 plot episodes, or events, in the story. The other characters are supporting characters.

The owl initiates the problem in the story by attacking Stellaluna's Mother. As a result Stellaluna is left on her own. Later, when Stellaluna falls into the birds' nest, a possible solution to her problem is presented—if she stays with the birds she will no longer be without a mother. This presents another problem, though—because Stellaluna is a bat, she does not know how to behave like a bird. There are a series of episodes wherein Mama Bird and the three baby birds try to teach Stellaluna to “act like a bird.” Each of these presents a minor problem and a resolution. Then, at the climax of the story, Stellaluna gets lost again. She subsequently meets up with a group of bats and reunites with her Mother. This reunion represents the first steps to the story's resolution. Stellaluna and her Mother “act like bats,” and Stellaluna wants to share these experiences with her bird family and does so—with an author's twist to exacerbate the



differences between bats and birds. The story concludes with an indirect restatement about the differences between bats and birds and an implication that birds and bats can remain friends despite their differences.

A classroom teacher or parent reading this story to an individual child or in a small group context would likely build the child's background knowledge about birds and bats before, during, and after the read aloud. Depending on the depth of the child's existing background knowledge about birds and bats, an adult would provide more or less information that is critical to understanding the story. General scientific knowledge about the habits of bats and birds and understanding of emotions are critical in drawing conclusions about the story's themes – identity and friendship. When Stellaluna is first without her mother, she trembles “with cold and fear.” Understanding of a baby's need for their mother for warmth would help a young child properly connect a cause to this event. Being able to personally connect with the vocabulary word *embarrassing* would help a young child to understand that Stellaluna really wanted to land on the branch like the birds, but could not do so because her instinct and anatomical structure prohibited her from landing on her feet.

General taxonomic (i.e., categorical) knowledge would help the young child connect challenging words like mango or grasshopper to fruit and insect, respectively. These larger taxonomic categories of insects and fruits are less specific terms and therefore are generally acquired first (Gelman, Coley, Rosengren, Hartman & Pappas, 1998). Such connections would be useful in retaining story information in the child's memory. Moreover, properties of specific components of a given taxonomy would accomplish the same goal – retention of story content. For example, bats and birds are both winged creature. Bats are nocturnal. They sleep hanging upside down. Fruit bats eat fruit. They can sleep anywhere they find space to hang and they use

echolocation to “see” where they are going at night. On the other hand, birds are diurnal. They sleep perched upright, build nests and mostly eat insects/crawly things. This information is key in understanding the story’s resolution and the theme of the story. Without it a child might think that Stellaluna enjoys “acting like a bird” and, therefore, desires to continue living with and acting like the birds.

In the process of supporting critical background knowledge, the adult would likely present, revisit explain, highlight, or demonstrate some challenging vocabulary presented in *Stellaluna* to make clear for the young listener the story’s content. Among these are words like *spied*, *limp*, *twig*, *clutched*, *trembling*, *grasshopper*, *gracefully*, *embarrassing*, *clumsy*, *anxious*, *ached*, *peculiar*, and *limb*. Because of the nature of children’s oral language and vocabulary development, several small misconceptions—primarily related to definitions of words (i.e., superordinates, synonyms, traits, etc.)—about each episode’s content are possible. For example, a child might say that an eagle, rather than an owl, attacked the baby bat. This would be an acceptable misconception because some of the features of an eagle are similar to those of an owl (e.g., winged, claws, larger than a bat). Table 3.1 summarizes the story elements, a description of each element, key ideas for a child to grasp (\* indicates that an idea is critical to understanding the story), and connections to background knowledge that facilitate story comprehension.

**Table 3.1. Story Elements, Key Ideas and Knowledge Connections in *Stellaluna***

| <b>Element</b> | <b>Description</b>   | <b>Key ideas</b>   | <b>Knowledge connections</b>              |
|----------------|--|--|---|
| Setting        | “a warm and sultry forest”   | outside where there are trees  |   |
| Characters     | Stellaluna, Mother Bat, Mama Bird, Pip, Flitter, Flap, Owl, other bats | *baby bat; chicks/baby birds; bad bird (owl)                                   |   |
| Theme          | identity and friendship  | *birds and bats are different and alike  | characteristics of bats & birds           |
| Episode 1      | Mama bat names baby “Stellaluna”                                       |  |   |
| Episode 2      | Owl attacks bats and baby is lost                                      | *another animal hit/hurt/flew into the baby and she fell off her mother        | predator/prey; food chain                 |
| Episode 3      | Stellaluna falls into birds’ nest                                      | *she fell where some birds live  | Habitats                                  |
| Episode 4      | Stellaluna eats insects  | *eats crawly stuff/insects/stuff that birds eat; she doesn’t like it           | food chain; characteristics of bats/birds |
| Episode 5      | Mama bird yells at Stellaluna  |  | Emotions                                  |
| Episode 6      | Stellaluna learns to fly with birds                                    | the babies learn to fly  |   |
| Episode 7      | Stellaluna embarrassed about difficulty landing                        | *she can’t sit on the tree and feels bad about it                              | characteristics of bats/birds; emotions   |
| Episode 8      | Stellaluna gets separated from birds                                   | she gets lost again  | Emotions                                  |
| Episode 9      | Stellaluna meets adult bats and her mother                             | *some other bats find the baby bat; her mother bat was there                   | emotions; characteristics of bats/birds   |
| Episode 10     | Stellaluna eats mangoes  | *she eats fruit; stuff that grows on trees; she likes it                       | food chain; characteristics of bats/birds |
| Episode 11     | Stellaluna returns to birds  | she goes back to where the birds live  |   |
| Episode 12     | Stellaluna and birds fly at night                                      | she takes the birds flying in the dark   |   |
| Episode 13     | Stellaluna rescues birds who can’t see in the dark                     | *the baby birds crash and the baby bat helps them because she can see at night | characteristics of bats/birds; emotions   |
| Resolution     | Bats live with bats and birds live with birds but remain friends.      | *the baby bat likes to act like a bat better than acting like a bird           | identity; characteristics of bats/birds   |

\* indicates that an idea is critical to understanding the story’s plot/theme

In addition to building background knowledge and supporting key vocabulary understanding during a storybook reading, an excellent teacher would also make periodic stops

throughout the story to summarize events, think aloud about/model his/her own story understanding (e.g., “I remember one time I was really embarrassed when...”), rephrase, and check for students’ understanding. In these ways, teachers continually support and monitor story understanding in a read aloud event.

### **Presentation format features.**

There were four presentation formats of *Stellaluna*. The first and second formats were housed on CD-ROM technology (CD-ROMa and CD-ROMb). The third format was available through <http://www.onemorestory.com> (OMS), and the fourth is available through <http://www.storylineonline.net> (SO). The story’s plot, theme and general sequence of events was constant across the presentation formats, but there were differences across the four presentation formats in the features associated with the activity structure and the text that may affect story comprehension. These differences are summarized in Table 3.2 and elaborated upon in the subsequent paragraphs.

**Table 3.2 Comparison of Main Features of *Stellaluna* Presentation Formats**

|                         | CD-ROMa        | CD-ROMb                  | OMS           | SO                              |
|-------------------------|----------------|--------------------------|---------------|---------------------------------|
| Duration of activity    | 24:48          | Unable to determine      | 20:56         | 10:46                           |
| Filmic effects          | Full animation | Full animation           | Static images | Panning, cropping, static image |
| Words read per minute   | 35             | 35+                      | 56            | 123                             |
| Tone of voice           | Moderate       | Moderate                 | Moderate      | Intense                         |
| Extra-textual discourse | Automatic      | Upon click               | None          | None                            |
| Hotspots                | Absent         | Page, text, illustration | Page and text | Absent                          |

### ***Duration of the activity.***

The first difference in the presentation formats was associated with the story listening activity. Duration is important when examining story comprehension from a cognitive

perspective because this perspective recognizes the role of attentional load in comprehension. If the read aloud activity endures beyond the limits of the child's attention span, he or she is unlikely to fully engage in the activity beyond that point (Paciga, et al., 2009), which may affect a child's story comprehension.

Duration of an electronic storybook presentation is the amount of time elapsed from the moment the cover of the book is shown and the title is read until the end of the story. CD-ROMa has a duration of 24 minutes and 48 seconds. It was impossible to determine the duration of the read aloud of CD-ROMb as it depended on the degree to which each child interacts with the hotspots. Pilot data indicated that students engaged in this read aloud activity for as little as 9 minutes (before abandoning the activity) and up to 60 minutes in experimental conditions (Paciga, 2008). The OMS format had a duration similar to that of CD-ROMa—20 minutes, 56 seconds. The SO format was considerably shorter than the other formats—approximately 11 minutes.

### ***Filmic effects.***

Filmic effects included musical accompaniment, animation, cuts, and pans. These features were present in three of the presentation formats for this story. The OMS format does not employ any of the aforementioned filmic features. It presented the participant, rather, with the static images that can be found in the paper version of the text. The OMS format did have musical accompaniment between page turns. One limit to this presentation format with respect to filmic features was the lack of visual gestures to help convey the story's meaning. The facial expressions remain constant on each page of the text.

CD-ROMa and CD-ROMb contained full animation with accompanying music. In this way, the CD-ROM formats offered a story listening experience that replicated many features of television. The participant in the story listening activity viewed the character's gestures and

changing facial expressions in the animations. In addition, both CD-ROM formats included many animated images which were “gratuitous intrusions into the story” (Unsworth, 2003, p.5) and did not appear in the printed version in any form. For example, when Stellaluna falls into the birds’ nest, there were several hotspots on the page a child can click on once the text had been narrated. On this particular page (see Figure 3.1, below), a ladybug wound around on the tree branches surrounding the nest and music reminiscent of someone tiptoeing would play if a child clicked on the ladybug. This is an example of a “gratuitous intrusion” because the ladybug is neither protagonist nor antagonist or related to any part of the plot or theme. Intrusions of this type were present on every page of the CD-ROM texts, in both presentation formats, although some have argued that the animations, music and voicing of CD-ROMa are primarily congruent with the plot (Labbo & Kuhn, 2000).

The SO format relied primarily on static images in the visual component of the text, but incorporated crops and pans to draw the reader’s attention to specific parts of the illustration when they were referred to in the oral rendition. The images were not fully animated, but were not entirely static, either: characters did not flap their wings or talk (as in the CD-ROM formats), but they did appear to move resultant from filmic effects such as panning and cropping. For example, when the bat attacked Stellaluna and her mother, the image was cropped in and presented in square segments – first the owl’s mouth, then the wing, then the claw and finally the bats being attacked. Moreover, when the text read, “she clutched the thin branch, trembling with cold and fear...” the bat shook back and forth on the branch in the SO format, likely contributing to children’s understanding of the word *tremble*. The participants in this condition also viewed the narrator’s gestures and facial expressions in addition to the static facial expressions of the

characters in the static illustrations. This additional source of semiotic meaning may facilitate story comprehension in the SO condition.

***Words read per minute.***

The number of words read per minute (WPM) certainly related to how long the read aloud activity endured, but this text-level variable across the four presentation formats also added an important feature difference in the story presentations. The SO format presented students with more WPM, which parallel general norms of television broadcasting (Jensema, 1999; Shroyer & Birch, 1980). The other three formats offered presentations with WPM that are far below the mean conversational rate found on television broadcasts for young children and also below the recommended third grade WPM measure of 110 WPM (see, e.g., <https://dibels.uoregon.edu/benchmark.php - 3grade3>). Although they were not dysfluent, the readings were often interspersed with accompaniment music (CD-ROMa, CD-ROMb and OMS) or animations portraying (a) an action in the plot (CD-ROMa and CD-ROMb) or (b) intrusions into the story (CD-ROMa and CD-ROMb). CD-ROMb's WPM had a minimum threshold of 35 but could exceed this if a child did not activate any hotspots on hotspot pages.

***Tone of voice.***

Another striking difference existed among the three narrators' internal variation in pitch and intensity, or tone of voice, while reading. Pitch and intensity analyses using Praat Phonetic Analysis (<http://www.fon.hum.uva.nl/praat/>) were conducted on the same 10-second segment of text for CD-ROM, SO, and OMS presentation formats. This segment reads, "...but the owl struck again and again. Down, down she fell into the forest below. Her baby wings were as limp and useless at wet paper." Table 3.3, below, reports the minimum, maximum and mean pitches and intensity for each presentation format.

**Table 3.3. Descriptive Data Associated with Tone of Voice**

|           | Min Pitch (Hz) | Max Pitch (Hz) | Mean Pitch (Hz) | Mean Intensity (dB) |
|-----------|----------------|----------------|-----------------|---------------------|
| CD-ROMa/b | 77.24          | 365.73         | 195.48          | 80.89               |
| OMS       | 76.26          | 330.16         | 185.78          | 74.72               |
| SO        | 109.62         | 510.67         | 330.93          | 81.42               |

From these, it is obvious that there was the greatest variance in the narrator's pitch in the SO presentation format, with minimal differences between the CD-ROMa/b and OMS formats. More sharp and continuous peaks and valleys in the pitch contours were present in the SO condition (Figure 3.0c) compared to those found in the OMS and CD-ROMa/b conditions (Figures 3.0a and 3.0b). Table 3.3 also shows similar values for CD-ROMa/b and SO presentation formats (80.89 and 81.42 decibels, respectively) with OMS scoring lower on intensity (74.72 decibels). From these data, it can be argued that the pitch contours of CD-ROMa/b and OMS showed moderate changes in pitch and the contour of SO showed intense changes in the narrator's pitch through the 10-second segment.

***Extra-textual discourse and language.***

Characters in CD-ROMa engaged in some extra-textual comprehension-supportive discourse. For example, when the mother bird brings food to the nest the text reads, "Stellaluna was terribly hungry, but *not* for the crawly things Mama Bird brought." In the CD-ROMa presentation format, the baby birds questioned Stellaluna, "What's the matter? Aren't you hungry? Don't you want some?" and likely supported children's understanding that Stellaluna did not desire to eat the bugs that Mama Bird offered.

Unsworth (2003) drew attention to the differences between the CD-ROM electronic narratives and the print format of *Stellaluna*. In this discussion, Unsworth pointed out that the



images and language are significantly different across the two formats. The illustrations were animated and the characters engaged in more dialogue in the CD-ROM presentation formats compared to the paper text. For example, when Stellaluna fell into the birds' nest, the text read "She listened to the babble of the three birds. 'What was that?' cried Flap. 'I don't know, but it's hanging by its feet,' chirped Flitter." This dialogue is not printed as text in the CD-ROM formats. It is enacted, rather, by the animated characters and elaborated upon in the following additional dialogue that appears in the CD-ROM storybook:

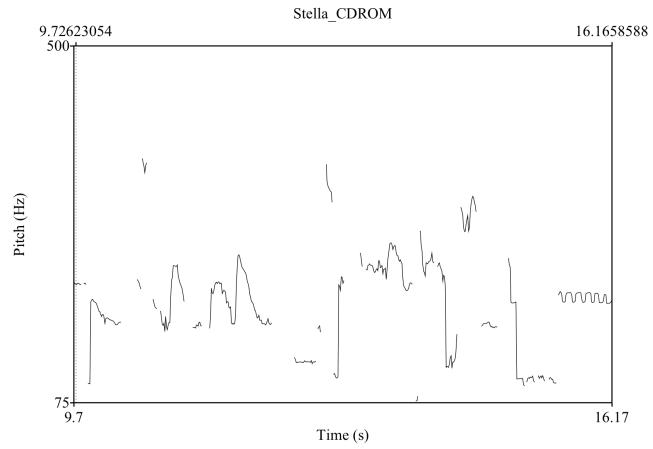
Flap: That's a strange looking bird.

Flitter: No tail feathers?

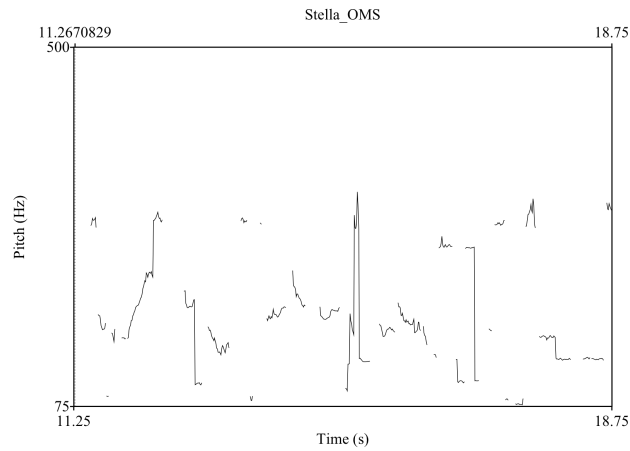
Flap: How weird.

So, when one carefully compares written text (Cannon, 1993) with the enacted text in the CD-ROM versions of *Stellaluna* (Cannon, 1996), it is evident that the dialogue carriers in the printed text may not be present or printed in every page of the CD-ROM text and additional extra-textual dialogue that is not present in the printed text is included in the CD-ROM enactment of the story. The omission of dialogue carriers and concomitant animation of characters in the CD-ROM formats offered children a more contextualized language than the fully decontextualized language of the OMS and SO formats, which were read verbatim from the printed text.

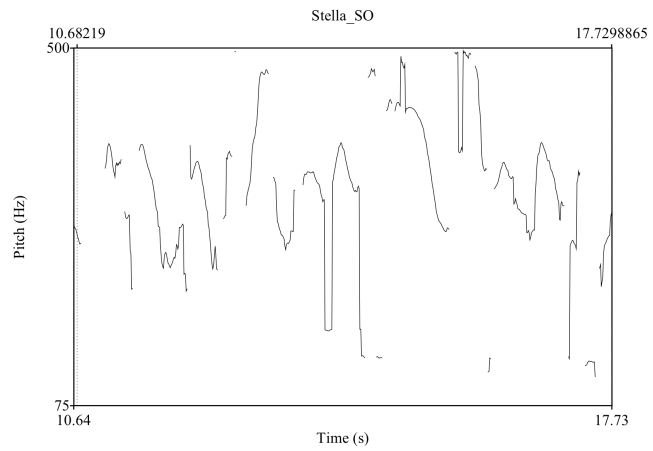
3.0a. CD-  
ROMa/b



3.0b. OMS



3.0c. SO

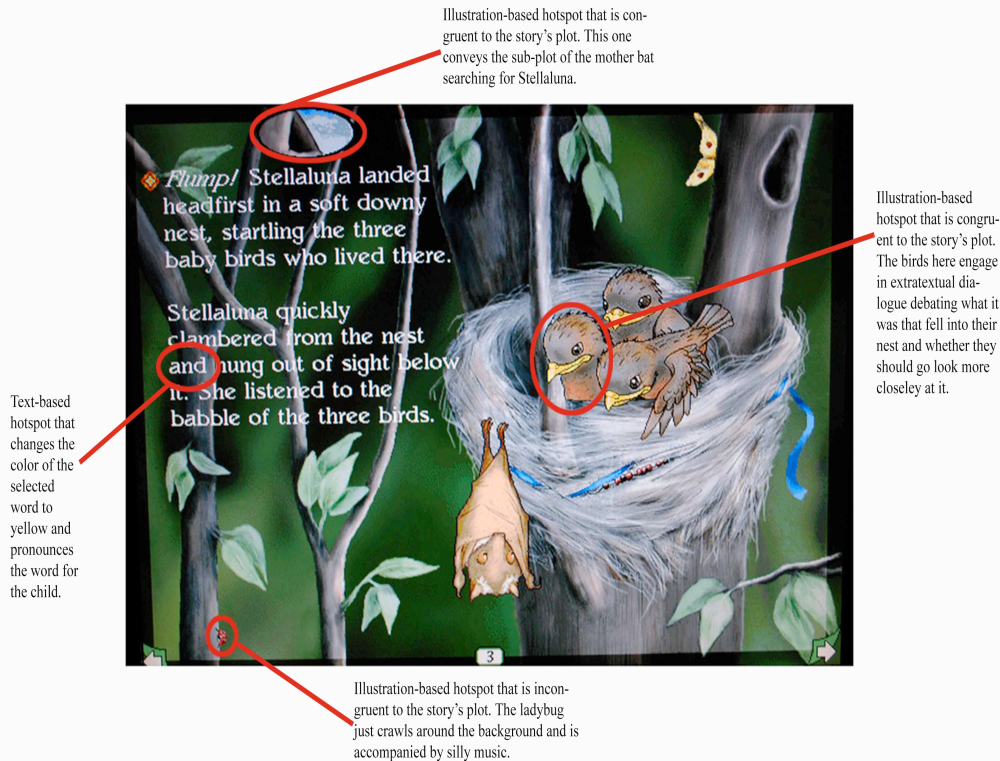


**Figure 3.0. Pitch Contours of Presentation Formats**

***Hotspots.***

An important subplot of the story of Stellaluna was embedded in the illustrations in the printed text. On every two-page spread, the thumbnail illustration above the printed words showed the mother bat searching for Stellaluna in different parts of the forest. These thumbnail illustrations were not present in two of the four presentation formats associated with this research (OMS and SO). The CD-ROMa and CD-ROMb formats had the thumbnail on the pages of the text. In the CD-ROMb format, this thumbnail was a hotspot; when a child clicked on it, the scene popped out and showed the mother bat looking in a cave, tall grasses, etc. and calling, “Stellaluna!”

Figure 3.1 shows this hotspot at the top left of the hotspot page. Pilot data (Paciga, 2008) indicated that most children questioned what happened to the mother following the attack and that those who did activate these hotspots were more likely to appropriately respond to the comprehension questions, “Where did Stellaluna’s mother look for her?” and “What happened to Stellaluna’s mother after the owl attacked them?” If the participant clicked on these hotspots in CD-ROMb, he or she accessed information about (1) what happened to the mother bat and (2) whether or not she cared that her child was missing. These pieces of information may contribute to the child’s explicit and higher-level story comprehension.



**Figure 3.1. Annotated Screenshot of an Interactive Hotspot Page (from CD-ROMb showing examples of the sub-plot of the mother bat and congruent and incongruent hotspots [Canon, 1996]).**

## Measures

This experimental study focused on a multi-faceted construct as an outcome measure, story understanding, and tested multiple constructs as predictors for story comprehension. Because this study employed the RAND framework (RAND Reading Study Group, 2002) for understanding comprehension, the measures and constructs described in this section are associated with the reader and are similar to the variables employed in research that utilizes the Model of Domain Learning (e.g., (Alexander, 1997; Lawless & Kulikowich, 1998) as an empirical framework. These kinds of measures and constructs are omitted in the extant research on young children's story understanding. Table 3.4 summarizes the reader-level measures employed in this study.

**Table 3.4. Summary of Measures**

| Scores obtained from measures          | Construct                    | Who completes? <sup>a</sup> | Predictor | Outcome |
|--|------------------------------|-----------------------------|-----------|---------|
| Peabody Picture Vocabulary Test (PPVT) | Receptive Vocabulary         | Child                       | X         |         |
| Assessment of Topic Knowledge (ATK)    | Topic Knowledge              | Child                       | X         |         |
| Concepts of Screen (COS)               | Domain Knowledge             | Child                       | X         |         |
| Pre-K Interest Survey (PKIS)           |                              |                             |           |         |
| Technology sub-scale                   | Situational Interest         | Parent                      | X         |         |
| Story sub-scale                        | Situational Interest         | Parent                      | X         |         |
| Animal sub-scale                       | Individual Interest          | Parent                      | X         |         |
| Child Interest Probe (CIP)             |                              |                             |           |         |
| Technology sub-scale                   | Situational Interest         | Child                       | X         |         |
| Story sub-scale                        | Situational Interest         | Child                       | X         |         |
| Animal sub-scale                       | Individual Interest          | Child                       | X         |         |
| Story Retelling Task (SRT)             | Story Recall                 | Child                       |           | X       |
| Story Sequencing Task (SST)            | Story Recall                 | Child                       |           | X       |
| Explicit Comprehension Probes          | Explicit story comprehension | Child                       |           | X       |
| Implicit Comprehension Probes          | Implicit story comprehension | Child                       |           | X       |
| Comprehension Composite                | General story comprehension  | n/a                         |           | X       |

<sup>a</sup> Note: All child measures are to be administered by the researcher who will read an item-specific verbal prompt and record the child's response to the prompt for each item.

### **Predictor variables: Measures of knowledge.**

As discussed in Chapter 2, traditional reading comprehension research conducted from a cognitive perspective posits that the reader's domain, topic, and/or background knowledge all factor into his or her ability to make sense of printed text. Because this research has adopted a cognitive perspective, these constructs were also of interest in helping develop understandings about young children's story comprehension. Accordingly, this research employed three knowledge measures—a receptive vocabulary measure, an assessment of topic knowledge related to the story's characters, and a measure of students' familiarity with the computer.

***Receptive vocabulary.***

The *Peabody Picture Vocabulary Test, 4<sup>th</sup> Edition* (PPVT) (Dunn, 2005) is an individually administered, norm-referenced assessment of listening comprehension for spoken words (receptive vocabulary) with standardized administration and is appropriate for use with individuals as young as two and a half years of age through adulthood. It is a single-scale test that is intended to measure English vocabulary knowledge. Administration took approximately 10-15 minutes. The tool consisted of 228 items equally distributed across 19 item sets; each set contained 12 items of increasing difficulty. The PPVT is available in the English language only. Internal consistency reliability coefficients range from .92-.95. Test-retest reliability is reported as .90. The PPVT manual also discusses four validation studies that were designed to assess the similarity to other kinds of vocabulary tests, in which validity ranged from  $r = .37$ -.84 (poor to high). The standard score distribution of the PPVT has a mean of 100 and a standard deviation of 15. Standard scores were normed by age for this study.

***Assessment of Topic Knowledge.***

In order to measure prior topic knowledge regarding bats in specific and animals in general, a 14 item, multiple-choice assessment (*Assessment of Topic Knowledge, ATK*) was created. Each item on this assessment had three or four response options, with only one correct choice. A score of 1 was awarded to each correct answer and incorrect answers are scored with a 0. A composite score for was created by summing all points awarded for correct responses to items on the assessment. Figure 3.2 provides a sample item from this assessment and the full scale is provided in Appendix A. To identify any problematic items and to ascertain internal consistency, the 14 items on the ATK for the entire sample were entered into an SPSS reliability test. Results indicated low internal consistency, Kuder-Richardson (KR20) = .51. The reliability test indicated that if items 5, 7 and 12 were deleted from the ATK Score internal consistency

could be significantly improved, Kuder-Richardson (KR20) = .71. Accordingly, a Revised ATK Score for each participant was created (sum of the number of correct responses in the remaining 11 ATK items). The Revised ATK Score was entered into all analyses.

Item 8. Which of these hunts for bats?

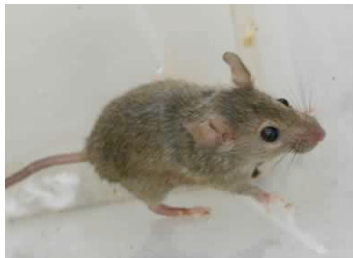
☐  
an owl



☐  
a worm



☐  
a mouse



☐  
an elephant



**Figure 3.2. Sample Item from the Assessment of Topic Knowledge (ATK)**

### *Concepts of Screen checklist.*

Because the context of this study was a digital environment, it was necessary to be certain that a child's skill in manipulating the hardware and software on a computer did not interfere with his or her comprehension of digital texts. In her year-long case study of computer use in a kindergarten classroom Turbill (2001a) noted:

It became clear that the not all students understood these concepts and, until they did, they were unable to access all that the computer offered, just as they would be unable to access books if they did not understand the 'concepts of print.' We also found that once the children began to learn these concepts and could navigate their way around the screen, they

tended to return to favourite e-books in Galaxy Kids, or to favourite talking books, just as they did with paper-based books. (p. 275)

The Concepts of Screen Checklist (COS, see Appendix B) is a product of Turbill's tenure in this classroom (Turbill, 2001b). There are 13 items in this observational checklist that are intended to provide information about each child's ability to control the mouse, use the hardware and software on the computer, and navigate within a given program. These items were scored on a four-point rating scale with anchors that are intended to describe the child's ability to complete a computer task independently (e.g., drag and drop and image)—not yet [independent], with help, novice, and [entirely] independent. A child who was rated as a novice on this task required a visual or verbal prompt to complete the task. A child who was rated "with help" required a visual or verbal prompt followed by a demonstration of how to complete the task, and then could correctly and independently complete the task.

The checklist also includes an item that inquires about student computer use in the home and another that assess student confidence in using the computer (e.g., frightened, reluctant but willing, or confident). The scoring for home computer use was binary—either a student used a computer at home or did not. Test-retest reliability data for this tool were not available in Turbill's published journal article. Protocol for administering the COS checklist are included in Appendix C. Ten percent of the study's sample was observed by two researchers. Each researcher arrived at COS item-level ratings independent of the other. Comparison scores indicate 91 percent agreement in observed scores.

### **Predictor variables: Measures of interest.**

Technology and story time represented situational factors that were related to the digital story listening activity. Because children listened to a story presented on a computer, their situational interest could be triggered by either the story, the technology, or by some combination



of story and technology.

***Pre-Kindergarten Interest Survey.***

In order to measure students' situational and individual interest related to story comprehension of the digital read aloud of *Stellaluna*, a parent survey was created (Pre-Kindergarten Interest Survey, PKIS, see Appendix D). This survey consisted of 21 items that provide information about children's interests across three dimensions—technology (items 1-8), stories (items 9-16), animals (items 17-21). Pilot data conducted with 58 Kindergarten children from similar urban at-risk backgrounds indicate acceptable internal consistency for each sub-scale of the PKIS, Cronbach's Alpha > .80 in each sub-scale of the PKIS.

To reduce the amount of time child participants spent completing predictor measures, parents completed the PKIS as a proxy measure for their child's interest. Parent reports were collected to serve as proxies of their child's interest. Research documents that parents serve as reliable reporters of medical and educational related concerns associated with evaluations for special education services (Ireton & Glascoe, 1995); it is therefore assumed that they also responded reliably to the items on the PKIS. Furthermore, the literature review established that parent report of student interest in storybook reading is commonplace in the literature base.

Creation of the items in each sub-scale of the PKIS was based on extensive literature reviews. A review of research related to interest in technology primarily yielded material that was designed to facilitate career choice (e.g., <http://www.careerclusters.org/resources/ccinterestsurvey/InterestSurvey.pdf>) or to probe whether a teacher or student was interested in learning more about a particular technology (e.g., <http://www.insightro.com/surveys/193>) such as Excel, Photoshop, PowerPoint, interactive whiteboards, etc. Because very young children do not read independently and are not likely to be knowledgeable about particular programs, more global ways to look at young children's use of

technology were needed. Recent publications have outlined several ways they see technology fitting into early childhood (McGee & Richgels, 2006; McKenna, Labbo, Reinking, & Zucker, 2007; Shuler, 2009; Van Scoter & Ellis, 2001). From these descriptive data, items 1-8 on the PKIS technology sub-scale were developed.





Literature searches for interest surveys related to storybook reading yielded a wealth of library science interest surveys where librarians were trying to gather data about which kinds of books children liked to read (e.g., [http://www.ala.org/ala/mgrps/divs/yalsa/teenreading/tipsenc/reading\\_interest\\_survey.pdf](http://www.ala.org/ala/mgrps/divs/yalsa/teenreading/tipsenc/reading_interest_survey.pdf)). Inventories of this type typically include questions that match fairly well with the items on the story sub-scale of the PKIS. Other items for the story sub-scale were based on an intriguing piece by Sipe (2002) in which he outlined the ways in which children engage in storybook reading. The first way children engage with literature is through *dramatization*, or acting out a story in verbal or nonverbal ways. *Critiquing* is another way children engage in story response. When a child critiques a character, he/she might suggest alternatives and/or draw the story to themselves in verbalizations about the story. The third relevant idea Sipe proposed is that children *take over* a story. They manipulate and interpret the story and use it as a launching pad for the expression of their own creativity. From these notions, several other items on the story sub-scale of the PKIS emerged.

The review of the literature revealed no interest scale related to the domain of animals so twelve items were created and pilot tested with 48 kindergarten students in an urban school. The five items with the highest internal consistency were selected for inclusion on the PKIS. All items relate to learning about animals through live observation and discussion, or through reading.

For parents reporting on the PKIS, each response was scored on a 1-4 scale, with “extremely interested” receiving 4 points and “uninterested” receiving 1 point. The decision to use an even number of scale nodes, avoiding a middle neutral response choice, was made based on research indicating that participants often avoid committing to anchors on the ends of Likert-like scales (Nunnally, 1967). Ratio scores were calculated for each domain measured by the PKIS by dividing the reported scores by the total points possible for each domain (total points possible for technology and story sub-scales = 32; animal sub-scale total points possible = 20). Higher scores indicate that a child has more situational (technology/story) or emergent individual interest (animals) in a given domain.

### ***Child Interest Probe.***

To ensure that parent reporting was an accurate measure of their child’s interest, each child was asked to respond to five questions on the Child Interest Probe (CIP). An example item is included in Figure 3.3, below, and the complete list of practice and test items is included in Appendix E. The decision to use a pictorial response format was made because of the likelihood that young children would more easily comprehend the significance of the options (McKenna, et al., 1995). Students received a score for each of the three sub- scales of the CIP. Each “uninterested” response receives zero points and all “extremely interested” responses receive three points. Sub-scale averages were calculated by dividing the total number of points received by the maximum points possible for each sub-scale.

| Are you interested in using computers?  |   |  |   |
|---|---|--|---|
| I would not like to do that at all. I'd rather be in time out.                    | I wouldn't like to do that, but I might do it if there was no other choice.       | I'd probably like to do that, especially if there is nothing else interesting to do. | I'd love to do that any time.   |
|  |  |    |  |

**Figure 3.3. Sample Item and Response Format for the Child Interest Probe (CIP).**

Note. Garfield images are from McKenna, M. C., Kear, D. J., & Ellsworth, R. (1995). Children's Attitudes toward Reading: A National Survey. *Reading Research Quarterly*, 30(4), 934.

### **Outcome variables: Measures of story understanding.**

Story understanding requires grasping information explicitly presented in the text—the characters, setting, problem, resolution, and sequence of events. In addition, it also requires higher-order thinking including inferencing, making connections, and predicting. Accordingly, this research includes two measures of story recall will be included. These measures focus on the child's ability retell the story in her/his own words and to sequence the story's events. Also included are measures of explicit and higher-order story comprehension.

### ***Story Retelling Task.***

The Story Retelling Task (SRT, see Appendix F) was designed following the models employed in extant research in read aloud research with children in early childhood classrooms, grades K-2 (e.g., Doty, et al., 2001; Matthew, 1996; Morrow, 1985, 1986; Morrow, Sisco, & Smith, 1992; Verhallen, et al., 2006). In these models, students are asked to retell the story "as if

they were telling it to a friend who had never heard it before." No prompts are given other than "what comes next?" or "then what happened?" A maximum of 10 minutes per child is allotted for each retelling.

Scoring of the SRT was based on the number and types of elements of story structure that children included in their retellings in both cases. Inclusion of setting, theme, plot episodes, and resolution were awarded points. To determine the number of points possible for the SRT four graduate students enrolled in a children's literature course completed a story analysis wherein they were asked to identify the setting, theme, all plot episodes, and the story's resolution. A total of 17 points were possible based on their analysis. Inter-rater reliability was .93, with theme being the main source of discrepancy. Two researchers observed ten percent of the participants responding to the SRT in the data collection phase of the current investigation. Each researcher arrived at SRT scores independent of the other with 98.5% agreement between the two observers in student SRT scores.

### ***Story Sequencing Task.***

A Story Sequencing Task (SST) was designed to measure the students' ability to order events from the story. Appendix G contains the SST administration protocol. These kinds of tasks have been employed in measures of listening comprehension and have been validated with preschool populations (De-Bruin Parecki & Quibb, 2010). Four graduate students enrolled in a children's literature course viewed one of the versions of *Stellaluna* and then selected six images representing key events in the story. The graduate students selected and recommended five of the six images included in the SST with 100% agreement. The last image recommended for the SST was evenly split between the page showing Mama bird feeding bugs to her babies and the page showing Stellaluna's difficulty with landing like a bird. After some discussion the graduate students arrived at consensus that the latter of the two recommendations should be included in

the SST because (1) it was central to one of the less obvious subplots, that Stellaluna was different from the birds because she couldn't land and (2) the page layout was presented differently in the four presentation formats. In other words, students would view the image associated with this event in different ways depending on their story listing condition assignment. Two researchers observed ten percent of the participants responding to the SST in the data collection phase of the current investigation. Each researcher arrived at SST scores independent of the other, with 100% agreement between the two observers in SST Scores.

***Explicit Comprehension Probes.***

The selection of content for Explicit Comprehension Probes was based on a review of the comprehension probes typically associated with story comprehension research (e.g., Collins, 2004; Dickinson & Smith, 1994; Paris & Paris, 2003; Reese & Cox, 1999; Teale & Martinez, 1996). Examples from this body of research typically address the basic story grammar (Black & Wilensky, 1979; Brewer & Lichtenstein, 1981) elements—characters, setting, problems or rising actions, and solutions or resolutions—and the general sequence of events of a story and so this measure consisted of eight items addressing the main story elements and sequence of events present in *Stellaluna*. Questions were derived from the contents of the analysis presented in Table 3.1. and are related to the general plot, such as “What happened to Stellaluna’s mother after the bat attacked them?” and “What are two of the things Stellaluna and the birds did together?” were also included in the Explicit Comprehension Probes. Student responses to these probes were scored as correct (1 point) or incorrect (0 points) and the sum of the eight items constituted the child’s Explicit Comprehension Score. The Explicit Comprehension Probes are listed in Table 3.5 along with a categorization of which story element is addressed by each question.

**Table 3.5. Categorization of Explicit Comprehension Probes**

| Explicit Comprehension Probes                                     | Category        |
|---|-----------------|
| Who is this story about?  | Character       |
| Where does the story take place?                                  | Setting         |
| How did Stellaluna and her mother get separated?                  | Plot – problem  |
| Who did Stellaluna meet after she got lost?                       | Plot – events   |
| What are two of the things Stellaluna did with the 3 baby birds?  | Plot – events   |
| What happened to Stellaluna’s mother after the owl attacked them? | Plot – events   |
| Does Stellaluna find her mother? How?                             | Plot – solution |
| What kind of food does Stellaluna love?                           | Plot – events   |

All of the information requested in the Explicit Comprehension Probes was essential to understanding the story of *Stellaluna* at a literal, basic level. Two researchers observed ten percent of the participants responding to the ECP in the data collection phase of the current investigation. Each researcher arrived at ECP Scores independent of the other, with 98% agreement between the two observers in recorded ECP Scores.

### ***Implicit Comprehension Probes.***

There are many examples of higher-level story comprehension probes in the extant read aloud literature (e.g., (Brabham & Lynch-Brown, 2002; Collins, 2004). These probes typically include questions asking children to draw conclusions about the story’s theme, infer characters’ feelings at a given point in the story, make connections between the text and some other text, their life, or the larger world, or to compare and contrast information presented across several pages of text.

**Table 3.6. Categorization of Implicit Comprehension Probes**

| Implicit Comprehension Probes  | Category                |
|--|-------------------------|
| How do you think Stellaluna felt when she landed in the tree and her mother wasn't with her anymore? Why do you think she felt ____? | Inference or connection |
| Why does Stellaluna feel tired during the daytime?   | Inference               |
| What were two of the places Stellaluna's mother looked for her?  | Inference*              |
| Why was Stellaluna embarrassed?  | Inference               |
| In this story, how were Stellaluna (a bat) and the birds different from one another?   | Inference               |
| At the end of the story, do you think Stellaluna wants to live with the bats or the birds? Why?                                      | Prediction              |

\*Note. This question could be considered an explicit probe in the print version or CD-ROMb presentation format because the information required to correctly answer the probe is explicitly presented in the thumbnail illustrations. But such information is not explicitly available in the other three formats.

Six probes, summarized in Table 3.6, were derived from the information presented in Table 3.1 and were employed to assess each child's implicit text comprehension and were scored as 'appropriate with response anchored in the text' (2 points), 'appropriate without response anchored in the text' (1 point), 'inappropriate' (0 points), or 'unable to code' (excluded from analysis). 2 points were awarded to answers in which students made an inference, prediction, or connection that (a) made logical sense in general and (b) jibed with the story's plot. Answers receiving only 1 point may have made logical sense in general, but were not directly connected to the facts presented in the story. For example, students who responded to "Why is Stellaluna tired or sleepy during the day?" with "Because she stayed up too late" would receive 1 point. Children providing this response were indicating that they know something about being sleepy



during the day; this information likely came from personal experience or from experience with another text, television program, movie, etc. rather than what he or she knew about bats.

Children were using what they already knew to help them make sense of the text so, while this response example was not entirely inappropriate, it was also not fully correct given the story.

Two researchers observed ten percent of the participants responding to the ICP in the data collection phase of the current investigation. Each researcher arrived at ICP Scores independent of the other, with 86.25% agreement between the two observers on recorded ICP Scores. The lower agreement for this measure localized to two items—"Why was Stellaluna embarrassed?" and "At the end of the story, do you think Stellaluna wants to live with the bats or the birds? Why?"—but because the overall percent agreement was not unacceptably low, the two items were included in analysis.

## **Procedure**

The data for this study were collected classroom-by-classroom. Each child interacted with the researcher and computer for no more than three days—averaging 10-30 minutes per day, depending on the story listening condition to which each child is assigned. The first data point collected was the PKIS. Surveys were distributed to parents in their child's homework folder or at parent report card pickup. Parents who did not return the PKIS were approached at arrival or dismissal and asked to complete the survey.

The researcher first administered the PPVT individually at a table outside the regular classroom. The next data points collected were the Assessment of Topic Knowledge (ATK) and the Child Interest Probe (CIP). These measures were administered to each child individually at the computer center in the child's classroom. Together, the administration of these items should not take more than 5 minutes. Immediately following the ATK and CIP, the researcher verbally

prompted each child through the Concepts of Screen (COS) checklist on their computer. The researcher followed the COS administration and scoring protocol outlined in Appendix C.

On a separate day (i.e., other than the day the predictor data were collected), each child was assigned to listen to one of the four presentation formats. Children were instructed to listen to the entire story in each condition. The researcher said, “I want you to listen to this story. When we are finished we will talk about what happened in it, so try to remember as much as you can.” Upon completion, children were invited to a small table outside the classroom door to complete the story free recall and story sequencing tasks and to respond to the comprehension probes. The researcher asked the children to orally respond to each comprehension probe, recording their responses with a digital recording device.

In cases where the child was either very young or lacked interest in the activity, the child was permitted to request to terminate their participation in the story listening activity. In these instances, the researcher offered encouragement to continue on three occasions and then gave way to the child’s request to terminate the activity. At this point, the researcher documented the child’s name and experimental condition and the point at which the child stopped listening to the story. Upon termination, children were asked to complete the recall and sequencing tasks and respond to the same set of comprehension probes as the other participants.

## CHAPTER IV: ANALYSIS AND RESULTS

Analysis for this study was carried out in three phases. In the first phase, data were examined for inter-rater reliability and internal consistency (see Chapter Three) and composite scores were created correspondingly. Data screening for problematic items, missing data, outliers, and normality were also carried out. Cleaned data were used in the second phase of analysis to answer the following research questions:

1. Does the presentation format of digital storybooks impact young children's story understanding in a digital environment?
  - a. To what extent do the various presentation formats support young children's free recall of the text?
  - b. To what extent do the various presentation formats support young children's ability to sequence story events?
  - c. To what extent do the various presentation formats support young children's understanding of elements explicitly presented in the text?
  - d. To what extent do the various presentation formats support young children's higher-level comprehension of the text?
2. Do individual differences in knowledge and interest predict young children's understanding of a digital storybook?

The third stage of data analysis explored the data set with the intention of finding a rationale for trends (or lack thereof) in the data. These additional analyses were guided by exploratory research questions that can be found later in this chapter.

The data that follow do not represent all of the data collected. Students who were identified by the teachers as speaking English as a second language ( $n = 16$ ) were not included in

analysis as the independent and dependent measures required a certain level of oral language proficiency in the English language.

### **Research Question One**

This study sought to determine whether the differences in electronic story presentation lead to differences in multiple measures of at-risk preschoolers' story understanding. There were four groups (CD-ROMa, CD-ROMb, OMS, or SO) and four dependent measures (SRT Score, SST Score, ECP Score, and ICP Score) in the design of the study.

### **Data screening.**

#### ***Missing data.***

Random missing data constituted less than five percent of missing data. Tabachnik and Fidell (2007) recommend deleting cases with random missing data and so these cases were not included in analysis. The sample sizes in subsequent analyses vary as a function of these instances of random missing data.

#### ***Outliers.***

Because the first research question associated with this study requires ANOVA/MANOVA analysis, the data were examined for outliers by story listening condition. The data file was split by story listening condition and z-scores were examined for cases with absolute standardized scores in excess of 3.29. Only two cases exceeded this value in only one of the outcome measures, the summary score for the Story Retelling Task. These two cases were only outliers on the one measure and have remained included in analysis.

## Evaluation of assumptions.

### *Normality.*

The first step in analysis was to examine frequency of each univariate variable. Continuous and categorical data that fell out of appropriate ranges were reexamined for entry errors and then rectified. Tests for normality (see Table 4.1) indicate moderate violations to normality, particularly associated with the Story Retelling Task Score and the Story Sequencing Task Score. M/ANOVA are fairly robust to moderate violations of normality (Lindman, 1974), especially when cell sizes are equal and sample size is big, so these analyses were pursued with the exception in the following paragraph.

**Table 4.1. Tests for Normality: Outcome Measures x Condition**

|           | Condition | Shapiro-Wilk |    |      |
|-----------|-----------|--------------|----|------|
|           |           | Statistic    | df | Sig. |
| SRT Score | CD-ROMa   | .842         | 33 | .000 |
|           | CD-ROMb   | .814         | 34 | .000 |
|           | OMS       | .886         | 35 | .002 |
|           | SO        | .794         | 35 | .000 |
| SST Score | CD-ROMa   | .824         | 33 | .000 |
|           | CD-ROMb   | .843         | 34 | .000 |
|           | OMS       | .813         | 35 | .000 |
|           | SO        | .834         | 35 | .000 |
| ECP Score | CD-ROMa   | .901         | 33 | .006 |
|           | CD-ROMb   | .912         | 34 | .010 |
|           | OMS       | .943         | 35 | .071 |
|           | SO        | .958         | 35 | .204 |
| ICP Score | CD-ROMa   | .888         | 33 | .003 |
|           | CD-ROMb   | .872         | 34 | .001 |
|           | OMS       | .854         | 35 | .000 |
|           | SO        | .943         | 35 | .070 |

Participants were unable to freely recall and retell story events, as evidenced by the problematic values of the tests for normality (Table 4.1) and the exceptionally low observed means for the Story Retelling Task (Table 4.2). The maximum scores and the mean for the SRT in Table 4.1 were so low that a floor effect is apparent. And although inter-rater reliability was high (98.5 % agreement between two raters) for this measure, Story Recall Task (SRT) data were not analyzed any further. One of the dependent measures, the summary score for the SRT, was not entered into analysis due to floor effects in the sample. Observed means and standard deviations for this and the other three dependent measures by story listening condition are presented in Table 4.2.

**Table 4.2. Descriptive Statistics for Research Question One**

| Condition (N) | SRT Score <sup>a</sup> |      | SST Score <sup>b</sup> |      | ECP Score <sup>c</sup> |      | ICP Score <sup>d</sup> |      |
|---------------|------------------------|------|------------------------|------|------------------------|------|------------------------|------|
|               | M                      | SD   | M                      | SD   | M                      | SD   | M                      | SD   |
| CD-ROMa (32)  | 1.67                   | 1.65 | 1.42                   | 1.64 | 2.77                   | 2.86 | 2.94                   | 2.73 |
| CD-ROMb (34)  | 2.06                   | 2.26 | 1.68                   | 1.77 | 4.01                   | 2.62 | 3.56                   | 3.24 |
| OMS (35)      | 2.40                   | 2.25 | 2.23                   | 2.34 | 3.57                   | 2.40 | 2.60                   | 2.67 |
| SO (35)       | 1.60                   | 1.82 | 2.00                   | 2.10 | 3.73                   | 2.25 | 2.94                   | 2.03 |
| Total (136)   | 1.93                   | 2.02 | 1.84                   | 1.99 | 3.99                   | 2.46 | 3.01                   | 2.69 |

a. Possible scores range from 0-17.

b. Possible scores range from 0-6.

c. Possible scores range from 0-8.

d. Possible scores range 0-12.

Examination of a dependent measures correlation matrix (Table 4.3) facilitated determination of the most appropriate parametric analysis. Tabachnik and Fidell (2007) explain, “MANOVA works best with highly negatively correlated DVs and acceptably with moderately correlated

dependent variables (DVs) in either direction (+/- .6)” (p. 268). Table 4.3 shows that the majority of the DV correlations are lower than Tabachnick and Fidell’s recommendation, so univariate ANOVA was employed. Bonferroni adjustments to  $\alpha$  were required because three univariate ANOVA analyses were completed. The decision rule for these analyses was to compare  $p$  to  $\alpha = .017$ . One caveat should be made before proceeding with these analyses: because multivariate analysis conceptually makes sense given the design of this study, MANOVA analysis was also run and is reported in subsequent sections.

**Table 4.3. Correlations: Dependent Measures (N = 136)**

|           | SST Score | ECP Score | ICP Score |
|-----------|-----------|-----------|-----------|
| SST Score | 1         |           |           |
| ECP Score | .373**    | 1         |           |
| ICP Score | .249**    | .702**    | 1         |

\*\* . Correlation is significant at the 0.01 level (2-tailed).

#### **Assessment of covariate.**

Because of the strong relationship between oral language and reading comprehension (Beck, Perfetti, & McKeown, 1982; Nagy, 2005), PPVT-IV standard scores were explored as a possible covariate for the analysis examining the effect of story listening condition on preschoolers’ story understanding. The overall observed means observed in the PPVT SS ( $M = 94.5$ ,  $SD = 12.84$ ) were slightly lower than the national average of 100 for the measure. The test for the homogeneity-of-regression (slope) yielded a significant interaction between the standard score on the PPVT and the SST scores, SST,  $F_{(3, 128)} = 3.91$ ,  $p = .01$ . As such, the PPVT SS was

not used as a covariate with story sequencing. A one-way ANOVA was run to determine the adequacy of the various story listening conditions in supporting young children's ability to sequence story events. A non-significant interaction was present between the PPVT SSs and explicit and implicit comprehension probe scores, ECP,  $F_{(3, 128)} = .87, p = .46$ ; and ICP,  $F_{(3, 128)} = 1.42, p = .24$ . Based on these findings, one-way analyses of covariance (ANCOVAs) were pursued to examine the adequacy of each story listening condition in supporting explicit and implicit story understanding.

#### **ANOVA: Story Sequencing Task Score as the dependent variable.**

The one-way ANOVA with story listening condition as the grouping variable and Story Sequencing Task Score (SST Score) as the dependent variable did not meet the assumption of homogeneity of variance (Levene's Test). This yielded no significant effect of story listening condition on students' ability to sequence story events,  $F_{(3, 133)} = 1.079, p > .017$  (see Table 4.4). In other words, participants' scores on the Story Sequencing Task did not vary as a function of condition; the four presentation formats did not differentially impact this measure of listening comprehension.

**Table 4.4. Tests of Between-Subjects Effects: Story Sequencing Task Score x Condition**

Dependent Variable: Summary score on SST

| Source          | SS     | df  | MS   | <i>F</i> | Sig. |
|-----------------|--------|-----|------|----------|------|
| Condition       | 12.79  | 3   | 4.27 | 1.08     | .36  |
| Error           | 525.67 | 133 | 3.95 |          |      |
| Corrected Total | 538.47 | 136 |      |          |      |

a. R Squared = .024 (Adjusted R Squared = .002)



### ANCOVA: Explicit Comprehension Probe Score as the dependent variable.

ANCOVA was used to test the effect of story listening condition on children's ability to understand content explicitly presented in the digital storybook. For this analysis story listening condition served as the independent measure and summary score on the Explicit Comprehension Probes was the dependent measure. Standard score on the PPVT (PPVT SS) was entered as the covariate. The assumption for homogeneity of variance (Levene's Test) was met,  $F_{(3, 132)} = 1.72$ ,  $p = .165$ . The ANCOVA yielded non-significant results,  $F_{(3, 131)} = 2.41$ ,  $p > .017$  (see Table 4.5). In other words, story listening condition did not have a significant effect on participants' ability to understand content explicitly presented in the digital storybook *Stellaluna* after partialling out differences in receptive vocabulary.

**Table 4.5. Tests of Between-Subjects Effects: Explicit Comprehension Probes Score x Condition**

Dependent Variable: ECP Score

| Source          | SS     | df  | MS     | <i>F</i> | Sig. |
|-----------------|--------|-----|--------|----------|------|
| PPVT SS         | 175.45 | 1   | 175.45 | 38.25    | .00  |
| Condition       | 33.15  | 3   | 11.05  | 2.41     | .070 |
| Error           | 600.91 | 131 | 4.59   |          |      |
| Corrected Total | 806.47 | 135 |        |          |      |

a. R Squared = .255 (Adjusted R Squared = .23)

### ANCOVA: Implicit Comprehension Probe Score as the dependent variable.

A third ANCOVA analysis was used to test the effects of story listening condition on the preschoolers' ICP Score. Implicit Comprehension Probe scores were entered as the dependent measure and PPVT SSs served as a covariate for this analysis. The assumption for homogeneity of variance (Levene's test) was met,  $F_{(3, 132)} = 2.54$ ,  $p = .060$ . This analysis produced non-significant results as well,  $F_{(3, 131)} = .341$ ,  $p > .017$  (see Table 4.6). In other words, implicit

comprehension scores did not exhibit statistically significant differences among story listening conditions.

**Table 4.6. Tests of Between-Subjects Effects: Implicit Comprehension Probes Score x Conditon**

Dependent Variable: ICP Score

| Source          | SS     | df  | MS     | F     | Sig. |
|-----------------|--------|-----|--------|-------|------|
| PPVT SS         | 172.29 | 1   | 172.29 | 28.74 | .00  |
| Condition       | 6.14   | 3   | 2.05   | .341  | .80  |
| Error           | 785.35 | 131 | 6.00   |       |      |
| Corrected Total | 973.88 | 135 |        |       |      |

a. R Squared = .194 (Adjusted R Squared = .169)

#### **Additional univariate analyses for research question one.**

In addition to the omnibus ANOVA and ANCOVA analyses to test the effects of presentation format by story listening condition a series additional analyses were carried out. Age, presentation features and task completion were explored to tease out the nuances of the data set. Finally, power analysis was run to determine the sample size requisite for detecting significant differences in the omnibus ANOVA/ANCOVA tests.

#### ***Age.***

First, the data were split by age with each child categorized as either three- and four-years-old based on date of birth and age at beginning of school year. The goal was to determine whether the effect of story listening condition might have been suppressed when posttest measures were combined across age groups. In addition, age was entered as a factor in ANOVA/ANCOVA analyses. In other words, *were the effects of story presentation differential across three- and four-year-olds populations? Was there an age x condition interaction?*

The first item of exploration centered on the notion that there may be differences among SST scores of children from different age groups (three-year-olds and four-year-olds). Story Sequencing Task data trended in the same pattern for both age groups with three-year-old SST scores marginally lower than those of the four-year-old participants. Results of a factorial ANOVA with Condition and Age as the factors and SST Score as the dependent measure indicated that Age was not a significant factor,  $F_{(7, 129)} = 2.56, p = .112$ , in Story Sequencing. Moreover, there was no Age x Condition interaction,  $F_{(7, 129)} = .173, p = .915$ .

With respect the ECP as the dependent measure, factorial ANCOVA with Age and Condition as the factors and ECP Score as the dependent measure indicated that age is a significant factor,  $F_{(1, 127)} = 12.44, p = .001$  but that there is no Age x Condition interaction,  $F_{(3, 127)} = .095, p = .963$ . Although Age *is* a significant factor in this model, there is no interaction or differential effect of Age particular to any given condition. After partialing out differences in receptive vocabulary (PPVT SS) four-year-old children exhibited better scores on the explicit measures of listening comprehension (four-years  $M = 4.56, SE = .234$ ; three-years  $M = 3.29, SE = .276$ ).

The third ANCOVA was re-run to try to determine whether ICP Scores varied with age by condition. The identified variations in presentation format by story listening condition did not produce an effect on students' Implicit Comprehension Probe Scores; variance in their ability to respond to higher-level comprehension questions was not resultant from the story listening condition. The differences in ICP Scores by Condition with Age indicate that ICP Scores do not follow similar trends for three- and four-year-olds. Factorial ANCOVA with Age and Condition as the factors and ICP Score as the dependent measure confirms that age is a significant factor,  $F_{(1, 127)} = 10.10, p = .002$  but that there is no Age x Condition interaction,  $F_{(3, 127)} = .248, p =$

.863. In other words, although Age is a significant factor in this model, there is no interaction or differential effect of Age particular to any given condition. After partialling out differences in receptive vocabulary (PPVT SS) four-year-old children exhibited better scores on implicit (four-years  $M = 3.58$ ,  $SE = .27$ ; three-years  $M = 2.26$ ,  $SE = .32$ ) measures of listening comprehension.

**Table 4.7 Descriptive Statistics by Age for Research Question One**

| Age     | Condition (N) | SRT Score |      | SST Score |      | ECP Score |      | ICP Score |      |
|---------|---------------|-----------|------|-----------|------|-----------|------|-----------|------|
|         |               | M         | SD   | M         | SD   | M         | SD   | M         | SD   |
| 4 years | CD-ROMa (18)  | 1.84      | 1.86 | 1.74      | 1.82 | 5.11      | 2.45 | 3.42      | 2.34 |
|         | CD-ROMb (21)  | 2.19      | 1.63 | 2.00      | 1.82 | 4.79      | 2.18 | 4.43      | 3.14 |
|         | OMS (19)      | 2.70      | 2.62 | 2.40      | 2.28 | 4.30      | 2.30 | 3.20      | 2.80 |
|         | SO (19)       | 1.79      | 1.93 | 2.11      | 2.16 | 4.16      | 2.32 | 3.37      | 2.22 |
|         | Total (78)    | 2.14      | 2.04 | 2.06      | 2.00 | 4.59      | 2.30 | 3.62      | 2.66 |
| 3 years | CD-ROMa (14)  | 1.43      | 1.34 | 1.00      | 1.3  | 4.07      | 2.59 | 2.29      | 3.15 |
|         | CD-ROMb (13)  | 1.84      | 3.08 | 1.15      | 1.63 | 2.77      | 2.86 | 2.15      | 3.00 |
|         | OMS (15)      | 2.00      | 1.65 | 2.00      | 2.48 | 2.60      | 2.26 | 1.80      | 2.34 |
|         | SO (16)       | 1.38      | 1.71 | 1.88      | 2.09 | 3.22      | 2.14 | 2.44      | 1.71 |
|         | Total (58)    | 1.66      | 1.98 | 1.53      | 1.95 | 3.16      | 2.46 | 2.17      | 2.51 |

a. Possible scores range from 0-17.

b. Possible scores range from 0-6.

c. Possible scores range from 0-8.

d. Possible scores range 0-12.

### ***Planned comparison for effect of presentation features.***

Second, the effects of specific features of the presentation format outlined in Table 3.2 were explored vis-à-vis a priori contrast tests. Here, the objective was to isolate differences in the duration (longer v. shorter), filmic effects (full animation v. static images and any kind of

animation v. static images), WPM (quick-paced reading v. more slowly read), extra-textual discourse (supports automatically present vs. no supports present) and interactivity (i.e., hotspots) and to answer the following question: *Do cell means in SST Score, ECP Score, and ICP Score differ as a function of the presentation features outlined in Table 3.2?* The design of the presentation formats does not really permit the isolation of a single presentation format feature so the planned comparisons are a bit confounded in that multiple features are really being tested in each comparison. Nonetheless, these planned comparisons serve as important first steps in determining whether specific presentation features are more or less related to listening comprehension outcomes. In total, 14 comparisons (7 tests x 2 age groups) were run resulting in a Bonferroni adjustment to  $\alpha = .05/14 = .004$ . All of these explorations produced non-significant results, but the test comparing the effect of extra-textual supports on ECP Score is worth discussing.

Table 3.2 identified CD-ROMa as containing automatic extra-textual supports, CD-ROMb containing these upon click, and the OMS and SO conditions containing no additional extra-textual supports. As such, the contrast coefficients entered into the analysis were -2, 0, 1, 1, respectively. The CD-ROMb condition was intentionally left out of the equation because it was impossible to determine whether the children assigned to this story listening condition were actually exposed to the supports because their navigational pathways were not recorded. Thus, CD-ROMa ECP scores were compared to combined OMS and SO ECP scores. This *F*-test shows an effect of extra-textual supports on ECP Score approaching significance after accounting for pre-existing differences in PPVT SS for the four-year-old sample only,  $F_{(1, 74)} = 4.27, p = .04.$ , indicating a possible intervening variable associated with age.

**Task completion.**

Third, Chi-square goodness-of-fit tests were run to determine whether children were abandoning the story listening activity more in one condition than in another and whether these differences were more predominant by age. The guiding question for this analysis was *Is there a relationship between the number of children who abandon the story listening and their assigned story listening condition, and are abandonments related to age?* Table 4.8 shows the observed and expected counts for task completion by story listening condition with age. Pearson's  $\chi^2$  tests yielded significant results for the total sample  $\chi^2_{(3, 137)} = 25.72, p = .000$ , three-year-olds only  $\chi^2_{(3, 55)} = 15.53, p = .004$ , and four-year-olds only  $\chi^2_{(3, 55)} = 14.02, p = .003$ . In other words, non-random patterns of children completing/abandoning the story listening task were present for both age groups and overall. A Pearson's  $\chi^2$  test was also run to determine whether more children in a particular age group were abandoning the story listening activity. This test produced non-significant results,  $\chi^2_{(1, 122)} = .733, p = .392$ . Writ large, the CD-ROMb condition was more frequently abandoned (at both age levels), and the SO condition was more frequently completed than the other conditions. It is important to note, however, that these trends had relationship to overall comprehension, as the ANOVA and ANCOVA analyses were all non-significant. It was not possible to analyze the point at which each child abandoned the story listening activity as those data were not collected as part of this study's design.

**Table 4.8 Observed and Expected Counts for Task Completion x Story Listening Condition with Age**

| Story Listening Condition | Age     | Session Complete* | Session Incomplete* | Total*  |
|---------------------------|---------|-------------------|---------------------|---------|
| CDROMA                    | 3 years | 8/9.1             | 7/5.9               | 15/15   |
|                           |         | 53.3              | 46.7                | 100     |
|                           | 4 years | 13/12.9           | 6/6.1               | 19/19   |
|                           |         | 68.4              | 31.6                | 100     |
|                           | Total   | 21/22.1           | 13/11.9             | 34/34   |
|                           |         | 61.8              | 38.2                | 100     |
| CDROMB                    | 3 years | 3/7.3             | 9/4.7               | 12/12   |
|                           |         | 25                | 75                  | 100     |
|                           | 4 years | 9/15.6            | 14/7.4              | 23/23   |
|                           |         | 39.1              | 60.9                | 100     |
|                           | Total   | 12/22.7           | 23/12.3             | 35/35   |
|                           |         | 34.3              | 65.7                | 100     |
| OMS                       | 3 years | 9/8.5             | 5/5.5               | 14/14   |
|                           |         | 64.3              | 35.7                | 100     |
|                           | 4 years | 17/14.3           | 4/6.7               | 21/21   |
|                           |         | 81                | 19                  | 100     |
|                           | Total   | 26/22.7           | 9/12.3              | 35/35   |
|                           |         | 74.3              | 25.7                | 100     |
| SO                        | 3 years | 14/9.1            | 1/5.9               | 15/15   |
|                           |         | 93                | 6.7                 | 100     |
|                           | 4 years | 16/12.2           | 2/5.8               | 18/18   |
|                           |         | 88.9              | 11.1                | 100     |
|                           | Total   | 30/21.4           | 3/11.6              | 33/33   |
|                           |         | 90.9              | 9.1                 | 100     |
| Total                     | 3 years | 34/34             | 22/22               | 56/56   |
|                           |         | 60.7              | 39.3                | 100     |
|                           | 4 years | 55/55             | 26/26               | 81/81   |
|                           |         | 67.9              | 32.1                | 100     |
|                           | Total   | 89/89             | 48/48               | 137/137 |
|                           |         | 65                | 35                  | 100     |

\*. Observed/Expected and % within condition reported.

***Power analysis.***

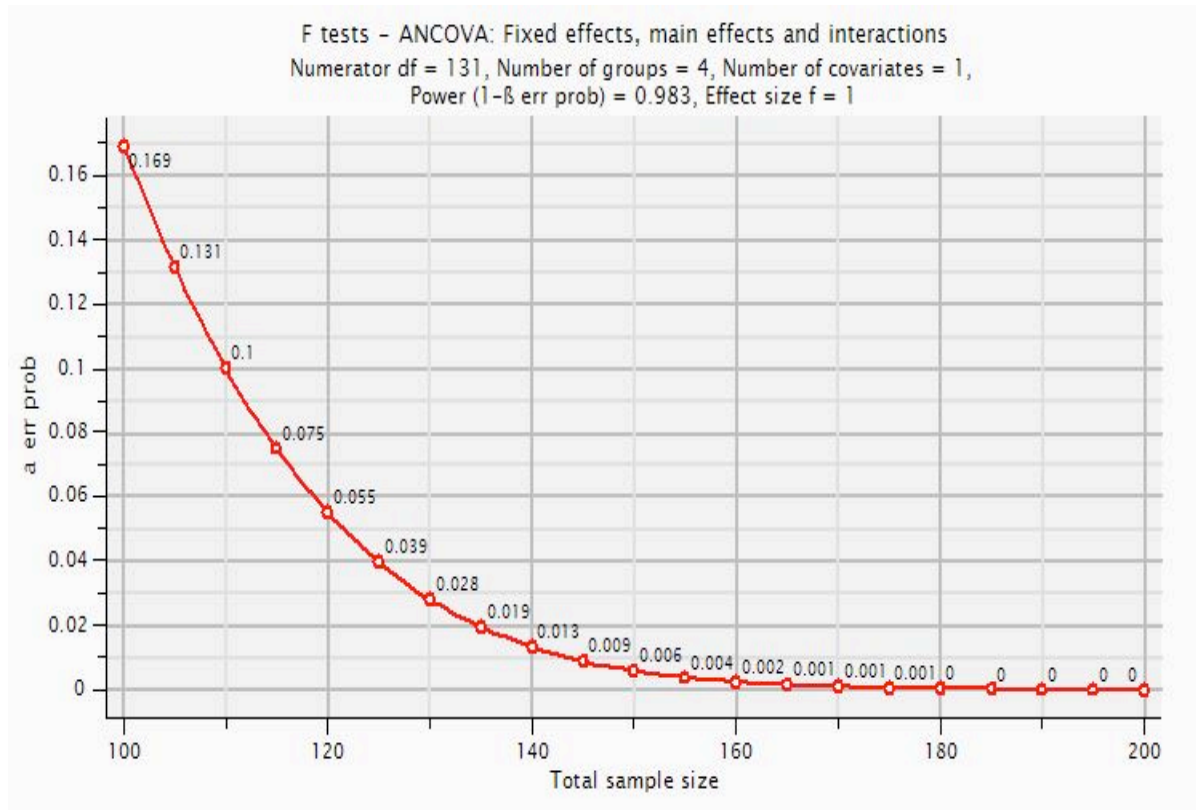
Power is the probability of rejecting the null hypothesis when a specific alternative hypothesis is true. Spybrook and colleagues suggest,

a researcher who retains the null hypothesis may have committed a Type II error and is therefore potentially vulnerable to the criticism that the study lacked power. Indeed, low power studies in which *H<sub>0</sub>* is retained are virtually impossible to interpret. One cannot claim a new treatment to be ineffective in a study having low power, because, by definition, such a low power study would have little chance of detecting a true difference between two populations represented in the study. (Spybrook, Raudenbush, Congdon, & Martinez, 2009, pp. 5-6).

Power analysis was run with these data to determine whether the design of this study predestined these results to be non-significant because of low power. G\*Power 3.1 statistical software (available at <http://www.psych.uni-duesseldorf.de/abteilungen/aap/gpower3/>) (Faul, Erdfelder, Buchner, & Lang, 2009) was used to determine whether the employed sample size of  $n = 135$  was large enough to detect significance at  $\alpha = .017$  given the design of the research for research question one. Results from G\*Power in Figure 4.1 indicate  $n = 135$  was below the necessary sample size requisite. A sample of 140 or more would have been more reliably suited to detect significance. A sample size of 165 or more would be ideally suited for this study and design.

This is not to suggest that having 180 participants would, with 100 percent certainty, change all of the non-significant results associated with this research question or all of those associated with the additional analyses for this research question. It is likely, though, that due to the proximity of the observed *F*-values in these analyses to their critical *F*-values the overall effect of condition on ECP Score in Table 4.5 and the planned comparison for ECP Score would be significant given ideal power.





**Figure 4.1. Power Analysis Plot**

### **Multivariate analysis for research question one.**

Although Tabachnik and Fidell (2007) recommend univariate analysis given the correlations of the three dependent measures (see Table 4.3), MANOVA conceptually makes sense given the design of this study. Specifically, story listening condition could effect any combination of the dependent measures or each one uniquely. Accordingly, multivariate assumptions were tested in SPSS and the most parsimonious model was selected. The following sections report the findings of these tests.

***Multivariate normality and linearity.***

Significance tests for MANOVA or MANCOVA are based on the multivariate normal distribution, meaning that the sampling distributions of the means of the various DVs in each cell and all linear combinations of them are normally distributed. The sample for this study exhibits violations to this assumption in both univariate and multivariate normality. Tabachnik and Fidell (2007) cite Mardia, “Even with unequal  $n$  and only a few DVs, a sample size of about 20 in the smallest cell should ensure robustness” (1971, p. 109). This study does meet these conditions, so multivariate significance tests were pursued despite this violation. Scatterplots were used to determine that there were no significant violations to the assumption of linearity.

***Outliers.***

Reports of univariate outliers can be found in the preceding sections. Tests for multivariate outliers yielded no additional cautionary cases. No changes, transformations, or deletions specifically for the subsequent analyses were made.

***Homogeneity of the variance-covariance matrices.***

The most common method to test the homogeneity of the variance-covariance matrices is through the Box’s  $M$  test. Results indicate homogeneity of the variance-covariance matrices,  $F_{(2, 22527)} = 1.21, p = .168$ . Levene’s test for the equality of DV variances are reported in Table 4.9. No violations were observed.

***Multicollinearity and singularity.***

Because multivariate methods are best suited when moderate correlations exist in the DVs, the bivariate correlations of the dependent measures were examined. Values in Table 4.3 do not exceed  $r = .7$  so no violations to these assumptions are present.

**Table 4.9. Levene's Test of Equality of Error Variances**

|           | F     | df1 | df2 | Sig. |
|-----------|-------|-----|-----|------|
| SST Score | 2.241 | 7   | 129 | .035 |
| ECP Score | .515  | 7   | 129 | .822 |
| ICP Score | 1.775 | 7   | 129 | .098 |

***Reliability of covariate.***

A full factorial GLM was run in SPSS with Age and Condition as the factors, PPVT SS as the covariate, and SST Score, ECP Score, and ICP score as the dependent measures. A significant Age \* Condition \* PPVT SS interaction was detected,  $\lambda = .927$ ,  $F_{(9, 287)} = 1.02$ ,  $p = .025$ , as well as a significant Age \* PPVT SS interaction,  $\lambda = .964$ ,  $F_{(3, 118)} = 1.46$ ,  $p = .036$ , indicating that PPVT SS is not well-suited as a covariate in this design. The univariate analysis in the preceding section confirms the interaction and indicates the SST Score DV to be the source of the interaction. As a result of the multivariate covariate interaction, MANOVA (rather than MANCOVA) was run to determine whether the effect of story listening condition had a combined effect on the listening comprehension measures employed in this study.

***MANOVA results.***

A 4 x 2 (Condition x Age) between-subjects multivariate analysis of variance was performed on three dependent measures: SST Score, ECP Score and ICP Score. Statistics for the multivariate significance tests are presented in Table 4.10. With the use of Wilks' criterion, the combined DVs were significantly affected by Condition and by Age. Partial-eta squared values indicate that 9.3%, a small amount, of the variance in means of the combined dependent

measures is accounted for by age and that 4.3%, also a small amount, is accounted for by Condition. No Age\*Condition interaction was observed.

The next step of MANOVA analysis calls for interpretation of the univariate effects. These statistics are reported in Table 4.11. The univariate effects mimic the trends observed in previous sections, with no significant effects of Condition on individual DVs, significant effects of Age on ECP Score and ICP Score, and no univariate Age\*Condition interaction.

**Table 4.10. Multivariate Tests**

|                    | Wilks'<br>$\lambda$ | <i>F</i> | <i>df1</i> | <i>df2</i> | <i>Sig.</i> | $\eta^2_{\text{partial}}$ |
|--------------------|---------------------|----------|------------|------------|-------------|---------------------------|
| Age                | .907                | 4.34     | 3          | 127        | .006*       | .093                      |
| Condition          | .876                | 1.93     | 9          | 309        | .048*       | .043                      |
| Age *<br>Condition | .983                | .242     | 9          | 309        | .988        | .006                      |

Plots of the estimated marginal means are presented in Figures 4.2 through 4.4. These plots facilitate visual examination of the relationships among each Condition, Age, and dependent measures of listening comprehension. Figure 4.2 for the SST Scores displays similar trend lines for Age, with four-year-olds consistently outscoring the three-year-olds, but OMS and SO conditions show higher SST Scores compared to the CD-ROM groups.

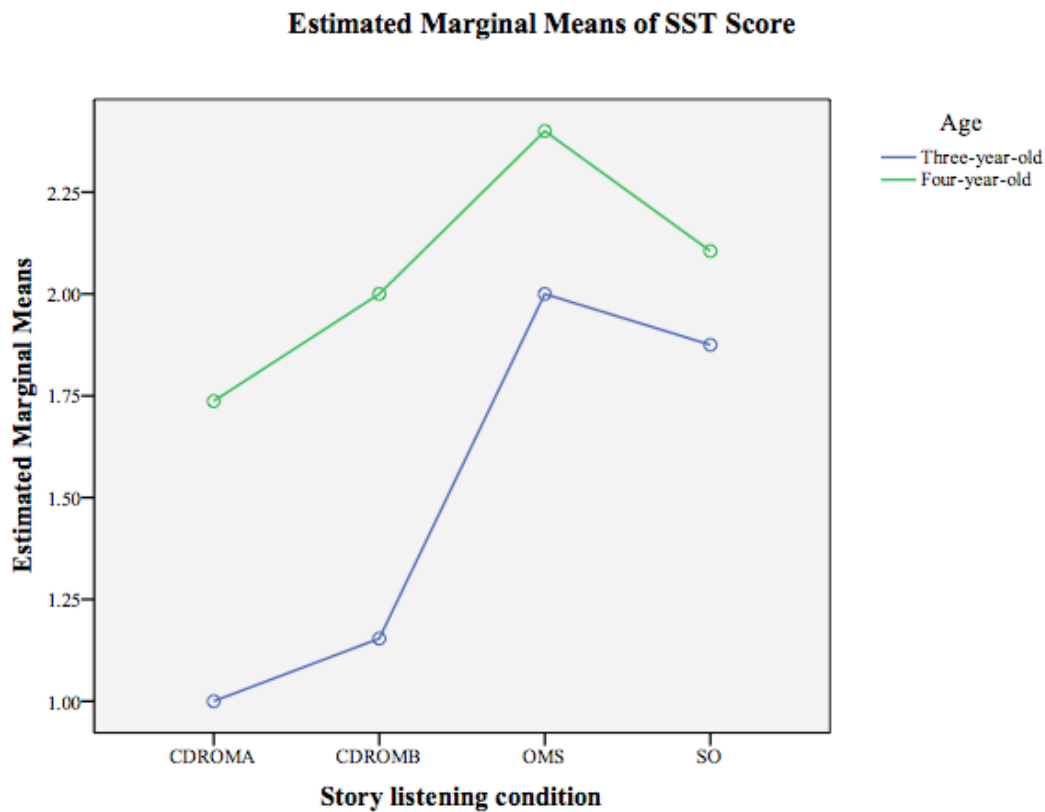
**Table 4.11. Tests of Between-Subjects Effects**

| Source             | DV        | SS     | df  | MS    | F     | Sig. | $\eta^2_{\text{partial}}$ |
|--------------------|-----------|--------|-----|-------|-------|------|---------------------------|
| Age                | SST Score | 10.20  | 1   | 10.20 | 2.56  | .112 | .019                      |
|                    | ECP Score | 67.38  | 1   | 67.38 | 11.99 | .001 | .085                      |
|                    | ICP Score | 68.61  | 1   | 68.61 | 9.94  | .002 | .072                      |
| Condition          | SST Score | 14.34  | 3   | 4.78  | 1.20  | .312 | .027                      |
|                    | ECP Score | 24.11  | 3   | 8.04  | 1.43  | .237 | .032                      |
|                    | ICP Score | 10.42  | 3   | 3.47  | .50   | .681 | .012                      |
| Age *<br>Condition | SST Score | 2.07   | 3   | .69   | .17   | .915 | .004                      |
|                    | ECP Score | 6.74   | 3   | 2.25  | .40   | .754 | .009                      |
|                    | ICP Score | 8.60   | 3   | 2.87  | .42   | .742 | .010                      |
| Error              | SST Score | 513.72 | 129 | 3.98  |       |      |                           |
|                    | ECP Score | 725.12 | 129 | 5.62  |       |      |                           |
|                    | ICP Score | 890.28 | 129 | 6.90  |       |      |                           |
| Corrected Total    | SST Score | 538.47 | 136 |       |       |      |                           |
|                    | ECP Score | 822.47 | 136 |       |       |      |                           |
|                    | ICP Score | 982.99 | 136 |       |       |      |                           |

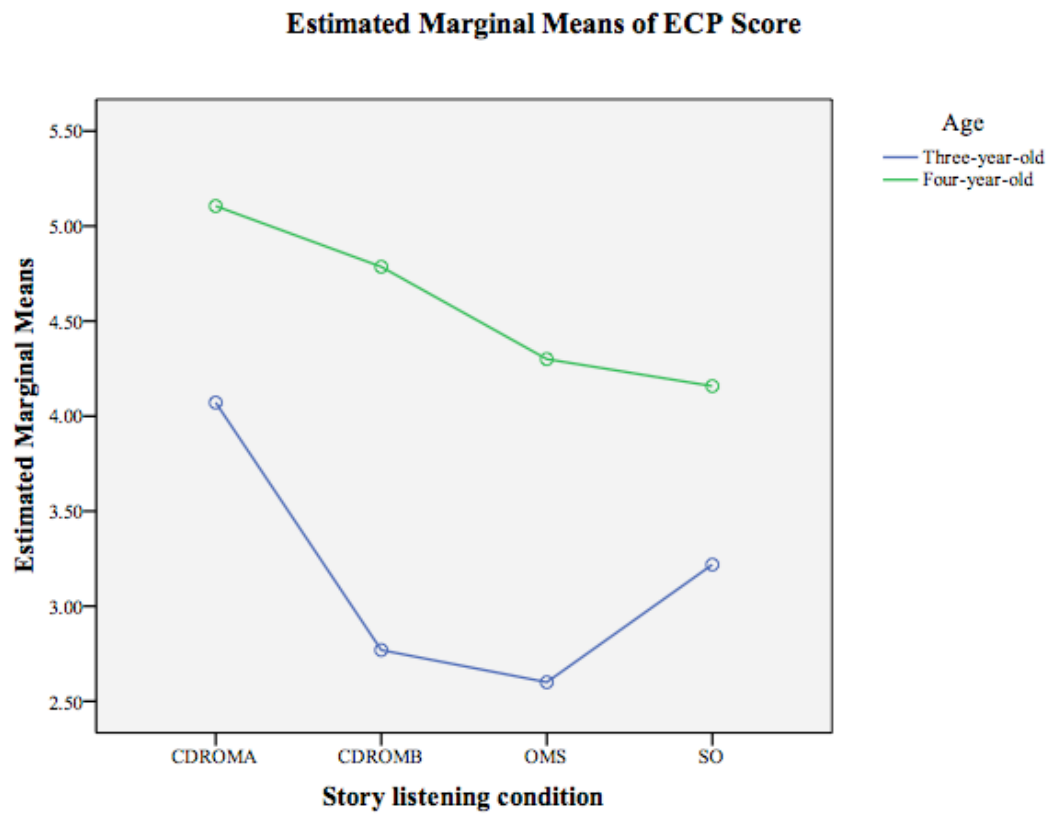
Figure 4.3 for the ECP Scores shows noticeable differences in CD-ROMa condition compared to the other conditions. Also, Figure 4.3's trend lines for the three-year-olds increases with a positive slope as it approaches the SO condition whereas the four-year-olds' trend line decreases with a continued negative slope as it approaches the SO condition. These differences are comparatively speaking (but not statistically speaking because no Age\*Condition interaction was found) intriguing and warrant discussion in the final chapter of this dissertation.

Figure 4.4 shows two interesting trends. First, the trend line approaching the CD-ROMb condition in the four-year-old group is much higher, or more positively sloping, than the trend line preceding the CD-ROMb condition for the three-year-old group. The second trend present in Figure 4.4 is related to the ICP Scores for the students assigned to the OMS condition. These

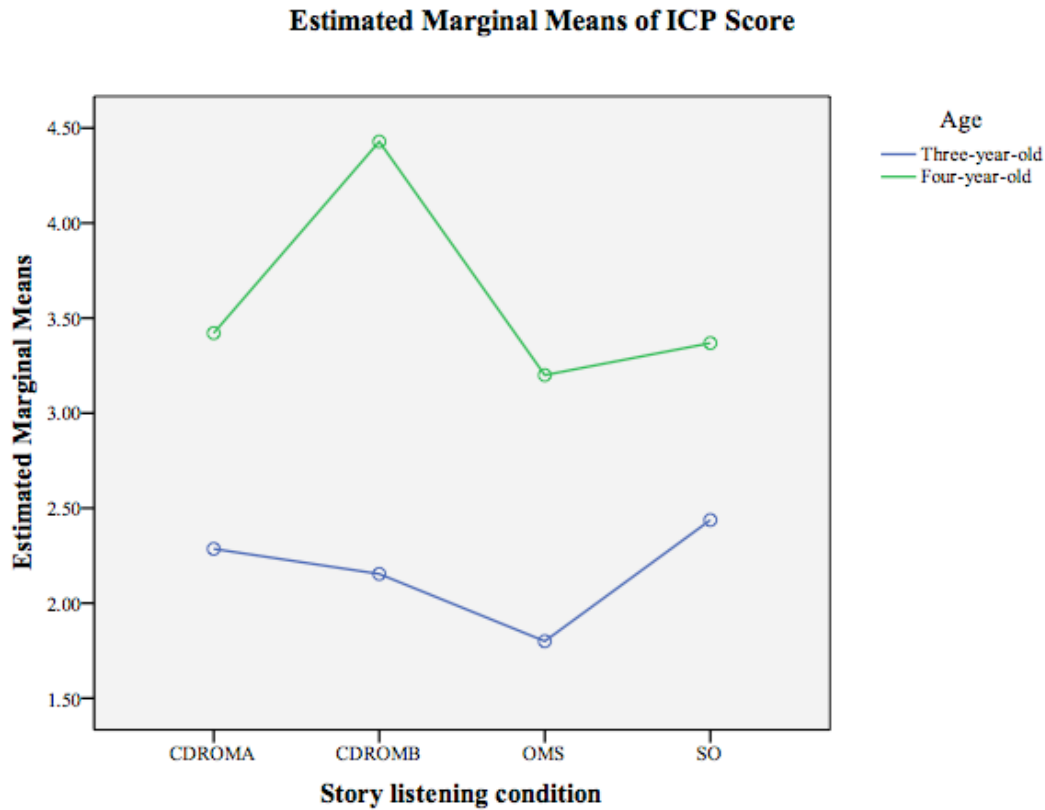
students exhibited the lowest ICP Scores for both age groups. In other words, ICP Scores in CD-ROMa and CD-ROMb and SO conditions appear higher (although not statistically significantly) than the observed ICP Scores in the OMS condition. These two trends are further discussed in Chapter Five.



**Figure 4.2. Estimated Marginal Means of Story Sequencing Task Score**



**Figure 4.3. Estimated Marginal Means of Explicit Comprehension Probes Scores**



**Figure 4.4. Estimated Marginal Means of Implicit Comprehension Probes Scores**

***Post-hoc tests.***

Because of the significant multivariate test in Table 4.10, post-hoc *F-Scheffe's* tests were run to determine whether there were any significant pairwise differences by Condition. For these tests, the critical  $F_{(3, 129)} = 2.68$  was adjusted to a critical *F-Scheffe* = 8.04. All of these comparisons yielded non-significant results; despite significant multivariate differences in the combined effect of the DVs by Condition, the mean differences on any given DV could not be attributed to any pair of conditions.



***Planned comparison for effect of presentation features.***

The planned comparisons that were run for the univariate sample (reported above) were repeated with the multivariate command in SPSS. The goal of these planned comparisons was to try to determine whether the differences in presentation features reported in Table 3.2 resulted in any noticeable differences in observed DV means. Here, the objective was to isolate differences in the duration (longer v. shorter), filmic effects (full animation v. static images and any kind of animation v. static images), WPM (quick-paced reading v. more slowly read), extra-textual discourse (supports automatically present v. no supports present) and interactivity (i.e., hotspots). The design of the presentation formats does not really permit the isolation of a single presentation format feature so the planned comparisons are a bit confounded in that multiple features are really being tested in each comparison. Nonetheless, these planned comparisons serve as important first steps in determining which presentation features are more likely to be associated with the multivariate differences in the observed DV scores.

Results of two of the seven planned contrast comparisons are reported here. The other five planned contrast comparisons were not nearly significant at the  $\alpha = .007$  level ( $\alpha = .05$  divided by seven comparisons). The test for extra-textual discourse shows an overall significant difference,  $\lambda = .902$ ,  $F_{(3, 127)} = 4.62$ ,  $p = .004$ , and a difference approaching significance in mean ECP Scores for CD-ROMa compared to OMS & SO together,  $F_{(1, 129)} = 4.06$ ,  $p = .046$ . This is the same planned comparison that was discussed for the four-year-old sample in the univariate analysis, above.

A second planned contrast comparison also yields a multivariate effect approaching significance. The test for filmic features (full animation vs. static images omitting the modified animation present in the SO condition) is approaching significance,  $\lambda = .939$ ,  $F_{(3, 127)} = 2.73$ ,  $p = .05$ , for the effect on the combined DVs, but no univariate effects are detected. In other words,

the filmic effects of animation may help facilitate better overall story understanding, but the benefits cannot be attributed to any specific dependent measure independent of the other two dependent measures.

### **Research Question Two**

To answer the second set of research questions, whether there is a relationship among individual differences in knowledge and interest and story comprehension, multiple regression methods were employed. The first step in these analyses was to examine the data set for problems. Missing data analysis and tests for outliers were carried out. Tests for the assumptions of multiple regression followed. Tabachnik and Fidell (2007) recommend evaluating normality, linearity, homoscedasticity, independence of residuals, and multicollinearity. After testing for assumptions, the next step was to run the multiple regression analysis. Three separate sequential multiple regression models were created in SPSS by entering PPVT Standard Score into the first step of the analysis to determine how much variance in the dependent measures could be accounted for by differences in PPVT Standard Score. The second step entry of Revised ATK Score and COS Score determined whether there was a significant increase in  $R^2$  when differences in topic knowledge (Revised ATK Score) and computer skill (COS Score) are added into the equation. PPVT Standard Score was entered first because, as discussed in Chapter Two, this measure is a global measure of receptive vocabulary and serves as a proxy for general background knowledge. Topic knowledge and computer skill represent more localized forms of background knowledge. The goal was to determine whether these more specific forms of knowledge accounted for any additional variance in listening comprehension measures beyond that accounted for by PPVT SS. As such Revised ATK Score and COS Score were reserved for the second step of these regression models.

**Missing data and problematic measures.**

Random missing data constituted less than five percent of missing data. Tabachnik and Fidell (2007) recommend deleting cases with random missing data and so these cases were not included in analysis. The sample sizes in subsequent analyses vary as a function of these instances of random missing data.

There was one instance of nonrandom missing data present in the Pre-Kindergarten Interest Survey measure (PKIS). Because the PKIS was a parent survey, approximately 50% of participants were missing these data. Missing data analysis revealed a pattern associated with the participants' classrooms. Conversation with classroom teachers indicated that participants whose teachers sent home surveys in children's backpacks had more missing PKIS data than students in classrooms where teachers asked parents to complete the PKIS at parent-teacher conferences held in the school. A sample size of 74 does not provide enough power for the multiple regression analysis required to answer the second research question. For this reason, the PKIS was dropped from analysis.

**Outliers.**

Because this research is concerned with the overall predictive value of the knowledge variables, Cook's D was employed to identify outliers for each dependent measure. None of the cases produced Cook's D values greater than .9 for any dependent variable so all cases without missing data were included in the analyses that follow.

**Evaluation of assumptions.**

All of the assumptions of regression were evaluated prior to running and parametric analyses. The results from the assumption tests are presented below.

***Normality.***

The first step in analysis was to examine frequency of each univariate variable. Continuous and categorical data that fell out of appropriate ranges were reexamined for entry errors and then rectified. Tests for normality (see Tables 4.12 through 4.14) indicate moderate violations to normality, particularly with respect to a negative skew on the independent variables and a positive skew on the dependent variables. Table 4.11 indicates a floor effect for SRT Score as students' performance on the Story Retelling Task and the overall means for this measure were well below the possible maximum score of 17 points. In the same table the maximum score recorded on the Implicit Comprehension Probe measure is three points below the maximum possible. This is likely due to one item on the measure that did not perform as well as the other items (see discussion in Chapter Three).

**Table 4.12. Tests for Normality – Knowledge Variables (IVs)**

|                   | Descriptive Statistics |          |      |       |       |       |           |     |           |     |
|-------------------|------------------------|----------|------|-------|-------|-------|-----------|-----|-----------|-----|
|                   | N                      | Possible | Min  | Max   | Mean  | SD    | Skewness  |     | Kurtosis  |     |
|                   |                        | Range    |      |       |       |       | Statistic | SE  | Statistic | SE  |
| Revised ATK Score | 136                    | 0-12     | 1.00 | 11.00 | 7.21  | 2.46  | -.43      | .21 | -.75      | .41 |
| COS Score         | 136                    | 0-42     | .00  | 40.00 | 29.98 | 9.74  | -1.76     | .21 | 2.76      | .41 |
| PPVT SS           | 136                    | 20-160   | 60   | 123   | 94.50 | 12.85 | -.134     | .21 | -.39      | .41 |

**Table 4.13. Tests for Normality – Interest Variables (IVs)**

|                     | N   | Possible | Min  | Max  | Mean | SD  | Skewness  |     | Kurtosis  |     |
|---------------------|-----|----------|------|------|------|-----|-----------|-----|-----------|-----|
|                     |     | Range    |      |      |      |     |           |     |           |     |
|                     |     |          |      |      |      |     | Statistic | SE  | Statistic | SE  |
| CIP tech subscale   | 136 | 0-3      | 1.00 | 3.00 | 2.79 | .50 | -2.10     | .21 | 4.36      | .41 |
| CIP animal subscale | 136 | 0-3      | .33  | 3.00 | 2.33 | .63 | -.74      | .21 | -.14      | .41 |
| CIP story subscale  | 136 | 0-3      | .00  | 3.00 | 2.21 | .94 | -.99      | .21 | -.02      | .41 |

**Table 4.14. Tests for Normality – Outcome Measures (DVs)**

|           | Descriptive Statistics |          |     |      |      |      |           |     |           |     |
|-----------|------------------------|----------|-----|------|------|------|-----------|-----|-----------|-----|
|           | N                      | Possible | Min | Max  | Mean | SD   | Skewness  |     | Kurtosis  |     |
|           |                        | Range    |     |      |      |      | Statistic | SE  | Statistic | SE  |
| SRT Score | 136                    | 0-17     | .00 | 9.00 | 1.93 | 2.02 | 1.27      | .21 | 1.50      | .41 |
| SST Score | 136                    | 0-6      | .00 | 6.00 | 1.84 | 1.99 | .85       | .21 | -.48      | .41 |
| ECP Score | 136                    | 0-8      | .00 | 8.00 | 3.99 | 2.46 | -.15      | .21 | -.99      | .41 |
| ICP Score | 136                    | 0-12     | .00 | 9.00 | 3.01 | 2.69 | .49       | .21 | -.84      | .41 |

The CIP and the PKIS were used to measure children's interest in technology, stories, and animals. PKIS missing data analysis indicated a non-random missing data pattern and were dropped from analysis. Although CIP data were collected on the entire sample as part of the pretest measures, a ceiling effect was present as evidenced in Table 4.13. As such, CIP data were not entered into any further analyses.

The participants in this study were not able to freely recall and retell story events as evidenced by the exceptionally low mean and the problematic values of the skewness, and

kurtosis statistics and standard errors for the Story Retelling Task in Table 4.3. The maximum scores and the mean for the SRT in Table 4.3 were so low that a floor effect is apparent. And although inter-rater reliability was acceptable (98.5 % agreement between two raters) for this measure, SRT data were not analyzed any further.

### ***Linearity.***

Scatterplots were used to evaluate the assumptions of linearity. These plots are not shown here, but it should be noted that all plots yielded linear relations between each of the dependent measures and the predictor variables. Bivariate correlations for these relationships can be found in Table 4.15. Among the IVs, the bivariate correlation between PPVT SS and Revised ATK Score is high; children who scored high on the PPVT SS measure also scored high on the ATK measure. Although this analysis is not evaluating the relationship among the DVs the degree to which children who attained high ECP Scores generally also attained higher ICP Scores is striking.

**Table 4.15. Bivariate Correlations: Predictor Variables x Dependent Measures (N = 137)**

|                   | PPVT<br>SS | Revised<br>ATK<br>Score | COS<br>Score | SST<br>Score | ECP<br>Score | ICP<br>Score |
|-------------------|------------|-------------------------|--------------|--------------|--------------|--------------|
| PPVT SS           | 1          |                         |              |              |              |              |
| Revised ATK Score | .585**     | 1                       |              |              |              |              |
| COS Score         | .238**     | .368**                  | 1            |              |              |              |
| SST Score         | .134       | .201*                   | .179*        | 1            |              |              |
| ECP Score         | .459**     | .625**                  | .384**       | .369**       | 1            |              |
| ICP Score         | .439**     | .535**                  | .360**       | .236**       | .707**       | 1            |

\*\* . Correlation is significant at the 0.01 level (2-tailed).

\* . Correlation is significant at the 0.05 level (2-tailed).

***Homoscedasticity.***

Homoscedasticity tests were run to assess the equivalence of variance across values of the predictor variables. Graphical methods were employed to test this assumption. Residuals were plotted against each of the predictor variables for each of the three dependent measures. The Loess lines in the residual v. predictor variables scatterplots generally followed the 0-line for each predictor in every model. Furthermore, the Loess lines in the residual versus predicted values plots also followed the 0-lines. Therefore, the assumption of homoscedasticity was met.

***Independence of residuals.***

This assumption is commonly not met when the design of a study yields clusters of data with similar trends. Because the sample was randomly assigned to story listening condition the test for this assumption, plotting the residual against the student id number, does not yield any violations.

***Multicollinearity.***

Multicollinearity typically exists when highly correlated independent variables are included in the same regression model. Issues of multicollinearity can lead to difficult to interpret regression coefficients, large standard error estimates, and wide confidence intervals. Collinearity diagnostics typically employ tolerance as a measure of the amount of independence one IV has of the other IVs in the regression model. Squared multiple correlation analyses of the predictor variables yielded tolerance greater than .1 for all IVs, indicating that the assumption of multicollinearity was met. As such, regression was pursued.

### Story Sequencing Task Score as the dependent variable.

The analysis tested whether the knowledge variables, PPVT SS, Revised ATK Score, and COS Score, predicted student scores on the Story Sequencing Task. A regression model with the three predictors account for 5.0% of the variance in SST Score for this sample,  $R^2 = .050$ ,  $F_{(3, 132)} = 2.33$ ,  $p = .077$ , a non-significant amount. Table 4.16 shows neither Revised ATK Score nor COS Score constituting a significant portion of the variance in the model. The partial correlations indicate that 1.6% of the full variance in SST Score is attributable to the unique contribution of the Revised ATK Score and that 1% of the variance in the SST Score is uniquely attributable to COS Score when the other variables are controlled. Zero percent of the variance in SST scores is uniquely attributable to PPVT SS in Table 4.16.

**Table 4.16. Regression Coefficients<sup>a</sup>: Story Sequencing Task Score as Dependent Variable**

| Model             | Unstandardized Coefficients |      | Standardized Coefficients | t    | sig. | Correlations |         |      | Collinearity Statistics |      |
|-------------------|-----------------------------|------|---------------------------|------|------|--------------|---------|------|-------------------------|------|
|                   | B                           | SE   | $\beta$                   |      |      | Zero-order   | Partial | Part | Tolerance               | VIF  |
| (Constant)        | .43                         | 1.34 |                           | .32  | .75  |              |         |      |                         |      |
| PPVT SS           | -.00                        | .02  | -.02                      | -.16 | .87  | .11          | -.01    | -.01 | .66                     | 1.52 |
| Revised ATK Score | .14                         | .09  | .17                       | 1.57 | .12  | .21          | .14     | .14  | .60                     | 1.67 |
| COS Score         | .02                         | .02  | .11                       | 1.15 | .25  | .17          | .10     | .10  | .86                     | 1.16 |

a. Dependent Variable: SST Score

The regression model with SST score was re-run without PPVT SS because analysis for the first research question associated with this dissertation indicate that PPVT SS is not a good



covariate for SST Score. This run yielded an overall significant model,  $R^2 = .050$ ,  $F_{(2, 133)} = 3.51$ ,  $p = .033$ , but neither predictor, COS Score or Revised ATK Score, held enough of the variance independently of the other SST Score to be identified as a significant predictor of this dependent measure.

### **Explicit Comprehension Probe Score as the dependent variable.**

This analysis tested whether the knowledge variables, PPVT SS, Revised ATK Score, and COS Score, predicted student scores on the Explicit Comprehension Probes. When PPVT SS alone is entered into SPSS REGRESSION, this variable accounts for 21.3% of the variance in the ECP Score, a significant amount,  $F_{(1, 134)} = 36.438$ ,  $p = .000$ . The addition of Revised ATK Score and COS Score into the regression model results in a significant  $R^2$  change, .215, with a corresponding F-change statistic,  $F_{\text{change } (2, 147)} = 24.796$ ,  $p = .000$ . The three predictors together account for 42.8%, a large amount, of the variance in ECP Score for this sample,  $R^2 = .428$ ,  $F_{(3, 132)} = 32.99$ ,  $p = .000$ . The unique contributions for two of the three predictors are significant in Table 4.17. Specifically, the partial correlations indicate that 19.5% of the total variance in ECP Score is uniquely attributable to the Revised ATK Score and that an additional 4.0% is uniquely attributable to COS Score. Only 2.4% of the variance in ECP Score is uniquely attributable to PPVT SS. In other words, this regression model leaves a large amount of the variance in ECP Score shared among the three variables.

**Table 4.17. Regression Coefficients<sup>a</sup>: Explicit Comprehension Probes Score as Dependent Variable**

| Model             | Unstandardized Coefficients |      | Standardized Coefficients | t     | sig. | Correlations |         |      | Collinearity Statistics |      |
|-------------------|-----------------------------|------|---------------------------|-------|------|--------------|---------|------|-------------------------|------|
|                   | B                           | SE   | $\beta$                   |       |      | Zero-order   | Partial | Part | Tolerance               | VIF  |
| (Constant)        | -3.33                       | 1.27 |                           | -2.61 | .01  |              |         |      |                         |      |
| PPVT SS           | .03                         | .02  | .15                       | 1.80  | .08  | .46          | .15     | .12  | .66                     | 1.52 |
| Revised ATK Score | .48                         | .08  | .48                       | 5.62  | .00  | .63          | .44     | .37  | .60                     | 1.67 |
| COS Score         | .04                         | .02  | .17                       | 2.36  | .02  | .38          | .20     | .16  | .86                     | 1.16 |

a. Dependent Variable: ECP Score

### **Implicit Comprehension Probe Score as the dependent variable.**

The third model tested whether the knowledge variables, PPVT SS, Revised ATK Score, and COS Score, predicted student scores on the Implicit Comprehension Probes. When PPVT SS alone is entered into SPSS REGRESSION this variable accounts for 18.7% of the variance in the ICP Score, a significant amount,  $F_{(1, 134)} = 30.88, p = .000$ . After controlling for the contribution of PPVT SS, the addition of Revised ATK Score and COS Score into the regression model results in a significant  $R^2$  change, .147, with a significant corresponding  $F$ -change statistic,  $F\text{-change}_{(2, 132)} = 14.55, p = .000$ . The three predictors together account one-third, 33.4%, of the variance in ICP Score for this sample,  $R^2 = .334, F_{(3, 132)} = 22.077, p = .000$ . The unique contributions of all three predictors in Table 4.18 are significant. Specifically, the partial correlations indicate that 10.8% of the total variance in ICP Score is uniquely attributable to the Revised ATK Score and that an additional 3.7% is uniquely attributable to COS Score. 3.1% of

the variance in ICP Score is uniquely attributable to PPVT SS. In other words, this regression model indicates a large amount of the variance in ICP Score is shared among these three variables.

**Table 4.18. Regression Coefficients<sup>a</sup>: Implicit Comprehension Probes Score as Dependent Variable**

| Model             | Unstandardized Coefficients |      | Standardized Coefficients | t     | sig. | Correlations |         |      | Collinearity Statistics |      |
|-------------------|-----------------------------|------|---------------------------|-------|------|--------------|---------|------|-------------------------|------|
|                   | B                           | SE   | $\beta$                   |       |      | Zero-order   | Partial | Part | Tolerance               | VIF  |
| (Constant)        | -4.89                       | 1.51 |                           | -3.23 | .00  |              |         |      |                         |      |
| PPVT SS           | .04                         | .02  | .18                       | 2.05  | .04  | .43          | .18     | .15  | .66                     | 1.52 |
| Revised ATK Score | .40                         | .10  | .37                       | 4.00  | .00  | .54          | .33     | .28  | .60                     | 1.67 |
| COS Score         | .045                        | .02  | .17                       | 2.26  | .03  | .35          | .19     | .16  | .86                     | 1.16 |

a. Dependent Variable: ICP Score

### **Additional analyses for research question two.**

In addition to the regression analyses to test the efficacy of the knowledge variables as a predictor of listening comprehension, a series of additional analyses were carried out to determine whether variation in the strength of each predictor changed as a function of the participants' age. For the following analyses the models reported in Tables 4.16 through 4.18 were re-entered into an SPSS REGRESSION function first with a file split by Age. For this analysis each participant was classified as either a three-year-old or a four-year-old. All children who were age-eligible for kindergarten the following fall were classified as four-years-old. Afterward, the SPSS REGRESSION commands were repeated for the entire file with Age

entered as a two level dummy variable in the second step of entry. Results from these additional SPSS runs were corroborated with the results presented in Tables 4.16 through 4.18.

### **Age and Story Sequencing Task Score.**

When the regression model for SST Score (Table 4.16) is run with a split file by age (three- and four- year olds) in SPSS, neither model yields significant results. In other words, the non-significance of PPVT SS, COS Score, and Revised ATK Score is more or less equally distributed between the two age groups. The additional SPSS run with Age as a dummy variable also confirmed that Age does not account for a significant portion of the variance in SST Scores.

### **Age and Explicit Comprehension Probes Score.**

When the regression model for ECP Score (Table 4.17) was run in SPSS with Age as a two-level dummy variable in the second step of entry, Age did not come up as a significant predictor of any measure of listening comprehension. When the file was split by Age the models for both the three-year-old participants,  $R^2 = .433$ ,  $F_{(3, 53)} = 13.47$ ,  $p = .000$ , and four-year-old participants,  $R^2 = .346$ ,  $F_{(3, 75)} = 13.223$ ,  $p = .000$ , are still significant. Moreover, these age-based models in Tables 4.19 and 4.20 show COS Score is a more relevant predictor of ECP score for the three-year-old sample than for the four-year-old sample. The partial correlations in these tables indicate that computer knowledge (COS Score) accounts for 7.3% of the unique variance in ECP Score for three-year-olds and 1.25% of the variance in ECP Score for the four-year-olds. Also, topic knowledge (Revised ATK Score) is a stronger predictor of explicit comprehension (ECP Score) in the four-year-old sample than it is for the three-year-old sample. The partial correlation squared shows that this variable accounts for 11.4% of the unique variance in explicit comprehension (ECP Score) in three-year-olds and 18.1% of the unique variance in explicit comprehension (ECP Score) in four-year-olds.

**Table 4.19. Regression Coefficients<sup>a</sup> : Three-year-old Sample with Explicit Comprehension Probes Score as Dependent Variable (n = 56)**

| Model             | Unstandardized Coefficients |      | Standardized Coefficients | t     | sig. | Correlations |         |      | Collinearity Statistics |      |
|-------------------|-----------------------------|------|---------------------------|-------|------|--------------|---------|------|-------------------------|------|
|                   | B                           | SE   | $\beta$                   |       |      | Zero-order   | Partial | Part | Tolerance               | VIF  |
| (Constant)        | -4.37                       | 1.99 |                           | -2.20 | .03  |              |         |      |                         |      |
| PPVT SS           | .042                        | .025 | .231                      | 1.68  | .10  | .52          | .22     | .17  | .57                     | 1.77 |
| Revised ATK Score | .386                        | .147 | .375                      | 2.63  | .01  | .60          | .34     | .27  | .53                     | 1.91 |
| COS Score         | .047                        | .023 | .224                      | 2.05  | .05  | .39          | .27     | .21  | .89                     | 1.12 |

a. Dependent Variable: ECP Score

**Table 4.20. Regression Coefficients<sup>a</sup> : Four-year-old Sample with Explicit Comprehension Probes Score as Dependent Variable (n = 78)**

| Model             | Unstandardized Coefficients |      | Standardized Coefficients | t     | sig. | Correlations |         |      | Collinearity Statistics |      |
|-------------------|-----------------------------|------|---------------------------|-------|------|--------------|---------|------|-------------------------|------|
|                   | B                           | SE   | $\beta$                   |       |      | Zero-order   | Partial | Part | Tolerance               | VIF  |
| (Constant)        | -2.62                       | 1.77 |                           | -1.48 | .14  |              |         |      |                         |      |
| PPVT SS           | .02                         | .02  | .12                       | 1.05  | .30  | .43          | .12     | .10  | .63                     | 1.58 |
| Revised ATK Score | .50                         | .12  | .47                       | 4.07  | .00  | .57          | .43     | .38  | .64                     | 1.55 |
| COS Score         | .03                         | .03  | .10                       | .99   | .33  | .25          | .11     | .09  | .91                     | 1.10 |

a. Dependent Variable: ECP Score

**Age and Implicit Comprehension Probe Score.**

When the regression model with ICP Score as the DV (Table 4.18) is run in SPSS with a file split by age, the models for both the three-year-old participants,  $R^2 = .301$ ,  $F_{(3, 53)} = 7.612$ ,  $p$

= .000, and four-year-old participants,  $R^2 = .305$ ,  $F_{(3, 75)} = 10.949$ ,  $p = .000$ , are still significant. Moreover, these age-based models in Tables 4.21 and 4.22 show computer knowledge (COS Score) is a more relevant predictor of implicit comprehension (ICP Score) for the three-year-old sample than for the four-year-old sample. The partial correlations in these tables indicate that COS Score predictor uniquely accounts for 8.12% of the variance in ICP Score for three-year-olds and less than 1% of the variance in ICP Score for the four-year-olds. Also, more of the unique variance in ICP Score in the four-year-old sample is attributable to the PPVT SS than it is for the three-year-old sample. The partial correlation squared shows that this variable uniquely accounts for 7.40% of the variance in ICP Score in four-year-olds and less than 1% of the variance in ICP Score in three-year-olds.

**Table 4.21. Regression Coefficients<sup>a</sup>: Three-year-old Sample with ICP Score as Dependent Variable (n = 56)**

| Model             | Unstandardized Coefficients |      | Standardized Coefficients<br>$\beta$ | t     | sig. | Correlations |         |      | Collinearity Statistics |      |
|-------------------|-----------------------------|------|--------------------------------------|-------|------|--------------|---------|------|-------------------------|------|
|                   | B                           | SE   |                                      |       |      | Zero-order   | Partial | Part | Tolerance               | VIF  |
| (Constant)        | -3.15                       | 2.28 |                                      | -1.38 | .17  |              |         |      |                         |      |
| PPVT SS           | .02                         | .03  | .09                                  | .59   | .55  | .37          | .08     | .07  | .57                     | 1.77 |
| Revised ATK Score | .36                         | .17  | .34                                  | 2.15  | .04  | .49          | .28     | .25  | .53                     | 1.91 |
| COS Score         | .06                         | .03  | .26                                  | 2.16  | .04  | .39          | .29     | .25  | .89                     | 1.12 |

a. Dependent Variable: ICP Score

**Table 4.22. Regression Coefficients<sup>a</sup>: Four-year-old Sample with Implicit Comprehension Probe Score as Dependent Variable (n = 78)**

| Model             | Unstandardized Coefficients |      | Standardized Coefficients $\beta$ | t     | sig. | Correlations |         |      | Collinearity Statistics |      |
|-------------------|-----------------------------|------|-----------------------------------|-------|------|--------------|---------|------|-------------------------|------|
|                   | B                           | SE   |                                   |       |      | Zero-order   | Partial | Part | Tolerance               | VIF  |
| (Constant)        | -5.96                       | 2.11 |                                   | -2.82 | .00  |              |         |      |                         |      |
| PPVT SS           | .06                         | .03  | .30                               | 2.45  | .02  | .49          | .27     | .24  | .63                     | 1.58 |
| Revised ATK Score | .37                         | .15  | .30                               | 2.53  | .01  | .49          | .28     | .24  | .64                     | 1.55 |
| COS Score         | .02                         | .04  | .05                               | .493  | .62  | .21          | .06     | .05  | .91                     | 1.10 |

a. Dependent Variable: ICP Score

## Summary of Analyses

### Research question one.

The first set of research questions sought to test the effect of the text—as presented in each story listening condition—on four measures of listening comprehension. Analyses indicate:

- After their first listen, three- and four-year-old children had a difficult time freely recalling the events of *Stellaluna* no matter the story listening condition—they fared better sequencing story events on picture cards and responding to open-ended probes for comprehension.
- There was no significant univariate effect of story listening condition on the measures of listening comprehension employed in this study.

Additional analyses beyond the scope of the research questions associated with this dissertation were run to tease out factors that may have been intervening. These analyses indicate:

- PPVT Standard Score is an acceptable covariate for explicit and implicit comprehension probes, but not for story sequencing. The kind of analytical thinking associated with the Story Sequencing Task likely appeals to some combination of ordering and story memory skills.
- According to Informal Reading Inventory scoring criteria of 70% for Instructional Level or 90% for Independent Level (Gillet, Temple, Temple, & Crawford, 2011), it can be concluded that very few children were able to comprehend the digital story. Observed means were well below 70 percent of items correct for the Explicit and Implicit Comprehension Probes (see Tables 4.2 and 4.7), with less than 15% of the sample exhibiting either ECP or ICP scores with greater than 70% correct. In general, though, children who exhibited higher explicit comprehension of *Stellaluna* also tended to exhibit higher implicit comprehension.
- Age factored significantly in univariate and multivariate tests of listening comprehension. Four-year-old children consistently achieved better scores on all measures of listening comprehension across all story listening conditions.
- Non-random patterns of task completion/incompletion indicate that the CD-ROMb story listening condition was least engaging and that the SO listening condition was most engaging for both age groups. These patterns exhibited little relationship to story listening comprehension as measured in this study.



- There are multivariate effects of Condition and Age on the combination of the three dependent measures, but no Condition x Age interaction was observed. The differences in story listening comprehension cannot be statistically attributed to any specific story listening condition over another.
- The identified differences in story listening conditions discussed in Chapter Three (Table 3.2) yielded no significant differences in listening comprehension for this sample as measured by the story recall and story sequencing tasks and by the implicit comprehension probes for listening comprehension. Significance testing found that embedded extra-textual discourse in digital storybooks could provide additional support for multiple measures of story listening comprehension, and it is likely that these kinds of additional supports bolster explicit comprehension the most. In addition, the filmic features of animation are also likely to support story listening comprehension more than still images.

**Research question two.**

The second set of research questions sought to determine the predictive value of knowledge and interest with respect to listening comprehension of digital storybooks. Analyses indicate:

- Quantitative, Likert-based methods of inquiry *exclusive of* qualitative triangulation are insufficient measures of preschoolers' emergent interests. These measures yielded ceiling effects and little variability—nearly all children were interested in everything.
- Receptive vocabulary (as measured by PPVT SS), domain knowledge (as measured by COS Score) and topic knowledge (as measured by Revised ATK score) are not

- significant predictors of story sequencing for any age group participating in this study.
- Receptive vocabulary (as measured by PPVT SS), domain knowledge (as measured by COS Score) and topic knowledge (as measured by Revised ATK score) are significant predictors of both explicit and implicit comprehension. These predictors are significant for both three- and four-year-old participants.
  - The majority of the variance in outcome measures of story listening comprehension was shared among the predictor variables, with topic knowledge (as measured by Revised ATK Score) accounting for the largest amount of unique variance in both explicit and implicit comprehension.

Additional analyses for the second set of research questions indicate that:

- The measure of computer skill (COS Score) accounted for larger amounts of unique variance in the three-year-old sample than in the four-year-old sample. In other words, the younger participants who were also less skilled in the domain of computers tended to exhibit lower scores on measures of explicit and implicit comprehension than those with better scores on the measure of computer knowledge. Also, the older participants who were more skilled in the domain of computers tended to exhibit higher scores on measures of explicit and implicit comprehension than those with lower scores on the measure of computer knowledge.

## CHAPTER V: DISCUSSION

The primary purpose of this study was to contribute to the field's developing understandings of young children's story listening comprehension in a digital context. The cognitive framework employed permitted examination of variables from the listener, the text, and the activity. This framework also shapes and colors the discussion of findings presented in this chapter. For simplicity and organization, each research question is discussed separately; and a general discussion of the implications, limitations and directions for future research complete this chapter.

### **Discussion: Research Question One**

The RAND Framework for Story Comprehension presented in Figure 2.2 posits that the text, the activity and the listener are key components of listening comprehension. The first part of this dissertation examined features of the text and activity and their relation to preschoolers' story listening comprehension; asking the extent to which the design of the four presentation formats supported listening comprehension. Previous literature examining story understanding consequent from digital and traditional story listening activities has significant gaps, particularly associated with this age group and generally associated with the multiple components of story understanding. Moreover, knowledge about CD-ROM based digital storybooks is outdated (i.e., some CD-ROM storybooks are not compatible with the most recent computer operating systems). Accordingly, the conclusions in the extant literature base do not allow transfer to other forms of digital storybooks as they inherently differ from CD-ROM storybooks in the features of animation, extra-textual discourse, and interactivity (Paciga, 2009). The discussion of the results related to these gaps in the literature duly focuses on these areas—the presentation features of

digital storybooks, the participants' age, and the components of story understanding—and relates them back to the larger body of literature on listening comprehension.

### **Effects of presentation format on listening comprehension.**

The first research question asked whether the identified differences in the design and presentation features of the four versions of *Stellaluna* (Cannon, 1993) employed in this study adequately supported preschoolers' listening comprehension and whether any identified differences in the presentation features (see Table 3.2) exhibited differential effects on the dependent measures. The univariate analyses presented in Chapter Four indicated that, when listening comprehension outcomes were considered individually, there was no differential effect of presentation format.

Presentation format did, however, lead to statistically significant differences in the multivariate analyses. In other words, after accounting for the shared variance of the dependent measures, presentation format was a significant factor and accounted for 4.3 percent of the variance in measures of listening comprehension. Given that the four presentation formats overlapped in many presentation features (i.e., it was impossible to isolate any single presentation feature from Table 3.2), this small, but significant, difference in the dependent measures indicates a need for more research and exploration of the roles individual design features and combinations of features play in listening comprehension.

The plots of the estimated marginal means for the MANOVA analyses suggested that discussion about the effects of presentation format was worth pursuing in more depth. It is important to note, however, that the ensuing discussion is *not* based on the statistics or the significance associated with the observations. Rather, this discussion is intended to identify possible explanations for the visual trends in the plots.

Figure 4.2 for the Story Sequencing Task Score shows higher SST Scores in the OMS and SO conditions than in the CD-ROMa and CD-ROMb conditions. Although these differences were not statistically significant, perhaps the interruptions interspersed into the story line, contained in the CD-ROM versions, contributed to lower observed SST Scores. Labbo and Kuhn's (2000) results align with the trend observed in Figure 4.2 and with the hypothesis that such interruptions may reduce the likelihood of successful listening comprehension. On the other hand, de Jong and Bus (2004) found that the interactive features that presented interruptions into the story did not interfere with story understanding in "a context where adults also read books to young children" (p. 379), but it should also be kept in mind that their students had three opportunities to listen to and interact with the digital text, or a higher dosage compared to the single exposure to text in this study.

With respect to explicit listening comprehension (ECP Score), Figure 4.3 shows differences in the CD-ROMa condition compared to the other conditions. The planned comparison intended to examine the role of extra-textual supports. To complete this examination, the presentation format with automatic extra-textual supports (CD-ROMa) was paired with the two presentation formats without any extra-textual supports (SO and OMS together). Results of this test approached significance. In addition, the comparison intended to examine the role of animations that paired the fully animated presentation formats (CD-ROMa and CD-ROMb) against the presentation formats with still images (OMS) together with minimal animations (i.e., zooms to still images; SO) also approached significance after the same adjustment. Perhaps it is the case that the omission of dialogue carriers and concomitant animation of characters in the animated formats (CD-ROMa and CD-ROMb) offer children a more contextualized language than the decontextualized language of the other two formats, which are read verbatim from the

printed text (OMS and SO). In this scenario, it is sensible that ECP Scores were higher for the CD-ROMa condition because contextualized language is typically easier to understand than decontextualized language (De Temple & Snow, 2003).

In regard to the plots of the Implicit Comprehension Probes Score (ICP Score; Figure 4.4), the lowest observed scores for this measure appeared in the OMS condition. This condition contained still images rather than animations. As such, participants assigned to this condition did not witness any of the enacted or embodied gestural cues present in the other story listening conditions. Perhaps the lower observed ICP Scores are associated with the phenomenon observed in several experiments wherein students in treatment conditions that included gestural cues attained higher scores on measures of understanding (Church, et al., 2004; Verhallen, et al., 2006).

A second defining characteristic of the OMS presentation format is that the narration exhibited moderate changes in tone of voice, rather than the more extreme highs and lows associated with more dramatic readings (see Figure 3.0c). Despite the literature base suggesting the important role of the reader's pitch, intonation, stress, rhythm, and accent (Cruttenden, 1986; Dickinson & Keebler, 1989; Teale, 2003), it remains largely unknown whether the moderate tone of voice pattern present in the OMS format (see Figure 3.0b) independent of the other presentation features (see Table 3.2) could have factored into the lower observed ICP scores for this story listening condition. The CD-ROM conditions also exhibited moderate changes in tone of voice and, by effect, muddled the results of the planned comparisons discussed in Chapter Four. The SO condition, with intense or dramatic changes in tone of voice, yielded the highest scores for the three-year-old participants but not for the four-year-olds (see Figure 4.4). Perhaps this study exhibited a phenomenon noted by Smiley and Huttenlocher (1991) wherein children of

approximately four and one-half years of age had accrued enough life experiences that they were able to appropriately infer character emotions in the absence of dramatic language.

Although not directly tied to outcome measures of listening comprehension, a clear effect of presentation format emerged for trends in task completion. Nonparametric analyses indicated that the lowest percentage of students completing the story listening task was in the CD-ROMb, condition and that the highest percentage \was in the SO condition (see Table 4.7). Two factors may have contributed to these results; however, these are suppositions and are not empirically supported. First, the CD-ROMb and the OMS presentation formats required students to interact with, or click, the screen to move to the next page of the story. The ECP and ICP Scores for both of these groups were the lowest for the three-year-old participants. The analysis and results for the second research question indicated that computer knowledge and skill (COS Score) accounted for more unique variance in younger students. Perhaps the child's ability to control a mouse and interact with digital media acted as an intervening variable in this instance. Second, the SO presentation format endured for approximately 11 minutes and the CD-ROMb format was open-ended, with a minimum duration of approximately 25 minutes. Research on classroom read alouds suggests that preschoolers' engagement is optimal for book reading activities that endure for 12 to 20 minutes in length (Paciga, et al., 2009), and this study does not refute these findings when children interact with digital storybooks.

The non-significant difference in listening comprehension among presentation formats, then, begs the question: Why? It turned out that the dependent measures exhibited lower than anticipated means and, accordingly, a restricted range and limited variability in observed comprehension scores, creating a bit of a statistical conundrum wherein achieving significant

differences in group means is near impossible. Causes for the low observed scores on the comprehension measures could be explained three ways.

First, it could be argued that *Stellaluna* is simply too difficult for this population. There is no doubt that *Stellaluna* is a challenging text, but there are other equally challenging texts (e.g., *Make Way For Ducklings* [McCloskey, 1941]) in published preschool curricula (e.g., Schickedanz, Dickinson, & Charlotte-Mecklenberg Schools, 2006) that are approved under the guidelines of Early Reading First and have been used successfully with children in the sample of this study. It is important to note that teachers' guides recommend that these kinds of challenging fiction texts be read aloud three to five times and also that teachers need to build background knowledge, support vocabulary, and monitor children's understanding throughout the book reading events. Opportunities for children to respond and interact with the reader and the text are presented during the book reading event and throughout the school day.

Secondly, the design for this study called for a single storybook interaction. It is possible that additional opportunities to interact with the digital storybook could have yielded better listening comprehension. Some of the existing research on CD-ROM storybooks has, in fact, employed multiple text exposures (e.g., de Jong & Bus, 2002, 2004; Korat & Shamir, 2007), and research on traditional (i.e. person-to-person) read alouds suggests that stories are best understood after multiple interactions with the text (e.g., McGee & Schickedanz, 2007; Morrow, 1988). In many cases, challenging texts are encountered in published preschool curricula (e.g., Schickedanz, et al., 2006) over a longer period of time (i.e., 3-5 weeks). The corpus of research with digital storybooks, however, presents less clear results regarding comprehension and indicates that children engage in the interactive features of the storybook environment after the first experience; young children tend to only listen to the entire story one time when interacting



with stories on a computer (e.g., de Jong & Bus, 2002,2004). Therefore, this study elected to have children to interact with *Stellaluna* only one time.

Thirdly, and most plausibly, is that none of the existing presentation formats of *Stellaluna* provided adequate support for story comprehension for this sample of children. In other words, the existing design features of the digital storybook environments employed in this study did not contain sufficient supports for building the background and vocabulary knowledge or for processing the inferences and other plot connections requisite for understanding this story (see Table 3.1). None of the presentation formats probed to see whether children had basic understandings of the living habits of bats and birds before or during the story reading. Among the children in this sample were many low scores on the Assessment of Topic Knowledge, suggesting that the group held minimal knowledge about these topics. An excellent live teacher would have built background knowledge into the storybook reading event, perhaps briefly talking about the different places bats and birds live on the page where Stellaluna falls into the birds' nest and about the kinds of foods birds and bats eat when the characters are feasting during the book-reading. In addition, an excellent live teacher would likely expand on these topics during other times of the school day. In science they might look at diagrams of the bone structures of bats and birds and discuss why Stellaluna might have had difficulty landing upright on the branches. To further elaborate on the function of anatomy in grabbing and standing, a teacher might ask children to try to stand on their hands or pick up objects with their feet, thus providing them with important life experiences to connect with their growing understanding of the story.

A lack of explicitly defined key vocabulary words is another contributing factor to poor story understanding resultant from inadequate scaffolding. The best-case for expanding on

unknown words was presented in the animated aspects of the presentation formats (e.g., Stellaluna shakes for *trembling*), but the burden of deducting the meaning of the unknown word here is left with the preschool listener. In this scenario, the preschooler is left without an external prompt, to infer these new word meanings. There were neither opportunities for the computer to summarize or restate what nor were there prompts for children to initiate this kind of thought process independently in any of the presentation formats.

With regard to implicit text comprehension, none of the existing presentation formats supported children in drawing causal connections among the plot elements. The existing formats do not prompt children to infer. Moreover, they also do not complete the next step in teaching children how to draw causal connections—building on or connecting what known by the child to what is in the text. For example, the existing design of these digital storybook environments did not prompt children to recognize that Stellaluna did not want to eat the bugs. A child might have suggested (incorrectly) that she simply was not hungry or (correctly) that Stellaluna did not like bugs. In the latter example, however, the program did not ask, “*Why?*” (the answer being because fruit bats do not typically consume insects). Also absent from these designs were any sorts of questioning during or after the reading to prompt children to infer *why* Stellaluna was able to save the birds when they were flying in the dark. So, it is not surprising, then, that few children identified “eating different foods” and “seeing in the dark” as differences between bats and birds in their responses to the Implicit Comprehension Probes. Without piecing together the differences between bats and birds, then, a preschooler may appropriately conclude that Stellaluna probably prefers to live with the bats (and her mother), but would not be able to conclude that Stellaluna would prefer to live with the bats *because* fruit bats prefer to lead nocturnal lives, eat fruit, and hang by their feet.

## Age.

The RAND framework (Figure 2.2 [RAND Reading Study Group, 2002]) posits that variables unique to each story listener also factor into the ways he or she comprehends text. In this study, Age emerged as a variable warranting exploration. Children in this study were preschoolers; ranging from three to five years of age. Many benchmark studies in emergent literacy have documented the stark differences in children in this age range across a variety of literacy skills, including vocabulary (Hart & Risley, 1995; Konold, Juel, McKinnon, & Deffes, 2003; Storch & Whitehurst, 2002), alphabet knowledge (Mol, et al., 2009), phonological awareness (Wagner, et al., 1997), print and word awareness, (Ferreiro & Teberosky, 1982; Justice, Kadaverek, Fan, Sofka, & Hunt, 2009; Justice, McGinty, Piasta, Kadaverek, & Fan, 2010) and story understanding measured by emergent readings (Sulzby, 1985). Very few studies have employed a cross-sectional design permitting conclusions about preschool age differences in comprehension with respect to story free-recall, picture sequencing, and open-ended probes for explicit and implicit listening comprehension.

After a single listening experience with the digital storybook employed in this study, three- and four- year olds significantly differed in their ability to understand stories read aloud by the computer. These differences encompassed listening comprehension of content *explicitly presented* in the test and understanding that is *inferred from* the text. A similar trend in age was observed in Paris and Paris' study of narrative text comprehension (2003) in which scores for explicit and implicit comprehension probes rose with age. Studies that employed emergent reading of storybooks have also documented a general increase in story understanding as a function of age when all other factors (e.g., exposure to text) are constant (de Jong & Bus, 2002, 2004; Sulzby, 1985).

One might argue that the differences in these measures of comprehension associated with Age are the result of differences in oral language ability. Two arguments can refute this claim. First, the factorial ANCOVA described in Chapter Four suggests that Age remains a significant factor even after accounting for pre-existing differences in receptive vocabulary. Second, standard scores for the PPVT-4 (Dunn, 2005) served as the measure of receptive vocabulary employed in this study. The standard scores were normed by age, permitting comparison of different age groups.

There was no statistically significant difference between three- and four-year-olds' ability to freely recall story events or to sequence six pictures corresponding to key story events. The addition of more pictures to the task might produce more visible differences between these age groups, but memory is likely to be an intervening variable in such a scenario. Accordingly, this study concludes that free recall and story sequencing tasks independent of open-ended probes for comprehension are not sufficient for fully understanding the listening comprehension of three- and four-year old children.

### **Components of story understanding.**

This study examined story understanding with four dependent measures of listening comprehension. The first, free recall, essentially flat-lined, exhibiting floor effects for both age groups with little variability. Accordingly, these data were deemed unsuitable for parametric analyses in the present study. Others have employed similar measures with Kindergarten students (e.g., Morrow 1985, 1990; Paris & Paris, 2003) and older students (e.g., Doty, et al., 2001) with more success than was observed in the current study. The lowest scores for this measure in the Paris and Paris study (2003) were observed at the kindergarten level. In their study, Kindergarten students averaged a score of 2.4 (SD 1.8) of a possible six points (40%

correct) on the retelling measure. Scores increased with age by a factor of .75. If this factor is translated down the age spectrum to children who participated in this dissertation study, it could be assumed that four-year-olds would likely get 30% of retelling items correct and that three-year-olds would likely get 23% of retelling items correct. The observed scores in the Story Recall Task for this research were substantially lower, with threes averaging 10% of retelling items correct and fours averaging 13% of retelling items correct. One possible explanation for the difference in anticipated retelling scores and those observed in this dissertation study is that the participants in the Paris and Paris study were from “diverse socioeconomic backgrounds” (p. 43) and those in the present study were all from high-poverty schools, with nearly all qualifying for free- or reduced-price lunch status. It is well-documented that children in high-poverty are at-risk for reading failure and that the literacy achievement of this demographic is lower than observed literacy skills in demographics sampled from higher SES populations (Burchinal & Forestieri, 2010; Snow, et al., 1998; Stanovich, 1986).

Story sequencing served as the second measure of listening comprehension employed in this study. Here, the observed correlation between SST Score and other measures of listening comprehension was significant, but much lower than the correlations observed between measures of explicit and implicit comprehension (Table 4.3). This measure of comprehension relies heavily on visual interpretation and is commonly employed in studies of television comprehension (Calvert, 2001). The results of this study showed no significant differences in scores on the Story Sequencing Task by Age or by Condition. This dependent measure was not suitable for a receptive language covariate while the variance associated with receptive language could be partialled for the open-ended probes. Exploratory runs in SPSS did reveal that the exclusion of this measure in the multivariate picture would yield a non-significant multivariate

effect. Thus, given the nature of the visual components of storybooks, this study concludes that Story Sequencing Tasks are necessary, but not sufficient, measures of digital storybook comprehension.

Probes for explicit and implicit comprehension were the third and fourth components of listening comprehension employed in this study. The findings indicated that there were no statistically significant differences in explicit or implicit comprehension as a function of story listening condition. Korat and Shamir (2007) assessed both explicit and implicit forms of story comprehension in Kindergarten students. They found no significant differences in story comprehension based on experimental condition (e-book, adult, or control) or based on SES. However, participants in their study did listen to the stories multiple times *and* the means for their measures were much higher than those observed in the present study. Analyses in the present study indicate that there is much overlap between explicit and implicit comprehension. Moreover, the differences in the two dependent measures in this study are indicative of a lag between the two, with ECP Score consistently more developed than ICP Score. Paris and Paris (2003) saw the same pattern when assessing the narrative comprehension of K-2 students; namely the explicit and implicit comprehension skills were highly correlated, with students consistently attaining higher scores on measures of explicit comprehension than on those of implicit comprehension.

### **Discussion: Research Question Two**

The RAND framework (RAND Reading Study Group, 2002) for comprehension positions the characteristics of the individual as central to the meaning-making process. The literature base examining younger students' story comprehension tends to focus on issues such as SES (Korat & Shamir, 2007; 2008) or emergent literacy skills (de Jong & Bus, 2002), including

oral language (Dickinson & Smith, 1994; Collins, 2004), as predictors of successful story understanding. This study differs from others in the field in that it also considers the important role of background knowledge and interest in the meaning-making process of preschool children. The findings associated with the second research question help connect the body of research on reading comprehension with that of listening comprehension.

### **The Model of Domain Learning and listening comprehension.**

This study employed the Model of Domain Learning (MDL) (Alexander, et al., 1995; Lawless & Kulikowich, 1998) as an empirical framework. As such, the role of domain and topic knowledge and individual and situational interests were tested as predictors of preschoolers' listening comprehension. The analyses in Chapter Four indicate that the MDL holds up to a certain extent. In other words, this study verified the important role of prior knowledge in listening comprehension of a digital storybook but the role of interest and the interaction between knowledge and interest variables were largely unexplored owing to difficulties in measuring the constructs of interest.

The Revised ATK Scores were significant predictors for measures of both explicit and implicit listening comprehension for both three- and four-year-olds. This is in line with the findings of Alexander, Kulikowich and Schulze (1994) and Alexander, Kulikowich, and Jetton (1995) where strong, positive correlations emerged between prior knowledge and text understanding. Although a causal relationship between prior knowledge and listening comprehension is not supported by this design, it is still clear in Table 4.15 that those who achieved higher Revised ATK Scores also exhibited better explicit and implicit story understanding. The shared variance among the predictor variables and the observed high correlation between the topic knowledge and receptive vocabulary measures confirm the

inextricable relationship between vocabulary and comprehension that has been documented by many (Nagy & Scott, 2000).

Moreover, this dissertation has demonstrated that computer skill (which served as a measure of domain knowledge in this study) also significantly predicts preschoolers' listening comprehension of digital storybooks, and that that factor accounts for more of the unique variance in dependent measures for three-year-old participants than it does in four-year-old participants. In other words, preschoolers with less computer skills or knowledge about computers were less able to comprehend stories presented on desktop computers. This trend is in line with the body of research on adept readers and digital text comprehension (Lawless & Schrader, 2008).

### **Models of interest development.**

The current theoretical models for interest (Alexander, et al., 1995; Hidi & Renninger, 2006) suggest that affective and cognitive components factor into interest development. These models propose that computer-based literacy activities can trigger situational interest (McKenna & Watkins, 1994, December; Reinking & Watkins, 2000) and children's willingness to complete story listening activities often in excess of 20 minutes confirms the existence of this phenomenon. It is also possible that the novelty of accompanying a researcher triggered situational interest in this population. The interest data collected from both parents and children exhibited the highest scores for situational interest as measured by the PKIS and CIP, respectively (Table 4.13), confirming the motivational aspect of technology demonstrated in other studies, even for our youngest school-aged students (Rideout, et al., 2010; Scholastic Inc. & Yankelovich, 2006, 2008).



Given that the interest scores in this sample exhibited little variability, the MDL's notion that those in the acclimation stage of domain learning have low individual interest and high situational interest (see Figure 2.3) appears to hold water—the “animal” subscales, which were intended to serve as measures of emergent individual interest on the CIP and PKIS (Table 4.13), exhibited marginally lower means than those observed for the “technology” subscales, which were intended to serve as a measure of situational interest. In theory, the “story” subscales, which were conceptualized as a situational interest measure should have yielded higher scores than the planned measures of individual interest, the “animal” subscale scores. In reality, however, the “story” subscales resulted in lower observed means than the “animal” subscale scores and indicates a need to refine the methods for measuring interest, discussed later in this chapter.

The affective factor associated with interest may have manifested itself in the extent to which the participants completed the story listening activities. Perhaps the familiarity of traditional read aloud contexts associated with a real human being presenting a storybook in the SO story listening condition resulted in an interpersonal engagement factor similar to the phenomenon observed in studies of attachment quality in parent-child book-reading (Bus, 2003; Bus, et al., 1997; Bus & van IJzendoorn, 1988). The Chi-square analyses presented in Table 4.8 suggested that this hypothesis may hold some validity, as the SO condition was completed more frequently than other story listening conditions.

On the contrary, differences in task completion presented in Table 4.8 could be related to a phenomenon observed by Paciga, Lisy and Teale (2009) in their study of teacher-led read alouds in preschool classrooms. In this study, whole-class book-reading activities that extended beyond 20 minutes were associated with lower levels of student engagement. The SO condition

in this dissertation was the only one below the 20 minute threshold and so it is also possible that the duration of the SO condition's story listening activity exceeded many participant's thresholds for engagement stimulated by situational interest. Also, Table 4.8 indicates that the lowest task completion rates were observed in the CD-ROMb story listening condition whose duration was open-ended. The CD-ROMb condition afforded children opportunities to click on picture- and text-based illustrations. Although not empirically examined in this study, extant theory on reading comprehension supports the supposition that these interactive opportunities could have served as "seductive details" (Garner, et al., 1992; Lehman, et al., 2007) leading children farther from the task objective (i.e., listening to the entire story) and interfering with story comprehension (Leu, Kinzer, Coiro, & Cammack, 2004).

In general, though, the data associated with interest in this study do not provide much concrete confirmation or refutation of existing theories of interest, as the variability and power were not sufficient for parametric analysis. Data emanating from work with preschool populations suggest that emergence of interests within conceptual domains are supported by home environments, particularly in the degree to which parents support the child's oral vocabulary development in a particular conceptual domain (Johnson, Alexander, Spencer, Leibham, & Neitzel, 2004). As Johnson, Alexander, Spencer, Leibham and Nietzel (2004) concluded, "[research] could substantially benefit from adopting a more holistic view of the process through which...interests emerge in young children" (p. 340). Implications associated with this conclusion are discussed in subsequent sections of this chapter.

## **Implications**

The findings from this study lead to implications associated with the ways in which we set up story listening activities for young children and are tied to several areas of theory,

pedagogy, and research. Primarily, matters of how best to support emergent literacy and listening comprehension exist when considering the implications for young children's interaction with digital storybooks.

### **Exposing young children to technology.**

If young children are to understand digital texts, they require a set of skills to access the text in a digital format. They need to be able to power-on devices, load electronic books, and navigate these environments. Many of the younger, three-year-old, at-risk preschoolers sampled in the current investigation struggled to accomplish these tasks during the assessment of computer skill and knowledge that preceded the story listening activity (COS Score), which is of little surprise because currently in the United States children from low SES and Black or Hispanic minority statuses—like those sampled in this study—use computers less frequently than peers from higher SES or of White or Asian American status (Rideout, Lauricella, & Wartella, 2011; Lee, Bartolic & Vandewater, 2009). Participating students who attained low scores for computer knowledge also exhibited lower scores on measures of listening comprehension. This finding begs us to continue advocating for purposeful inclusion of technology with young children in schools, particularly in communities at-risk for reading failure where parents are less likely to have access to the newest technologies, lest technology skills have a compounding effect on the ever present achievement gap.

Early childhood centers should include computers as a choice for activity for children. Teachers, assistants, or volunteers should be available to assist less-skilled children in their computer interactions. In these ways, we can begin to ensure that all children start to develop domain knowledge about the computer. From a cognitive standpoint, additional exposure to technology would lead to increased domain knowledge and could have a positive impact on

listening comprehension outcomes (Kintsch & van Dijk, 1978). In addition, the sociocultural model for learning (Vygotsky, 1978) suggests that if children are provided more opportunities to see how technology works and if they interact with a more-knowledgeable adult or peer and are given additional scaffolds and opportunities to practice the technological prerequisites for engaging in computer activities it is likely that their computer skills could be improved (Turbill, 2001a, 2001b).

### **Designing digital storybooks to support listening comprehension.**

Much of understanding literature depends on making meaning of the nuances of the verbal and visual cues present in texts (Paivio, 1986; Teale, 2003). Excellent adult-child interactions surrounding text typically include scaffolds, or supports, for young listeners' story understanding. In these interactions, the adult reader often identifies the subtleties of the illustrations that provide pieces of the plot, define challenging vocabulary, or clarify decontextualized language (Hammett, van Kleeck, & Huberty, 2003; McGee & Schickedanz, 2007; Price, et al., 2009). It is within the bounds of reason to suspect that, given the pervasiveness of digital books as apps on tablet PCs, iPads and mobile devices, society may witness a rise in the frequency of digital storybook reading activities among younger age groups, thus increasing the child's exposure to storybook language that may not be supported or not scaffolded by a human adult. The ramifications of these additional story listening opportunities on listening comprehension of digital activities remain largely unknown; but essentially, the body of research on listening comprehension in traditional reading contexts concludes that the kind of deep, critical thinking we strive for in comprehension instruction will not emerge independent of scaffolded interaction and support from humans (McGee & Schickedanz, 2007; Sipe, 2008; Van Kleeck, et al., 2003). The limited availability and variability of the types, quality,

and density of extra-textual supports in existing designs of digital storybooks for young children (Paciga, 2009) are, again, likely insufficient for fostering the kinds of deep, critical thinking required to be successful in a digital era (Leu, 2006).

Software developers and authors creating digital storybooks could work to include extra-textual supports for understanding information explicitly related to the story's plot. These types of supports likely lead to better explicit story understanding, as evidenced by the planned comparisons approaching significance in this study. That is, digital storybooks can include extra-textual discourse or prompting designed to help young children understand or think about (a) *who* might be talking, (b) *what* a difficult or challenging word might mean, or perhaps (c) *when* and *why* a particular story event occurs relative to other story events. Given that no story listening condition exhibited univariate or multivariate differences with respect to implicit comprehension, it is difficult to draw implications about how to better support implicit comprehension within a digital storybook listening activity.

As far as design is concerned, it would be possible to design pre-reading assessments of background knowledge or vocabulary that feed into digital storybook programming to determine the density of extra-textual scaffolds a child is exposed to when interacting with a digital storybooks. Children with less background knowledge would be exposed to more scaffolds than children who have more sufficient levels of background knowledge to comprehend a story. Moreover, text-embedded or post-listening comprehension questions could prompt children to think about the explicit and implicit content of the story. Student responses to such questions could provide teachers with useful data for classroom follow-up instruction centered on comprehension strategies. Responses to text-embedded or post-listening comprehension questions could also potentially serve to feed some conditional programming wherein if a student

struggles with inferring character emotion, for example, then a narrator or on-screen teacher takes the student back into the digital storybook at key points in the plot and explains sequences of events that led the character to feel scared, embarrassed, or tired. These design features could serve, perhaps, to mimic the kinds of in-the-moment supports observed in high-quality book-reading events. Determination of the efficacy or cost-benefit of these kinds of automated additional supports would require substantial research.

Given the low observed scores on the Story Retelling Task for the participants in this study, perhaps incorporation of additional storybook components designed to help children practice story retelling would benefit at-risk populations. Research with at-risk kindergarten and first-grade students indicates that training in story structure can improve retelling scores (Stevens, Van Meter, & Van Middlesworth, 2007). Virtual peers have also been proven successful in helping at-risk children develop storytelling skills (Kehoe, Goldman, Cassell, et al., 2004; Kehoe, Goldman, Dai, et al., 2004).

### **Differentiation for age.**

Research indicates that parents intuitively differentiate book-reading strategies for children of different ages birth through age three (Fletcher & Reese, 2005; Senechal, Cornell, & Broda, 1995). Results from this study indicate statistically significant age differences in explicit and implicit comprehension. This finding serves to confirm that the emergent literacy field—in young children's homes, classrooms and in the commercial market—necessarily needs to distinguish between these two age groups.

In addition, this study also found significant differences in the technological competencies and comprehension abilities associated with age. If the research lens were opened to include a wider age-range of participants, it is likely that these competencies will vary more

greatly as a function of age. Given the differences in children's technological competencies and early literacy skills between the ages of three and seven (i.e., the age target for marketing of digital storybooks), teachers and parents should be aware that three-year-olds likely require different kinds or degrees of supports in digital storybook experiences than seven-year-olds. Yet, the commercial market consistently pushes the same products to three-year-olds as it does to seven-year-olds.

### **Limitations and Directions for Future Research**

This study's quantitative results hold promise for significant contribution to the field of literacy. These results, however, are duly cast beside this study's limitations and have logical implications for future research. Throughout the course of design, data collection and analysis several limitations—associated with measurement, sampling, and issues with the design of presentation features—emerged.

#### **Measurement issues.**

Given the complexities of examining the constructs of listening comprehension and interest and the nuances of gathering empirical data with very young children, and the more omnipresent role of technology in our lives future research is both warranted and called for. The implications for such work emanate from lessons learned through the design, fieldwork, and analysis of the data for this study. Consideration of the following issues will contribute to gaps not filled by this dissertation.

#### ***Listening comprehension.***

With respect to measuring the construct of listening comprehension with young children, multiple issues emerged. First, despite its success in measuring story comprehension of older readers, the free recall task was a poor measure of story understanding for this age group.

Additional practice with this sort of task has proven an effective intervention for improving story comprehension (Morrow, 1985, 1986) and would certainly increase the likelihood that at-risk preschoolers could freely recall a story.

A second measurement issue surfaced upon examining the data for the Story Sequencing Task. The scores for the presentation formats with archaic or no animation (OMS and SO) appear higher than the SST Scores for the other two presentation formats that contained animation (CD-ROMa and CD-ROMb) in Figure 4.2. Upon reflection, there was likely a confounding factor possibly contributing to the graphical differences in story sequencing scores; the still images employed in the Story Sequencing Task were color copies of the images from the paper text rather than images specific to each presentation format. In other words, this measure would be more reliable with use of screenshots from each presentation format, resulting in four sets of SST picture card sets.

Also, the strong research base tied to the study of adult-child read alouds, indicates that hearing the same text multiple times is most beneficial for story comprehension and vocabulary retention (McGee & Schickedanz, 2007; Van Kleeck, et al., 2003). The high story comprehension scores observed in CD-ROM storybook studies by Korat and Shamir (2007) were likely attributable to the dosage, or frequency, of story listening activities employed in their design. The substantially lower comprehension scores observed in this study could have been the effect of the opposite problem—limited dosage to the storybook listening activity. Future directions for research might systematically investigate the role of dosage in the comprehension picture, but this study hypothesizes that results similar to the manipulation of dosage with traditional read alouds would emerge in digital contexts as well wherein vocabulary learning and story understanding improve as a function of dosage.



Finally, lower overall means on the implicit comprehension probes caused some reflection about how the digital storybook reading activity could be better designed to facilitate high-level thinking about text. In classroom read alouds, teachers have the opportunity to embed implicit questioning immediately after a specific story event; reducing the necessity of the listener to (1) recall a particular story event from shorter-term memory and (2) accurately infer based on that event. One key example of this emerged in this dataset related to the question “Why did Stellaluna feel embarrassed?” Because she was a bat, Stellaluna instinctively defaulted to grabbing branches and hanging upside down. The baby bat felt embarrassed because she had difficulty landing upright on a branch like the other baby birds.

Although this event was salient in the story’s plot, students frequently misplaced this particular item on the Story Sequencing Task, and it was infrequently included in preschoolers’ free recall in the Story Retelling Task, even in instances where observed scores were in the higher end of the possible range. The data collection protocol presented this question without any story reconstruction and was removed from the event in the story. If children had difficulty recalling this particular story event, it is likely that they were also unable to infer why the character felt a particular emotion unless they had background knowledge from their personal lives to support that inference. In other words, as study of traditional reading comprehension suggests (Cain, Oakhill, & Bryant, 2004), story memory might have acted as an intervening variable in the current investigation. Researchers might explore the benefit of embedding implicit comprehension probes into the reading task in future work to help reduce the influence of this confound when measuring implicit listening comprehension. This would be particularly useful if an increased dosage model were employed wherein these embedded implicit questions

only appear in the third or fourth text-listening experience thusly allowing children to focus on understanding explicit content without interruptions into the story line.

Such a modification to the story listening and comprehension measurement tasks would also serve to reduce likelihood that unfamiliar or challenging vocabulary in the probe stem interferes with properly measuring the child's ability to infer character emotion. The decontextualized use of the vocabulary word "embarrassed" employed in the question presented in the preceding paragraph may have been slightly difficult for these at-risk preschoolers. Another possibility to reduce the likelihood that a preschooler might not know a challenging vocabulary word is to increase the dosage, or number of times a child is exposed to the text.

***Individual and situational interest.***

Existing models of interest development propose that individual interests during acclimation to a given domain are lower than their situational interests in the domain (Alexander, et al., 1994). Observed scores from the pilot testing conducted with Kindergarten students described in Chapter Three followed this trend, but the Child Interest Probe (CIP) exhibited little variability with the preschool sample examined in this study; results indicated that most three- and four-year olds generally expressed high interest in everything, causing a ceiling effect among scores from measures of situational and individual interest. More items associated with each subscale of the CIP could perhaps have led to more reliable scores with greater variability; better differentiating between individual and situational interest.

Perhaps alternate measures of interest would be a more prudent option for this age group. Direct observation of a child's home activities coupled with a parent's reporting may be more appropriate than the child's self-report of emerging individual interest in animals and situational interest in book reading and technology that was employed in the current investigation. Given (a) the low frequency of reading as a classroom free-play activity noted in Rowe and Neitzel's

(2010) study of young children's interests and emergent writing behaviors, and (b) the low percentages of teacher-reported child time on the computer in preschools (Lisy & Paciga, 2010), isolated observations of children at play *in schools* does not appear to be a good fit for observing situational interest; situational interests change over time and often change as a function of social interaction (Brophy, 1983) and these often depend on the structured curricular themes and kinds of activities the teachers set out for children in a given day, week, or month in a school setting.

Observing children in their more naturalistic home play environments over multiple days might be better suited for capturing situational and individual interests. In home environments children are less likely subject to the structure of a curriculum and school schedule and may have more time to independently engage in self-directed play. Also, children—especially those from high- or middle-SES groups—are more likely to have access to toys, technologies, and books that are associated with their interests in their home environments. Future research might look at how children elect to spend their free time at home. Rowe and Neitzel (2010) recommend that the kinds of requests young children make for social interaction (isolation vs. interaction), the kinds activities they engage in and the amount of time spent in these activities, and the materials they use in their free play can be used as variables associated with the study of interest development in young children.

**Sampling issues.**

This design of the current investigation was considerably constrained by the resources available to the researcher. Future research will benefit from expanding on the following issues associated with sampling.

***Participants.***

This study intentionally sought to investigate the listening comprehension of at-risk preschoolers. Therefore, transferability of the results of this study is limited to participants of the same demographic—at-risk preschoolers from metropolitan areas. These data cannot be extrapolated to populations of older students, English Language Learners or to children from higher socio-economic statuses. Accordingly, future research will benefit from additional work to test the generalizability of this study's findings with other populations. A particularly interesting design might be to compare results from the present population to those attained from students of higher socio-economic status, as the role of computer skill might not weigh in as significantly for children with more access to technologies (Grunwald Associates, 2010; Shuler, 2009) and with more books at home (Neuman & Celano, 2001) because of more prior knowledge.

***Statistical power.***

Retention of the first univariate null hypothesis, that story listening condition would have no effect on listening comprehension, was necessary as the requisite Bonferroni adjustment to alpha resulted in non-significant  $p$ -values on all  $F$ -tests. The power analysis in Chapter Four (see Figure 4.1) is indicative of the inadequacy of this design's sample size. Follow-up studies should include in excess of 165 participants, with a minimum cell size of 40 participants (i.e., 20 per age group) with complete data sets.

Power also adversely affected the analysis of the interest component of the second research question. Because of poor response rates on the PKIS the interest measures were rendered unsuitable for regression analysis. Despite the validity of parent reports of their child's interest noted in the prior literature (DeLoache, Simcock, & Macari, 2007; Johnson, et al., 2004), the Pre-Kindergarten Interest Survey (PKIS) return rate in the current investigation was not

sufficient to use these data in parametric analyses. Teachers in participating classrooms who requested that parents complete the form on-site while waiting for parent-teacher conferences exhibited better rates of return than those who asked parents to complete the surveys at home and send them back to school. If the parental measure of child interest is to be used in future investigations, this “in person” procedure for completing the measure should be implemented. If survey methods similar to the PKIS are intended in future designs, it would be necessary to obtain more than the exhibited 60 percent rate of return or to increase the sample size so that the interest variable(s) could be tested with the existing rate of return.

### ***Text selection.***

The rationale for selecting *Stellaluna* was presented in Chapter Three—it is a piece of award winning literature, commercially availability in multiple digital formats, and it is age-appropriate. The population for this study was comprised of students who were primarily of African American descent, so the story’s content and language might not have been readily connected to the discourse and experiences of this population. In other words, *Stellaluna* is not the most relevant piece of literature or particularly high-interest for this population. Future work might consider higher-interest literary texts or even expository texts. The latter may be better suited to test domain knowledge but lack of available digital expository texts precluded this possibility in design stages of this study.

### **Designing digital storybook environments for research.**

Table 3.2 presented the differences in the design of presentation features across the four story listening conditions. As discussed in Chapter Four, the commercially available formats of *Stellaluna* did not allow for isolation of specific presentation features. The current investigation observed multivariate effects of the extra-textual supports approaching significance in the first

presentation format (CD-ROMa). Distinguishing features of this presentation format included (1) automatic presentation of extra-textual dialogue which presented interruptions in the story, (2) no interactivity, and (3) full animation. The inclusion of animation was also associated with observed multivariate lambda and *F*-values approaching significance. As such, it is impossible to determine whether full animation in the absence of extra-textual supports would also impact a multivariate story listening comprehension effect or whether the combination of these two features together contributed to these results.

Future work in designing digital storybooks intended for research in listening comprehension might purposefully follow-up on these presentation features approaching significance to better tease out whether these extra-textual scaffolds or animations or the combination of both lead to better listening comprehension outcomes. More clear distinctions between presentation formats and better isolation of the presentation features in Table 3.2 might produce more clear results. For example, if there were three presentation formats of the same text that differed only on image animation features (e.g., fully animated, static, archaic animation), it would be possible to determine whether the animations did, in fact, contribute to the multivariate differences approaching significant identified by the planned comparisons presented in Chapter Four.

### **Conceptualizing Emergent Literacy in a Digital Era**

Theories of emergent literacy development are well-documented and well-supported in the field (Ferreiro & Teberosky, 1982; Teale & Sulzby, 1986; Whitehurst, & Lonigan, 2001; Yaden, et al., 2000). Traditional notions of emergent literacy development and pedagogy should be challenged and expanded to incorporate benchmarks for digital literacy in addition to benchmarks for traditional literacy. There is evidence that the pendulum is beginning to sway

toward the purposeful inclusion of technology as a tool for literate activity in early childhood. For example, the 2011 draft of the position statement of the National Association for the Education of Young Children (NAEYC) and the Fred Rogers Center for Early Learning and Children's Media (2011) acknowledges that technology is here to stay, but caution (1) that "the push to integrate technology into early childhood settings can lead to inappropriate use" and (2) "current attitudes and practices contribute to the growing digital learning divide" (p. 3). In other words, great strides still remain for early childhood centers and those who work with at-risk preschoolers who are less likely to encounter computer-based media in the home (Rideout, Lauricella, & Wartella, 2011).

Teachers and parents need to strategically expose children to these tools for literate behavior and support their young child's use and understandings of the purposes for which and the methods through which literacy goals are accomplished. The NAEYC & Fred Rogers Center position statement recommends that appropriate use of technology and screen media depends on the age, developmental level, needs, interests and abilities of each child. In addition, the role of play is paramount in young children's developing understandings about the ways things work; children need time to practice and play with technologies. Merchant's work (2005a, 2005b) revealed that young children can and do engage in dramatic play with new technologies when given the opportunity. It is likely that, as this dissertation suggests, children who engage with technology at home and school—in work or play—also have the most background knowledge about technology and also tend to do better on measures of computer-based text comprehension.

In addition to providing children with exposure to and experiences with new technologies, parents, early childhood teachers, administrators, and even policy makers need to recognize that technological devices and software are *tools* for doing literacy. Accordingly,

International Society for Technology in Education (ISTE) NETS standards for students (see <http://www.iste.org/standards/nets-for-students.aspx>) do not suffice and neither do the Common Core State Standards (CCSS; see <http://www.corestandards.org/the-standards>). This opinion is repeated in the most recent position statement by NAEYC and the Fred Rogers Center (2011), “Lack of intentional integration and use of technology in early childhood classrooms can place children without technology exposure at a disadvantage and impede their ability to compete in the 21<sup>st</sup> century workforce” (p. 3). The NETS and CCSS do not portray technology as a central aspect of learning in language arts, mathematics, science, the arts, social studies, health and physical education, and social-emotional development. NETS and CCSS do not even exist for preschool students and even the most progressive states with regard to technology haphazardly incorporate technology into their early learning standards (Lisy, Paciga, & Teale, Unpublished). Moreover, the folk psychology that *all* technology is harmful to young children’s psychological development perpetuates the barriers to school-based emphases on technology. The American Academy of Pediatrics rightly recommends that parents *limit* their children’s daily on-screen time ([www.aap.org/advocacy/mmgguide.pdf](http://www.aap.org/advocacy/mmgguide.pdf) - 2010-05-26), but it does not suggest in any way that computers are or will ever be the demise of children’s intellectual development. Of course, anything associated with more sedentary lifestyles can put children at-risk for certain health issues, but it is revealing that parents tend to be more aware of the potential harms of technology than its potential benefits—global, social interaction; access to information; adaptive capabilities for individualization of instruction; ease of multimedia composition; and the ability to assess and track students learning to develop appropriate instruction.

In addition to critically examining how we conceptualize emergent literacy in this digital era, we also need to attend to the larger context in which literate activity occurs (Berliner, 2009;



Bronfenbrenner, 1979). The extant research has demonstrated access to books a critical issue in literacy development (Evans, Kelly, Sikora, & Treiman, 2010; Neuman & Celano, 2001) and that Black and Hispanic (i.e. at-risk) populations access technology less frequently than White or Asian American populations outside of school contexts (Rideout, et al., 2011; Lee, Bartolic & Vandewater, 2009). Moreover, access to technology has plagued education in recent past (Cuban, 2001; Hutchinson, 2009). Accordingly, access to the hardware and software associated with digital book reading remain important issues for educators. Hardware components including, but not limited to e-book readers like the Nook or iPad, personal computers or laptops and Internet connections fast enough to download or stream digital storybooks are needed in schools, especially those who work in high-poverty schools where students are less likely to have at-home access to these devices. In addition, software that gives easy access to digital storybooks, like digital storybook libraries (e.g., One More Story, Tumblebooks, Scholastic Bookflix), or downloaded applications for e-book reading devices are needed to provide students with access to this new form of text. Recent news suggests that eBooks and eReaders could “help reignite a love of reading among today’s tech-oriented students” and that “because many classics are available electronically free of charge,” digital formats instantly put 500-book libraries in the hands of every child (Carr, 2011)! Most recently, children’s magazines have been going digital, too (<http://www.pbs.org/mediashift/2011/05/childrens-magazines-cater-to-true-early-adopters-with-mobile-apps137.html>).

Perhaps the largest issue associated with issues of access is that of funding. Who will have access? Will funds be available to ensure that schools, branch libraries, and families even in low SES neighborhoods have access? Currently there are a few grant programs from the federal government that provide some budget for the kinds of hardware and software requisite for digital

storybook interaction (e.g., E-RATE, GEAR-UP, Early Reading First, Race to the Top), but, as Hutchinson (2009) noted, the devices and software are not the only barrier to technology integration in schools. Teachers, and arguably parents, need professional development to better understand the workings of digital storybooks (Education Week Editors, 2001; Henry, 2008)—their strengths and limitations—and how they can effectively use these genres with young children to help them become successful readers in a digital era.

Just as teachers and parents likely require the skill and background knowledge to use digital storybooks, so too do children. This study has demonstrated that computer knowledge and skills likely interfere with comprehension of digital texts even at very young ages; confirming findings of studies with adult populations. If young children aren't able to properly manipulate technological hardware or cannot access the software on a digital device, they cannot access the text. This has the potential to act in a similar manner as children who are starting to access texts independently but lack phonics knowledge to sufficiently decode the text. As more and more reading activities become digitized the lack of emergent digital literacy skills could potentially have a compounding effect on the already dramatic differences in reading achievement as evidenced by the achievement gap.

The achievement gap will not be minimized and the fourth-grade slump will not be overcome by maintaining the status quo of using traditional pedagogies with traditional texts. This study demonstrated that young children do encounter difficulties with digital storybook comprehension when they interact with these texts independently. It also put forth the idea that what a child knows about (1) the content of the text (i.e., topic knowledge) and (2) computers (i.e., domain knowledge) plays an important role in how he or she comes to understand digital texts. Today's children live in a digital world with digital texts (Grunwald Associates, 2010;

Rideout, et al., 2010; Shuler, 2009; Zevenbergen & Logan, 2008) and, given the omnipresent role of technology today and the likelihood that technology will become even more integrated into our lives in the future, work understanding how children from a very young age come to understand these text forms is crucially important. This kind of work will not be easy, but it is necessary to ensure that children have continued access to high-quality texts that are educative and teachers and parents who can help them use, navigate and understand these new text forms.

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## APPENDICES

## Appendix A. Assessment of Topic Knowledge

Name

Date

1. Which of these is a bat?

☐☐☐☐

2. Where does a bat sleep?

☐

bed

☐burrow/hole  
in ground☐

tree

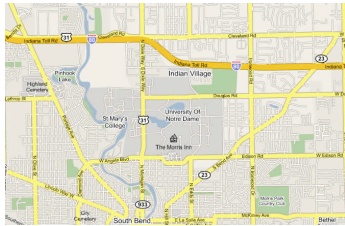
☐in the coral  
in the ocean

### 3. How do bats find their way in the dark?

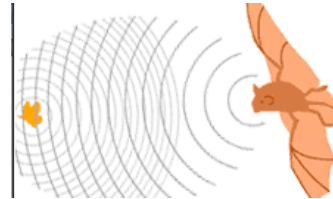
☐  
they use a  
flashlight



☐  
they use a  
map



☐  
they use  
sound  
vibrations



### 4. When are bats awake?

☐  
when the  
sun is  
coming  
up



☐  
during the  
daytime



☐  
at night time



## 5. Which of these would a fruit bat eat?

☐  
mango



☐  
flowers



☐  
bugs or  
insects



☐  
leaves

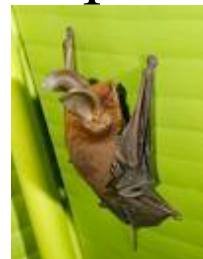


## 6. How does a bat sleep?

☐  
hanging/  
upside  
down



☐  
right side  
up/standing



☐  
lying in a  
bed



☐  
sitting in a  
nest



## 7. How does a mommy bat carry her baby?

☐  
on her  
back



☐  
on her belly



☐  
in a  
stroller



☐  
in a  
backpack



## 8. Which of these hunts for bats?

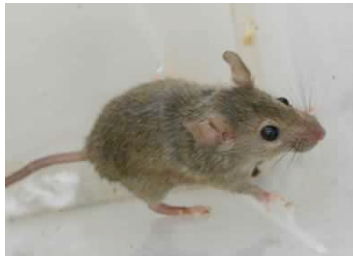
☐  
an owl



☐  
a worm



☐  
a mouse



☐  
an elephant



## 9. How do bats go from their homes to other places?

☐  
walking  
like you  
do in  
shoes



☐  
flying like a  
kite



☐  
skating  
on wheels



☐  
surfing on a  
wave



## 10. Which of these is a bird?

☐



☐



☐



☐





## 11. Where does a bird sleep?

☐  
nest



☐  
burrow/hole  
in ground



☐  
bed



☐  
in the coral  
in the ocean



## 12. When are birds awake?

☐  
when the  
sun is  
coming  
up



☐  
during the  
daytime



☐  
at night time



### 13. How does a bird sleep?

☐  
hanging/  
upside  
down



☐  
right side  
up/standing



☐  
lying in a  
bed



☐  
sitting in a  
nest



### 14. Which of these does a bird like to eat?

☐  
carrots



☐  
sticks



☐  
worm



☐  
leaves



**Appendix B. Concepts of Screen Checklist**

|                   |   |   |   |  |                          |
|-------------------|---|---|---|--|--------------------------|
| Child's Name      |   | Date  |   |  |                          |
| <b>Interest</b>   |   | Unwilling to use computer<br><input type="checkbox"/> | Takes some convincing<br><input type="checkbox"/>           | Interested<br><input type="checkbox"/>           |                          |
| <b>Confidence</b> |   | Frightened <input type="checkbox"/>                   | Willing to observe others & try<br><input type="checkbox"/> | Expresses confidence<br><input type="checkbox"/> |                          |
| <b>Home</b>       |   | No<br><input type="checkbox"/>                        | Yes<br><input type="checkbox"/>                             |  |                          |
|                   |   |   |   |  |                          |
| <b>Skills</b>     |   | <b>Not Yet</b>  | <b>With help</b>  | <b>Novice</b>                                    | <b>Independent</b>       |
| Mouse             | Move mouse with one hand  | <input type="checkbox"/>                              | <input type="checkbox"/>                                    | <input type="checkbox"/>                         | <input type="checkbox"/> |
|                   | Use index finger on left side of mouse  | <input type="checkbox"/>                              | <input type="checkbox"/>                                    | <input type="checkbox"/>                         | <input type="checkbox"/> |
|                   | Match mouse and cursor  | <input type="checkbox"/>                              | <input type="checkbox"/>                                    | <input type="checkbox"/>                         | <input type="checkbox"/> |
|                   | Use mouse to click in right place   | <input type="checkbox"/>                              | <input type="checkbox"/>                                    | <input type="checkbox"/>                         | <input type="checkbox"/> |
|                   | Use double click to open icons  | <input type="checkbox"/>                              | <input type="checkbox"/>                                    | <input type="checkbox"/>                         | <input type="checkbox"/> |
|                   | Use click and drag  | <input type="checkbox"/>                              | <input type="checkbox"/>                                    | <input type="checkbox"/>                         | <input type="checkbox"/> |
| Programs          | Turn on computer  | <input type="checkbox"/>                              | <input type="checkbox"/>                                    | <input type="checkbox"/>                         | <input type="checkbox"/> |
|                   | Locate appropriate program on desktop   | <input type="checkbox"/>                              | <input type="checkbox"/>                                    | <input type="checkbox"/>                         | <input type="checkbox"/> |
|                   | Insert a CD-ROM   | <input type="checkbox"/>                              | <input type="checkbox"/>                                    | <input type="checkbox"/>                         | <input type="checkbox"/> |
| Navigation        | Recognize basic icons and their functions: x to close                         | <input type="checkbox"/>                              | <input type="checkbox"/>                                    | <input type="checkbox"/>                         | <input type="checkbox"/> |
|                   | Recognize basic icons and their functions: next page (in digital storybooks)  | <input type="checkbox"/>                              | <input type="checkbox"/>                                    | <input type="checkbox"/>                         | <input type="checkbox"/> |
|                   | Recognize basic icons and their functions: forward or back page (on internet) | <input type="checkbox"/>                              | <input type="checkbox"/>                                    | <input type="checkbox"/>                         | <input type="checkbox"/> |
| Directionality    | Scroll  | <input type="checkbox"/>                              | <input type="checkbox"/>                                    | <input type="checkbox"/>                         | <input type="checkbox"/> |
| Notes:            |   |   |   |  |                          |



## Appendix C. Protocol – Concepts of Screen Checklist

To administer – on a day OTHER than, but before, the day the student will read Stellaluna:

- Use a computer with an Internet connection. Before you get child, open an Internet Explorer window and log on to <http://onemorestory.com/tour/samplebook.html>. Click on the green button below “Rattletrap Car.”
- Invite child to come play a game on the computer with you (assess student interest). If student takes some convincing or unwilling to use computer, invite him or her to observe a classmate and then try later (assess confidence).
- Ask child if they have a computer at home. Sit down at computer. Always let child try to complete task unassisted first (if able, score as “independent”). If unable, you may point at the screen and give a visual prompt with your hands (e.g. when you demonstrate clicking) (if able, score as “novice”). If child is unable to complete task following visual/verbal prompts, you may help child, placing your hand on top of theirs and navigating, clicking, etc. with them and then ask them to try by themselves (if able, score as “with help;” if still unable, score as “not yet”).
- To assess double click to open icon, locate appropriate icon on desktop, and open program - Ask child to open the internet. Researcher logs on to [pbskids.com](http://pbskids.com) unless there is a shortcut on the desktop to the website already (if so, prompt child to open [pbskids.com](http://pbskids.com)). If he does not know how, point to the appropriate icon. If they cannot double click, prompt to click two times really fast with their pointer finger (give a visual prompt). If still unable, try it with them.
- To assess mouse control - Ask child to click on picture of the Berenstien Bear (open program) on wheel.
- To assess scroll – Ask the child to show you how you can see the pictures down at the bottom of the screen. If he cannot scroll independently you can point to the side bar and tell them to move it down to see the pictures at the bottom of the screen (if you need to do this, score as novice).
- Tell the child to click on the little girl bear in the tree to get to the games menu. Click on dress a bear. Choose a bear to dress. Click and drag their clothes onto their bodies.
- To assess navigation – ask child to go back (internet navigation) to play a different game with the bears. If child does not know how, point to the back icon and tell the child to click it to go back. Prompt the child to choose “match book” game. Let child make one match (not to assess anything above, but to make the task authentic).
  - Ask child to close the page. If they don’t know how, point to the red X to close.
  - Open window with Rattletrap Car. Ask child to show you how to go to the next storybook page to hear the story.
- Fill out “*concepts of screen checklist*” for each child. Before saving - click tools, options, save tab, and select “save data only for forms,” ok. Click file, save copy as, and enter child’s last name\_COS. Click save (it should be in Plain text format). Post on server.

## Appendix D. Pre-Kindergarten Interest Survey



University of Illinois at Chicago  
Center for Literacy  
1640 W. Roosevelt m/c 628  
Chicago, IL 60647  
312-413-0143

### **Please return to your teacher with homework next week.**

Dear Parents/Guardians,

We are trying to understand more about how young children like yours understand books, and we would like your help with this. A child's interest seems to be important, so we would like to get some information about your child's interests.

**Instructions:** Read each item on the attached pages. Every item describes an activity that may or may not interest your child. Please consider your child's interests and **CIRCLE** the most appropriate response **FOR EACH ITEM**, below. It does not matter if your child completes these activities by him/herself or with adult help.

Use the following descriptors as a guide:

If your child is **extremely interested** in an activity, he or she may frequently (i.e., more than 3 times per week) request this activity and chooses to do it over other activities.

If your child is **interested** in an activity, he or she sometimes (i.e. 1-2 times per week) requests to engage in the activity and freely selects this activity over other activities less interesting to him/her.

If your child is **moderately interested** in an activity, he or she requests this activity less frequently (i.e., less than 3 times per month) and engages in this activity if asked to choose from a limited range of activities.

If your child is **uninterested** in an activity, he or she seldom (i.e., less than once a month) requests to engage in it and, if given the choice, will not choose to engage in this activity.

Thank you for your help,

Katie Paciga  
PhD Candidate, University of Illinois at Chicago

**Please return to school with your child's homework next week.**

**TO WHAT EXTENT IS YOUR CHILD INTERESTED IN:**

|   | Uninterested | Moderately Interested | Interested | Extremely Interested |
|---|--------------|-----------------------|------------|----------------------|
| 1. Watching a movie?  | U            | M                     | I          | E                    |
| 2. Using a CD-ROM on a computer?  | U            | M                     | I          | E                    |
| 3. Watching educational TV programs (e.g., Dora or Sesame Street)?  | U            | M                     | I          | E                    |
| 4. Playing video games (e.g., Nintendo, Playstation, or XBOX)?  | U            | M                     | I          | E                    |
| 5. Playing a game on the computer?  | U            | M                     | I          | E                    |
| 6. Typing on a keyboard?  | U            | M                     | I          | E                    |
| 7. Playing with an educational electronic toy (e.g., VTech toy computer, Leapfrog reading system or toy, etc.)? | U            | M                     | I          | E                    |
| 8. Taking pictures with a digital camera?   | U            | M                     | I          | E                    |
| 9. Drawing a picture about his/her favorite part of a story he/she read?  | U            | M                     | I          | E                    |
| 10. Looking at and pretending to read a picture book?   | U            | M                     | I          | E                    |
| 11. Reading a magazine?   | U            | M                     | I          | E                    |
| 12. Going to a library or a bookstore?  | U            | M                     | I          | E                    |
| 13. Recommending or giving a book to a friend?  | U            | M                     | I          | E                    |
| 14. Being read to by you or someone else in the family?   | U            | M                     | I          | E                    |
| 15. Talking about a story that was read to him/her?   | U            | M                     | I          | E                    |
| 16. Having his/her own books at home?   | U            | M                     | I          | E                    |
| 17. Discussing what animals do?   | U            | M                     | I          | E                    |
| 18. Going to see animals (in the neighborhood or the country, or at the zoo)?                                   | U            | M                     | I          | E                    |
| 19. Visiting a pet store to see the animals?  | U            | M                     | I          | E                    |
| 20. Watching a program (e.g., on the TV or computer) about animals?   | U            | M                     | I          | E                    |
| 21. Being read or looking at a book about animals?  | U            | M                     | I          | E                    |

## Appendix E. Child Interest Probe





### Practice Items

1. Are you interested in coloring?
2. Are you interested in recess?

### Test Items

1. Are you interested in computers?
2. Are you interested in reading a story?
3. Are you interested in animals?
4. Are you interested in birds?
5. Are you interested in bats?

### Response format

|   |  |  |  |
|---|--|--|--|
| <p>I would not like to do that at all. I'd rather be in time out.</p>  | <p>I wouldn't like to do that, but I might do it if there was no other choice.</p>  | <p>I'd probably like to do that, especially if there is nothing else interesting to do.</p>  | <p>I'd love to do that any time.</p>  |
|---|--|--|--|

## Appendix F. Story Retelling Task

**Directions:** After the child listens to the story ask him/her retell the story using ONLY the following prompts. The maximum time allotted for each child's retelling is 10 minutes.

Can you retell this story as if you were telling it to a friend that has never heard it before?

What comes next?

Then what happened?

**Scoring:** The total points possible for the SRT is 17. Award 1 point for each element in the table below.

### Key Elements for Story Retelling Task

| Element         | Description   | Score (+/-) |
|-----------------|---|-------------|
| Setting         | "a warm and sultry forest"  |             |
| Theme           | identity and friendship   |             |
| Plot episode 1  | Mama bat names baby "Stellaluna"                                  |             |
| Plot episode 2  | Owl attacks bats and baby is lost                                 |             |
| Plot episode 3  | Stellaluna falls into birds' nest                                 |             |
| Plot episode 4  | Stellaluna eats insects   |             |
| Plot episode 5  | Mama bird yells at Stellaluna                                     |             |
| Plot episode 6  | Stellaluna learns to fly with birds                               |             |
| Plot episode 7  | Stellaluna embarrassed about difficulty landing                   |             |
| Plot episode 8  | Stellaluna gets separated from birds                              |             |
| Plot episode 9  | Stellaluna meets adult bats and her mother                        |             |
| Plot episode 10 | Stellaluna eats mangoes   |             |
| Plot episode 11 | Stellaluna returns to birds                                       |             |
| Plot episode 12 | Stellaluna and birds fly at night                                 |             |
| Plot episode 13 | Stellaluna rescues birds who can't see in the dark                |             |
| Resolution      | Bats live with bats and birds live with birds but remain friends. |             |
| Gist of story   | Child tells gist (50% of above elements)                          |             |

## Appendix G. Story Sequencing Task

**Directions:** I want you to look at all of these pictures. They are from the Stellaluna story you just listened to. This one is a picture of Stellaluna's mother and the baby Stellaluna from the very

beginning of the story. I am going to put it right here because that's the first thing that happened in the story. Look at the rest of these pictures. For each of the subsequent pictures (5 total) ask:

Which one happened next? Can you put it here (in the next box)?

When all six (the one you modeled plus the 5 the child selected) are ordered say, "Look carefully at the pictures. Is that how it happened in the story you listened to? Is there anything you'd like to change?"

**Scoring:** Award one point for each correctly sequenced plot episode (pictures 2-5). Award 2 points for correctly sequenced pictures at the end (picture 6). Correct responses are pictured below. There are a total of 6 points possible for this task.

| Scoring Responses for Story Sequencing Task (SST) |                          |         |
|---|--------------------------|---------|
| Position  | Correct Picture Response | Scoring |
| 1   |                          | n/a     |
| 2   |                          | /1      |
| 3   |                          | /1      |
| 4   |                          | /1      |
| 5   |                          | /1      |
| 6   |                          | /2      |
| Total   |                          | /6      |

## VITA

Kathleen A. Paciga  
University of Illinois at Chicago

### ACADEMIC PREPARATION

#### University of Illinois at Chicago

- Ph.D. Curriculum & Instruction: Literacy, Language, & Culture 2006- 2011
- M.Ed. Instructional Leadership – IL Type 03 Standard Elementary Certificate and Reading Endorsement 2003-2006

#### Loyola University Chicago

- B.A. Spanish 1997-2002
- B.S. Elementary Education -IL Type 03 Initial Elementary Certificate with Middle School Endorsements in Science and Spanish 1997 -2002

### EMPLOYMENT

- 2008-2011 Instructor, University of Illinois at Chicago
- 2007-2011 Graduate Research Assistant, Early Reading First, University of Illinois at Chicago
- 2009 Teacher's Assistant, University of Illinois at Chicago
- 2002-2007 Kindergarten Teacher, Berwyn North School District 98, Illinois

### PUBLICATIONS

- Paciga, K.A. (2011). Reading, writing and sharing: The journey to become Kindergarten authors. In C.C. Pappas & E. Tucker-Raymond (Eds.), *Becoming a teacher researcher for literacy teaching and learning*. New York: Routledge.
- Teale, W.H., Paciga, K.A. & Hoffman, J.L. (2010). Beginning reading instruction in urban schools: The curriculum gap insures a continuing achievement gap. In Strickland, D. (Ed.), *Essential readings on early literacy*. Newark, DE: International Reading Association.
- Teale, W.H., Hoffman, J.L. & Paciga, K.A. (2010). Where is NELP leading preschool literacy instruction? Potential positives and pitfalls. *Educational Researcher*, 39, (4), 311-315.

- Teale, W.H., Paciga, K.A. & Hoffman, J.L (2010). What it takes in early schooling to have adolescents who are skilled and eager readers and writers. In K. Hall, U. Goswami, C. Harrison, S. Ellis & J. Soler (Eds.), *Interdisciplinary perspectives on learning to read: Culture, cognition and pedagogy* (pp.151-163). London: Routledge.
- Teale, W. H., Hoffman, J. L., Paciga, K. A., Lisy, J. G., Richarson, S., & Berkel, C. (2009). Early literacy: Then and now. In Y. Goodman & J. V. Hoffman (Eds.), *Changing literacies for changing times: An historical perspective on the future of reading research, public policy, and classroom practice* (pp. 76-97). New York: Routledge/Lawrence Erlbaum.
- Paciga, K.A., Lisy, J.G. & Teale, W.H. (2009). Examining student engagement in preschool read alouds. In Leander, K., Rowe, D.W., Dickinson, D.K., Hundley, M. Jimenez, R.T., & Risko, V.J. (Eds.) *58th yearbook of the National Reading Conference* (pp. 330-347). Oak Creek, WI: National Reading Conference.
- Paciga, K.A. (2008) Book Review: Information and communication technologies: Consideration of current practice for teachers and teacher educators. The 106<sup>th</sup> Yearbook of the National Society for the Study of Education, Part 2. In *Educational Media International*, 45, (2), 137-139.
- Teale, W.H., Paciga, K.A. & Hoffman, J.L. (2007). Beginning reading instruction in urban schools: The curriculum gap insures a continuing achievement gap. *The Reading Teacher*, 61(4).

### PEER REVIEWED PRESENTATIONS

- Lisy, J.G. & Paciga, K.A. (December, 2010). Paper presented at the 60<sup>th</sup> annual meeting of the Literacy Research Association/National Reading Conference. Fort Worth, TX.
- Paciga, K.A. (December, 2010). Paper presented at the 60<sup>th</sup> annual meeting of the Literacy Research Association/National Reading Conference. Fort Worth, TX.
- Brookfield, J.L., Paciga, K.A., Lisy, J.G., Norris, N., Teale, W.H., Hoffman, J.L. (May, 2010). Tier 3 intervention in an urban Early Reading First project. Paper presented at the International Reading Association Annual Convention, Chicago, IL.
- Paciga, K.A. (2009, December). Differences in presentation formats of digital storybook read alouds: A feature analysis. Paper presented at the National Reading Conference/Literacy Research Association. Albuquerque, NM.
- Teale, W.H., Garrette, J.L., Hoffman, J.L., Paciga, K.A., Yokota, J. & Richardson, S.R. (2009, May). What we read aloud to young children makes a difference: Book features and their consequences. Paper presented at the International Reading Conference Annual Convention, Early Childhood Preconference, Minneapolis, Minnesota.
- Paciga, K.A. & Garrette, J.L. (2008, December). Examining the effects of student engagement on comprehension in preschool read alouds. Paper presented at the National Reading Conference. Orlando, FL.
- Paciga, K.A., Hoffman, J.L., Teale, W.H. & Garrette, J.L. (2008, May). Read alouds in preschool classrooms: Teacher strategies, children's engagement, learning outcomes. Poster presented at the International Reading Association Annual Convention, Atlanta, Georgia.



Teale, W.H., Hoffman, J.L., Paciga, K.A. & Garrette, J.L. (2008, May) What it takes to make read alouds make a difference with young children. Paper presented at the International Reading Conference Annual Convention, Early Childhood Preconference, Atlanta, Georgia.

Hoffman, J.L., Paciga, K.A., & Garrette, J.L. (2008, March). Developing early childhood teachers' use of assessment data in differentiated instruction. Paper presented at the annual convention of the Illinois Reading Council, Springfield, IL.

Paciga, K.A. (2007, December). Teachers and text: Their roles in preschoolers' engagement in read alouds. Paper presented at the National Reading Conference. Austin, Texas.

Paciga, K.A. (2007, April). The written genre in kindergarten. Paper presented at the International Conference of Teacher Researchers. Chicago, Illinois.

Paciga, K.A. (2007, March). A semantic map of reading: Socially, historically, and culturally embedded. Poster presented at the 2<sup>nd</sup> Annual Chicagoland Graduate Student Conference. Education and the Public Good: Interdisciplinary trends in graduate scholarship. Chicago, Illinois.

#### **AWARDS, HONORS, AND APPOINTMENTS**

University of Illinois at Chicago Dean's Scholar Award, 2010

Who's Who Among America's Teachers Award, 2005