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# Effects of Working Memory and Presentation Condition on Narrative Production and Inferencing Skills in Children with Language-Learning Impairment

Carren Eby Mills
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To the Graduate Council:

I am submitting herewith a dissertation written by Carren Eby Mills entitled "Effects of Working Memory and Presentation Condition on Narrative Production and Inferencing Skills in Children with Language-Learning Impairment." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Speech and Hearing Science.

Lori A. Swanson, Major Professor

We have read this dissertation and recommend its acceptance:

Peter Flipsen, Jr. Ann Michael, Ilsa Schwarz, Tara Wass

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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# Effects of Working Memory and Presentation Condition on Narrative Production and Inferencing Skills in Children With Language-Learning Impairment

A Dissertation Presented for the Doctor of Philosophy Degree

The University of Tennessee, Knoxville

Carren Eby Mills

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# Dedication

This dissertation is dedicated to my family: to my husband, Snell, who gave me love, support, and technical guidance throughout this process; to my parents, who always encouraged me to work to realize this dream; and to my sister, Susan, who with humor and candor helped me process it all along the way.

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Abstract

Ten children with language-learning impairment (LLI, M = 11;2 years) were compared to chronological age- (CA, M = 11;2 years) and language age- (LA, M = 8;4 years) matched peers to examine presentation condition effects on level of syntactic complexity and number of story grammar components recalled for stories that were at or below the children's reading level. Children were also compared on their ability to correctly answer information, value, and logical inferencing questions based on the stories. In addition, verbal and non-verbal working memory skills were assessed for group differences, and to determine the degree to which verbal and/or non-verbal working memory skills correlated with narrative recall measures and inferencing scores.

No presentation effect was found for any of the measures. Children in the LLI group recalled fewer story grammar components than their CA and LA peers, although the pattern of story grammar responses was similar for all groups. Recalled narratives of children with LLI yielded lower DSS scores than the LA and CA peers, and the LA peers earned significantly lower DSS scores than the CA peers. Children with LLI answered fewer inferencing questions correctly compared to LA and CA peers, but a similar hierarchy of inferencing skills emerged for all of the groups: more children answered information inferencing questions correctly, followed by value and logic inferencing questions. Finally, children in the LLI group earned lower verbal working memory scores than their CA peers, but all groups earned similar non-verbal working memory scores. Verbal working memory scores significantly correlated with ten of the twelve language variables, but no correlation was found for the non-verbal working memory measure and the language variables.

For story grammar, syntactic complexity and inferencing skills, children in the LLI group produced a delayed, and not a developmentally unique, pattern of responses compared to CA and LA peers. Possible contributors to the difficulties children with LLI face during story recall and comprehension are discussed, including reading comprehension disorders, incomplete situational models, and inefficient working memory. Treatment techniques that target story grammar organization, cohesive devices, and activation of previously learned and experienced knowledge are suggested.

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# CHAPTER I

## Introduction

Narrative comprehension and production are two important skills necessary for successful reading, writing, and verbal communication. Children with language-learning impairment (LLI) produce narratives with less complex story grammar features, inaccurate or immature sentence grammar and content, and ambiguous cohesive ties than typically developing peers (Catts, Fey, & Proctor-Williams, 2000; Gillam & Carlile, 1997; Gillam & Johnston, 1992; Liles, 1985; Merritt & Liles, 1987; Summers & Newhoff, 1990). Given the wide range of skills associated with narrative comprehension and production, it is not surprising to find that children with LLI may have some degree of difficulty with the following skills: explaining story action, events, and cause and effect relationships, describing character motivation, answering inferencing questions based on factual, evaluative, and interpretative information, and summarizing information in correct sequence. These deficits contribute to the struggle children with LLI face to succeed both academically and socially.

Narrative comprehension includes the ability to infer (Kamhi & Catts, 1999). Inferencing skill reflects one's ability to construct meaning based on implicit information provided in the text and one's prior knowledge and experience. Children with LLI score lower than chronological age-matched children on measures of inferencing skill, but similar to language age-matched children (Bishop & Adams, 1992; Crais & Chapman, 1987; Ellis Weismer, 1985; Wright & Newhoff, 2001). Further study into the nature of inferencing skill disorders shows that children with LLI have the ability to make inferences, but may require assistance to understand when and how to apply inferential processing strategies (Crais & Chapman, 1987; Wong, 1980).

Working memory, or the ability to hold and manipulate information, has been found to influence successful narrative comprehension (Cain et al., 2004; Oakhill, 1984; Oakhill, Yuill, & Donaldson, 1990; Oakhill, Yuill, & Parkin, 1986; Seigneuric, Ehrlich, Oakhill, & Yuill, 2000). Children with poor language (Ellis Weismer et al., 1999) and reading comprehension skills (Cain & Oakhill, 2003; Nation, Adams, Bowyer-Crane, & Snowling, 1999) have been shown to possess impaired verbal working memory skills. While some researchers found that inferencing is associated with memory and narrative recall ability (Cain et al., 2004; Craik & Tulving, 1975; Johnson-Laird & Bethell-Fox, 1978; Paris & Upton, 1976; Westby, 1999) others dispute such a connection (Omanson, Warren, & Trabasso, 1978).

Two theories of working memory deficits have been proposed that might account for narrative comprehension and production problems in children with LLI. The limited capacity processing theory holds that the *nature* of the information being processed is not as important as the *way* in which the information is processed. Processes can be limited due to restrictions in resources, described according to characteristics of space, energy, or time (Kail & Salthouse, 1994). Limitations in these resources are not mutually exclusive, as deficits in processing can be discussed in terms of an individual resource deficit, or a combination of one or more resource deficits. While researchers differ in reference to the use of single versus multiple process limitations (Kail & Salthouse), the limited processing capacity theory has been used to account for a number of linguistic and non-linguistic deficits, including those that fall within the realm of pragmatics, comprehension (including inferencing skill), morpho-syntax, and phonology (Leonard, 1998).

Other researchers dispute the limited processing capacity theory, stating that the difficulties some children have in working memory are specific to a single domain (Nation et al., 1999), specifically the verbal skills realm. While these researchers found that children with poor reading comprehension did not perform as well as children with good reading comprehension on abstract word recall and verbal working memory tasks, the fact that both groups performed similarly on spatial memory skills led them to conclude that the deficit encompasses verbal skills only. Additional research using both verbal and non-verbal memory tasks is necessary to support their theory.

Further research is warranted to determine whether children with LLI differ from typically developing children on narrative recall and inferencing skill. A complete story grammar and syntactic analysis based on multi-episodic stories will allow for a more complete assessment of the narrative skills in children with LLI and their CA and LA peers. Using stories with more episodic tokens will allow for more inferencing questions to be asked, which may yield a more accurate description of inferencing skills in children with LLI, and their LA and CA peers. In addition, assessing a variety of working memory skills may support associations between memory and language variables (Cain et al., 2004), such as narrative and inferencing skills in children with and without language impairment. Finally, identifying the verbal and non-verbal components of working memory that are associated with reading comprehension and production will also provide support for the limited capacity processing and/or the single domain theory.

# CHAPTER II

## Review of Literature

### *Narrative Skills*

The ability to comprehend narratives reflects skills that extend beyond reading comprehension skills, or the ability to decode and understand words and passages in written text. As children become more fluent in their reading skills, their awareness of narrative structure and style is a vital component in their transition from learning to read to reading to learn (Westby, 1999). Narrative comprehension and production skills are important developmental tools to aid children in their ability to acquire and/or share knowledge (Westby, 1999). Beginning in preschool and early elementary grades, children are evaluated based on their ability to comprehend stories that are read aloud and to re-tell stories in a complete and organized manner (Gillam, McFadden, & van Kleeck, 1995; Klecan-Aker, Flahive, & Fleming, 1997). Socially, children are known to use narratives to establish and maintain peer and adult relationships by engaging in activities such as gossiping, expressing support, impressing, clarifying point of view, telling jokes, empathizing, criticizing, persuading, threatening, and befriending (Eder, 1988; Preece, 1987; Stuart, 1992). These social skills are associated with successful academic, personal, and vocational aspects of an individual's life (Walker, Schwarz, Nippold, Irvin, & Noell, 1994), and failure to develop proficient narrative skills may have devastating repercussions. Determining how narratives are acquired in typically developing children and identifying what components of narratives are impaired in children with language-learning disabilities will help further define language impairment and may contribute to remediation of the problem.

*Narrative development in children.*

Narratives are sequenced events that unfold over time and are linked according to causal principles (Westby, 1999). Comprehending or producing narratives therefore requires an appreciation of temporal associations and two types of cause and effect associations: physical and psychological. Physical cause and effect associations reflect the laws of the physical world (e.g., lightning storms cause forest fires or a dropped vase breaks). Psychological cause and effect associations embody the objectives or driving forces of characters in a narrative.

An understanding of how the characters in a narrative plan and work to achieve their goals is vital in narrative comprehension and production because how and why goals are achieved is a major focus of a narrative (Bruce, 1980; Wilensky, 1978). The steps characters take to achieve their goals require the ability to perceive (1) planning stages, (2) others' perspectives, (3) the traits and attributes of others, (4) and the intentions, feelings, and thoughts of others (Westby, 1999). Competent producers and comprehenders of narratives must simultaneously identify or produce these components in the action of a story, in association with the actions, thoughts, and responses of other characters in the narrative.

Several researchers have examined the progression of narrative development in typically developing children (e.g., Applebee, 1978; Botvin & Sutton-Smith, 1977; Liles, 1993; Stein & Glenn, 1979; Westby, 1999). Children begin to produce narratives as early as 2 ½ years of age, but these personal narratives lack episodic organization and suffer from vague referential information. After 3 years of age, children's awareness of episodic structure, syntactic and semantic development all result in more coherent narratives (Westby). While most researchers agree that children are able to produce an adult-like narrative by 6 to 7 years of age, form and content of narratives continue to develop well into adolescence (Liles). Specifically, increases in the number of narrative episodes and the ability to link multiple episodes develop as children progress in narrative skill production (Purcell & Liles, 1992; Roth & Spekman, 1986). The following is a summary of Westby's developmental progression of narratives from preschool to adulthood.

According to Westby (1999), preschool children typically include descriptions of events in a narrative that do not reflect a temporal organization. These contain labels and simple descriptions of objects or characters with no interconnections defined. Within an action sequence, a central character or theme may be identified with a general temporal relationship described in the action sequence. Here characters often are described within action sequences, but the characters act independently of one another. Westby states that any reactive sequences that preschool children produce during narratives have a cause and effect chaining of actions. No explicit planning is described.

Early elementary children may describe an abbreviated episode with a central theme/character present and a simple story grammar including an initiating event or problem, a response, and a consequence (Westby, 1999). These narratives include goals or intentions, but no planning is provided at this age. Characters' emotions may be described reflecting the concept of psychological cause and effect, a perception that people feel and think, and the ability to take on the perspective of another. In addition, stereotypical perceptions of characters are also present at this age (e.g., wolves are mean and try to eat pigs and people; princes save princesses and live in a castle). Complete episode narratives of early elementary children have a more complete story grammar, including an initiating event, internal response, plan, attempt, and consequence. In addition to features described in the abbreviated episode, children also include plans for reaching goals, further development of psychological cause and effect, further perspective taking, longer time frames for stories (e.g., days and weeks), and a meta-awareness of the need to plan and to justify planning.

Later elementary children produce complex episodes that include obstacles and several attempts to reach goals. Westby (1999) states that these children are able to develop more elaborate plans and can appreciate the perspective of more than one character due to an expansion of working memory capabilities. They show an emerging awareness of character growth (e.g., attributes change over time as result of specific events), and can recognize and produce deception/trickery elements in their stories. The time frame for their stories is further expanded (e.g., seasons, years) and their knowledge of multiple word meanings and figurative language is present in their stories. In multiple sequential episodes, later elementary school aged children develop chapters in their stories that reflect a specific chronological time frame. These chapters cover extended periods of time and reflect more complex planning skills.

Adolescents and adults are able to produce and comprehend interactive episodes that contain two or more characters with intertwining goals, or embedded episodes with one structured narrative rooted within another. Westby (1999) states that further increase in working memory allows ideas from the beginning or first episode to be held while a second episode is described. Flashbacks and flash-forwards, which require an advanced understanding of time and space, are also present, along with comprehension of multiple meanings and allegories. At this age, children are able to discuss components of the narrative, including story structure, character development, themes, and plots.

*Narrative skills in children with LLI.*

The term "language-learning impairment" is often used to refer to difficulties experienced by school age children in several aspects of communication that impact their ability to succeed. Most children with LLI are diagnosed with an expressive and/or receptive language delay in early childhood, and experience difficulty in a variety of communication modalities, including reading, speaking, and writing (Fey, Catts, Proctor-Williams, Tomblin, & Zhang, in press; Gillam & Johnston, 1992; Klecan-Aker, 1993; Laing & Kamhi, 2002; Milosky, 1987; Montgomery, 1995; Wright & Newhoff, 2001). Other children with LLI have an unremarkable preschool speech sound and language history, but develop problems upon entering elementary school while attempting to transition from oral to written language (Paul, 2001). A diagnosis of LLI precludes nonverbal cognition deficits, hearing impairment, and emotional disturbances or frank neurological impairments (Leonard, 1998). However, children with LLI do show neurological signs that indicate central neurological impairment (Tager-Flusberg, 2004).

Several studies have found that narrative comprehension and production skills are limited in children with LLI (Bishop & Adams, 1992; Crais & Chapman, 1987; Ellis Weismer, 1985; Gillam & Carlile, 1997; Gillam & Johnston, 1992; Liles, 1985; Merritt & Liles, 1987; Summers & Newhoff, 1990; Wright & Newhoff, 2001). For example, Gillam and Johnston (1992) examined the production of written and spoken narratives in nine to twelve year old children with LLI and compared them to chronological age-, spoken language age-, and reading age-matched peers. They found that children with LLI performed similarly to typically developing age-matched, spoken language age-matched, and reading age-matched peers when measuring amount of language form (i.e., morphemes per T-unit, T-units per story), organization of language content (i.e., predicate types per T-unit, dyadic constituents) and amount of language content (i.e., propositions per T-unit, constituents per story) in spoken and written narratives. Significant group differences did arise on measurements of organization of language form (i.e., complex T-units, and connectives per T-unit). Children with LLI and their reading age-matched peers produced a higher percentage of complex T-units and connectives per T-unit in spoken narratives than written narratives. In contrast, chronological age- and spoken language age-matched children produced a higher percentage of T-units and connectives per T-unit during the written narratives. Overall, children with LLI did not perform as well as typically developing peers on a measure of complex sentence usage and produced a larger percentage of grammatically incorrect simple and complex sentences, especially in written narratives.

When comparing the written and spoken narrative production for all children, Gillam and Johnston (1992) found that spoken narratives were longer, but not more complex, than written narratives. Specifically, the spoken narratives contained precise linguistic forms that defined associations between and within contiguous T-unit links. However, the otherwise numerous unconnected components of the spoken narratives revealed an overall disorganized textual content that was not present in the written narratives. Gillam and Johnston attributed this modality difference to the on-line processing demands that are present in spoken, but not written mode. When orally producing a story, the speaker must simultaneously develop the discourse goals specific to the current task, evaluate text production to fit discourse goals, and map content onto linguistic forms that are appropriate to the semantic, syntactic, and pragmatic level. Written narratives are not subject to the same expression time rates, as writers have the luxury of re-reading and editing their productions without the concern of interrupting the flow of the narrative.

Wright and Newhoff (2001) examined the comprehension of narratives in children (mean age = 11;3) who were diagnosed with LLI and compared them to typically developing children matched according to chronological age (CA) and language age (LA). Children heard and read four stories in both modes, and were then asked to retell each story and answer two each of the following types of inferencing questions: premise, informational inference, value inference, and logical inference. Wright and Newhoff found that children with LLI and their LA peers were not as successful as the CA children in their story recall and inference question responses, regardless of presentation mode. Wright and Newhoff note, however, that unlike the narrative task used in the study by Gillam and Johnston (1992), no pictures were used in this study; therefore the task may have been more difficult. In addition, Wright and Newhoff also report that no difference in story recall among groups was found regarding mode of presentation. The researchers state that their method of narrative analysis may account for this difference. Unlike Gillam and Johnston, Wright and Newhoff only analyzed the three most commonly recalled parts of story grammar (i.e., setting, initiating event, and consequence), which are more prominent and therefore more easily recalled by children with LLI and their LA peers.

Wright and Newhoff (2001) also found differences between typically developing and language-learning impaired groups regarding inference question performance by presentation mode. Overall, children with LLI answered fewer inference questions correctly than their CA and LA cohorts. Children with LLI responded correctly to more inference questions during the heard condition, whereas CA and LA peers responded correctly to more inference questions in the read condition. Wright and Newhoff attributed this difference to decoding difficulties, delays in inferencing skills, and impaired cognitive skills (including inefficient working memory systems, inability to attend to relevant information, and in appropriate metacognitive skills for task performance). They explained that the small number (two only) of each type of inferencing question might have limited the scope of testing of inferencing skill. Increasing the number or length of stories within presentation modes would allow for a greater number of questions to be asked within each question category. They did note that increasing the length of stories may result in poorer inferencing scores for children with LLI due to working memory deficiencies. Therefore, Wright and Newhoff suggest that an assessment of other cognitive skills, such as working memory, may be necessary to explain differences in the children's retention and processing abilities and may clarify inferencing process differences inherent within heard and spoken modes.

*Inferencing Skill*

The ability to infer information from text is one of the most important skills in narrative comprehension (Oakhill & Garnham, 1988). The ties that connect ideas in a text are not always explicitly stated. Therefore, the reader or listener must infer information in order to comprehend the full meaning of a text. Inferences are made based on explicit, factual information provided in the text, as well as the reader's own knowledge base. The writer depends on inferences to provide story coherence, and the reader or listener makes inferences to understand the story (Kintsch & van Dijk, 1978).

*Development of inferencing.*

Inferencing skills have been shown to develop in children as early as five years of age (Omanson, Warren, & Trabasso, 1978), and are considered by some to develop as a precursor to reading development (e.g., McConaughy, 1980). Researchers have examined children of various ages to determine how the ability to infer changes over time. For example, Paris and Upton (1976) found that six-year-olds had more difficulty than ten-year-olds answering questions that required inferencing than questions based on factual information. While these researchers initially concluded that the ability to infer is dependent upon a general knowledge base, a subsequent study (Paris, Lindauer, & Cox, 1977) revealed that six year old children could infer information that was outside their general knowledge base.

Other factors, such as memory, have also been examined to highlight relative contributions to the ability to infer information in text. Omanson, Warren, and Trabasso (1978) examined memory for text and inferencing skills in five and eight year olds. Even after assuring that the children's memory for the story was sufficient to make inferences, the researchers found that five-year-old children answered fewer inference questions correctly during story recall than eight-year-old children. They concluded that inferential skill is independent of memory of the text.

Researchers have found a strong link between memory and inferencing skills. For example, Masson and Miller (1983) examined twenty-nine undergraduate students on three measures of memory. In the letter span test, nine series of consonants ranging in size from four to ten items were presented via slide projector for one second each. After each series was presented, the subjects wrote as many letters they could recall in order of appearance. The reading span test consisted of six sets of unrelated sentences ranging in length from 2 to 5 sentences with a range of 14 to 20 words per sentence, all ending with a noun. Each sentence was presented via a slide projector for 8 seconds, and after reading each series, subjects wrote the final noun from each sentence in order of appearance. A third cloze test was included to assure that subjects were reading each sentence completely rather than only the final word in the sentence. One sentence from each series of the reading span test was presented with two or three content words and the final noun missing. Subjects were required to write the content and final words in their correct locations. Subjects were then asked to read two passages and answer questions that were based on information in the text that was explicitly stated or required inferencing. Finally, reading comprehension was measured by the number of correct responses to multiple choice questions developed from the two passages.

Coefficient correlations revealed positive associations among all tests except the letter span test. In addition, a series of hierarchical multiple regression analyses using alternating criterion and prediction variables revealed no significant change in the predicted variance, signifying that the predictor variables accounted for similar portions of variance in the criterion variable. Masson and Miller (1983) concluded that working memory is an important component that aids in encoding text information into long-term memory. In addition, the high degree of shared variance shows that long-term memory encoding may be a pivotal part of the relationship between text comprehension and reading span skills.

Singer, Andrusiak, Reisdorf, and Black (1992) examined 135 undergraduate students using the same reading span and cloze test as Mason and Miller (1983). They found that scores on the reading span test were significantly correlated with bridging inference skill. Bridging inferences serve as connections among propositions underlying discourse, and are required when the reference for specific information cannot be accessed by long-term memory skills (i.e., information that is specific to the text). Multiple linear regression analyses revealed that reading span was a significant predictor of bridging inference accuracy. Singer and colleagues concluded that readers with larger working memory capacities would most likely be more successful in bridging inferences, as their increased capacity allows for easier access to a reference for at least one of the text propositions in question.

*Inferencing skills in children with impaired comprehension.*

Researchers have found that children with poor reading or language comprehension skills have weak inferencing abilities. In a series of studies examining reading comprehension and inferencing in seven to eight year old children, Oakhill

(1982, 1983, & 1984) and Yuill and Oakhill (1988, 1991) found that children with good reading comprehension were better at making inferences than children described as less skilled in comprehension for information provided both explicitly (in which the reader must connect ideas in the constructive process of the text) and implicitly (in which the reader must fill in missing details from the text). While both groups of children improved in their inferencing ability when given an opportunity to review the text, the children with good comprehension skills continued to outperform their less skilled comprehension peers.

To determine if reading comprehension and inferencing skills are associated or casually related, Cain and Oakhill (1998) examined the accuracy of inferencing responses in “less skilled” comprehenders (mean age = 7;8), same age “skilled” comprehenders, and a group matched to the less skilled comprehenders based on reading and vocabulary age (mean age = 6;8). Children from each group read aloud one practice and four experimental stories. After each story, the children were asked to retell the stories and then answer two literal information based and four inferencing questions. Two of the inferencing questions were intersentence connecting inferences, which require the reader to connect explicitly stated information across sentences. The other two inferencing questions were gap filling, which required the reader to apply their own knowledge base in order to understand implicit textual information.

Skilled comprehenders outperformed the two other groups on all types of questions. Even after reviewing the text, skilled comprehenders outperformed the two other groups on the implicit information based questions. Further assistance was then provided to help the less skilled and reading and vocabulary age-matched children find the relevant text passage in order to correctly answer the question, but this also failed to improve their inferencing performance. Cain and Oakhill (1998) concluded that because less skilled comprehenders' performance was inferior to both same-age skilled and comprehension-age-matched groups, poor inferential skill is more likely a contributor to comprehension failure than a result of it. Inferior short-term memory for the text was disregarded as a possible source of inferential failure because there was no difference in the amount of literal text information recalled between the skilled and the comprehension age-matched groups. Instead, the authors stated that differences in text processing, a lack of understanding of when to apply general knowledge, and limited working memory capacity might explain the differences found among groups. Previous research supports a relationship between functional memory capacity and comprehension skill for similar text processing (Yuill, Oakhill, & Parkin, 1989). However, Cain and Oakhill maintain that a reduced memory capacity could not explain all the differences found among the groups.

Inferencing skills have also been examined in children diagnosed with language disorders, specifically to define the relationship between comprehension and cognition (inferencing). Ellis Weismer (1985) examined three groups of children (12 per group): second graders with language disorders (mean CA = 8;4), typically developing children (mean CA = 8;3) matched on non-verbal cognition scores (COG), and typically developing kindergartners (mean CA = 6;2) matched on language comprehension scores (LC). The groups were compared on two tasks, an Oral task, in which 3 sentence stories were orally presented without pictures, and a Picture task, in which 3 pictures representing a story were presented. After two stories were presented, four yes/no questions were asked: two questions regarding information in the text that was explicitly stated or depicted (premise questions), and two questions regarding information that must be inferred from the story (inference questions). Ellis Weismer found that LD and LC groups responded to significantly fewer inference and premise questions correctly during the Oral task than the COG group. No significant differences were found between the LD and LC groups, however. In the Picture condition, the LD and LC groups performed as well as the COG group on the literal questions, but significantly worse on the inferencing questions. Ellis Weismer reported that these results indicate deficiencies in understanding or memory for specific information relative to a cognitive deficit. Ellis Weismer concluded that the LD group may be able to understand specific words or phrases, but they are unable to develop connections between concepts in order to integrate information into a cohesive whole.

In a similar study, Crais and Chapman (1987) compared sixteen 9 to 10 year old children with language-learning disorders (LLD) to typically developing age-matched (AGE) children and six to seven year old receptive vocabulary age-matched (RVOC) children. Children with LLD scored significantly lower than the AGE group, but similar to the RVOC group on measures of non-verbal reasoning ability and vocabulary comprehension skills. The RVOC group also scored significantly lower than the AGE group on these measures. Twelve stories, comprised of 7 to 10 sentences each, were read to each child. After each story, children were asked to answer 4 inferencing true/false and 4 premise true/false questions regarding the story, either before or after they re-told the story. They found that both the LLD group and the RVOC group answered significantly fewer questions correctly than the AGE group. The LLD and the RVOC groups did not differ significantly, however. Crais and Chapman also compared children in the LLD group who scored lowest on comprehension vocabulary skills (as tested by the Peabody Picture Vocabulary Test-Revised, PPVT-R) to 8 RVOC children with similar PPVT-R scores on performance of false inference questions. According to Crais and Chapman, the significant difference between these groups for false inference questions confirmed that vocabulary comprehension, and not non-verbal cognition, is more closely related to story comprehension for children operating below a 7-year vocabulary level. Crais and Chapman explain that the LLD children had more difficulty on false rather than true questions due to the nature of the development of the questions. False questions were developed using information that was synonymous to story content and were generally plausible, but the sentence format of the false questions differed from the story. True questions were more often identical to story format sentence form.

Story recall did not aid inferencing, according to Crais and Chapman (1987), for one of two reasons. Either the question-answering task triggered an immediate inference that concealed the benefit of story recall, or story recall truly did not influence inferencing skills. Crais and Chapman conclude that it is vocabulary comprehension skills rather than cognitive skills that are related to story comprehension. They recommend that a more precise definition of comprehension, including syntactic comprehension, should be included in future studies in order to assess how syntactic skills and inferencing skills are associated.

Bishop and Adams (1992) included a grammatical analysis in a study of inferencing skill while comparing sixty-one 8-12 year old children with specific language impairment (SLI) and ten typically developing control children in each of the following age groups: 5, 6, 8, 10, and 12 years. Subjects with SLI performed similarly to the control children on measures of non-verbal skills, but scored significantly lower than the control group on the Test for Reception of Grammar (TROG). The children were presented four stories in one of two formats: in a picture format, where 4 pictures were displayed without verbally telling the story, or orally without showing the pictures. Fourteen questions (7 inferential, 7 literal) were then presented (without pictures present). Responses were scored using a 3-point scoring system: 2 points assigned for complete and accurate responses, 1 point for a partial response, and 0 for no response or an incorrect response.

Analysis of covariance revealed that children with SLI performed on an age equivalent level approximately 2-3 years below their actual age (based on control group comparisons). Both groups gave more correct responses on literal questions than inferential questions, but mode of presentation (verbal versus pictorial) did not affect scores. The researchers also found significant group effects when using TROG scores as a covariate. In addition, when the SLI group was further divided into those that fit a clinical description of semantic-pragmatic disorder and those that did not, SLI children with a semantic-pragmatic disorder performed significantly poorer on the story comprehension test, regardless of question type or presentation mode, than the SLI children without a semantic-pragmatic disorder. Finally, when correlating the scores from the story comprehension task with other pre-screening language measures, the authors found that non-verbal tests and measures of expressive language did not significantly correlate with story comprehension. Rather, measures of conversational inappropriateness and comprehension were significantly correlated with story comprehension scores.

Differences in presentation condition findings between the Bishop and Adams (1992) study and the Ellis Weismer (1985) study were accounted for by differences in sample size, which was larger in Bishop and Adams. In addition, Bishop and Adams used inference and literal questions that required simple 2 to 3 word responses rather than the yes/no responses required by Ellis Weismer. Therefore, children with expressive impairments may have difficulty providing simple responses, even if they do know the answer. Bishop and Adams contend, however, that expressive language scores were not significantly correlated with story comprehension measures. The role of pictures in story comprehension was also discussed as a possible explanation for the poor performance in children with SLI. If picture prompts help children to comprehend or remember the story, then higher scores on question responses would be expected for the picture mode. However, in the picture mode, the children with SLI performed significantly worse on inferencing questions than their mental age-matched peers. Instead, Bishop and Adams argue that children with SLI perform poorly on measures of story comprehension due to their inability to constructively process connected text. This would explain their poor performance on both literal and inference based questions: because children with SLI do not define a structure within a text, they are also unable to understand and recall all components of the story, including components that are presented factually and those that require inferencing.

*Taxonomy of inferencing.*

Inferences can be divided into three main sources of information (Warren, Nicholas, & Trabasso, 1979). The first source, logical, relates to the causes, motivations, and conditions within a text and reflect the responses to “Why?” and “How?” questions. Second, informational inferences, include the characters, instruments, contexts of events, time, places, and objects within a text and are supported by the “Who?,” “What?,” “When?,” and “Where?” questions. The third category is value inferencing, which reflects the reader’s world knowledge base of the text, specifically the knowledge regarding the words that are used, the items that are described, and the contextual descriptions between them. The reader’s knowledge base is developed through previous experience and verbal interactions, and influences understanding of logical and informational text relations. Inferences must be made for propositions of text that are not specifically related, but need to be for text cohesion (Warren et al.).

*Constructionist theory of inferencing.*

The constructionist theory of inferencing aims to account for inferences developed within the situation model of a narrative. The situation model encompasses the reader’s interpretation of the people, setting, action and events presented implicitly or explicitly within a narrative (Graesser, Singer, & Trabasso, 1994). Inherent in the constructionist theory is the search (or effort) after meaning principle (Berlyne, 1960; Spiro, 1980; Stein & Trabasso, 1985), which holds three crucial assumptions. First, the reader’s goal assumption states that the reader builds a situation model that mirrors the reader’s goals and reflects deep (e.g., referential associations) rather than shallow (e.g., lexicon and syntax) levels of processing. Second, the coherence assumption addresses the reader’s attempts to develop a situation model that is congruous at local (connections among adjacent or short sequence clauses) and global (local chunks organized and related to complex order chunks) levels. Finally, the explanation assumption explains the reader's endeavor to account for actions, events, and states described in the narrative. The constructionist theory states that some inferencing takes place on-line or as the reader comprehends the narrative, while other inferences occur later during subsequent text retrieval. Inferences that would take place on-line include the identification of: superordinate goals of characters that direct explicit facts in the narrative, causal antecedents that provide explanations for explicit actions, events, or states in the narrative, and global thematic inferences that incorporate main ideas or components of the text and reflect the author's message. Readers will not make these on-line inferences if they feel the text lacks coherence and a main idea, if the reader's background knowledge is insufficient to make inferences, and/or if the reader does not develop a situational model of the text (as in the case of proof-reading for spelling errors).

Several assumptions that explain the manner in which narratives are conceptually represented and understood by the reader define the constructionist model. First, the reader creates the situational model based on information provided from the text (i.e., graphemes, phonemes, syntax, vocabulary, propositional and clausal ties), from background knowledge structures (including specific and generic), and from the pragmatic content of the message (i.e., from the author's message, the reader's interpretation, components of story grammar) (Graesser et al., 1994). Second, there are three levels of cognitive code that are developed during comprehension: the surface code (i.e., the precise word structure and syntax), the text base (explicit narrative propositions and inferences necessary for cohesion), and the situation model, previously discussed (Kintsch, 1988, 1992; van Dijk & Kintsch, 1983). A reader's focus may alternate among any of these three levels, with increased attention given to any one area based on reader's interest (Bower, 1989). Third, the constructionist model defines three memory stores that are active during inferencing, including short-term memory (which holds the most immediate clause), working memory (which holds up to the last two sentences, plus actively recycled information), and long-term memory. Fourth, the degree or strength of encoding explicit or inferential information is dependent upon the extent to which informational resources are activated, and the degree to which these informational resources are conceptually taxed (Golden & Rumelhart, 1991; Graesser & Clark, 1985). Finally, the constructionist theory states that with repetition, the efficiency and speed in which knowledge structures are accessed increases. Automatized processes are much less taxing on the processing resources in working memory. Each of the five components of the constructionist's model could therefore be evaluated through an examination of children's narrative production and comprehension of stories. Specifically, an analysis of story grammar, syntactic complexity, and semantic content found within children's recall of narrative, as well as an assessment of how well children answer inferencing questions based on the stories, would represent how well children are able to process and understand stories. In addition, an analysis of children's narrative recall skills and verbal and non-verbal working memory would provide an indication of the degree to which processing resources contribute to narrative comprehension and production success.

Components that are distinctive to the constructionist theory include the satisfaction of the reader's goals, the achievement of both global and local coherence, and the understanding of explicit information. The constructivist theory maintains that special attention must be paid to the goals of the reader, because if the reader's goals are not recognized, the level of inferencing may be shallow or not completed at all. In addition, the degree to which the reader feels the text achieves coherence at both a global and local level will also influence the degree to which inferences are made. The reader will build a situation model and inference information only to the degree to which the factual text based information is presented clearly and accurately to the reader, and to the degree the reader's background knowledge structures support the text. A globally coherent situational model is achieved when textual information supports global coherence, the reader possesses adequate background knowledge, and the reader's goals do not prevent comprehension of the text (Graesser et al., 1994). Finally, readers aim to comprehend the text through the answering of "why" questions. Research shows that narrative comprehension is dependent upon causal explanations of actions, events, and states (Black & Bower, 1980; Fletcher, 1986; Graesser, 1981). Successfully responding to inferencing questions would therefore reflect the degree to which the reader's goals are achieved.

*Working Memory*

Empirical research suggests that memory plays an important role in reading skill development (Cornwall, 1992; de Jong, Seveke, & van Veen, 2000; Maclean, Bryant, & Bradley, 1987; Mann & Liberman, 1984; McBride-Chang, Manis, & Wagner, 1996; McDougall, Hulme, Ellis, & Monk, 1994; Naslund, 1990; Naslund & Schneider, 1991, 1996; Nation et al., 1999; Rohl & Pratt, 1995; Whitehurst & Lonigan, 1998). One component of memory specific to reading development is working memory. Working memory, or the ability to maintain and manipulate information in memory to achieve a specific goal, has been stated to play an important role during narrative development, inferencing, and reading comprehension, especially for novel information (Cain et al., 2004; Graesser et al., 1994; Just & Carpenter, 1992; Seigneuric et al., 2000).

*Theoretical models of working memory.*

Working memory includes several specific components that aid in phonological manipulation, beginning reading, and the transfer of learned information to long-term storage. For beginning readers who have not fully automated the reading process, working memory is theorized to serve as a storeroom for higher level processing of linguistically complex information (Baddeley, 1990; Cowan, 1988; Gathercole & Baddeley, 1993). Cowan (1995) states that acoustic, temporal, and sequential attributes of sound are stored for a short time in a "sensory trace" before fading. Through phonological coding, this sensory trace information is transferred into phonological representations. These representations or codes are stored with assigned meanings in long-term memory (Dollaghan, 1987). Through the use of rehearsal, these codes can be immediately accessed (Gillam & van Kleeck, 1996).

In order to account for the limitations of memory due to stimulus complexity or age differences, researchers have proposed elaborate working memory models. For example, Baddeley (1990) defined working memory as a triad system composed of a central executive, a visuospatial sketchpad, and a phonological loop (Baddeley, 1986; Baddeley & Hitch, 1974). In the latest revision of the model (Baddeley, 2000), an episodic buffer was added. The central executive directs processing and determines where visual, spatial, and linguistic information will be stored. The visuospatial sketchpad holds visual and spatial information in a passive form (verbal information is stored separately). Information (auditory input or read material that is sub-vocalized) is stored in the phonological loop and subvocal rehearsal refreshes decaying traces of information in working memory. The phonological loop accounts for individual differences in memory span for language material (McDougall et al., 1994). The episodic buffer integrates components of working memory and long term memory into a single episodic representation that may be in response to an event or experience. This integrative system is thought to be an important component of learning (Alloway, Gathercole, Willis, & Adams, 2004).

Alternatively, Cowan's (1995) "virtual short-term" working memory model and Ericsson and Kintsch's (1995) "long-term working memory model" do not depend on short-term memory stores. In these models, chunks of information are stored by contextual categories that indicate relevant situations when the information will be useful. When needed, information held in long-term memory is temporarily activated and extended beyond the focus of attention. Changes in the activated material are updated and stored based on relevant contextual categories, which are then easier to retrieve than other stored information (Cowan, 1997).

Working memory is theorized to consist of separate subsystems that independently maintain and manipulate spatial and causal information (Friedman & Miyake, 2000). This is consistent with Baddeley's model of working memory, in which verbal and speech-based information is maintained via the phonological loop, and visuospatial information is maintained via the visuospatial sketch pad. Empirical evidence supports these two distinct subsystems, and indicates that both subsystems work more independently than was first described in Baddeley’s model. For example, Shah and Miyake (1996) examined reading span and spatial span working memory skills in undergraduate students to see which skills best predicted performance on reading comprehension and spatial thinking tasks. They found that reading span scores best predicted reading comprehension performance, but not spatial thinking performance. In addition, spatial span scores predicted spatial thinking, but not reading comprehension performance. Shah and Miyake concluded that separate working memory systems were in operation for language comprehension and spatial thinking.

Support for the theory of a domain-specific segmentation of the central executive is found in the work of Alloway, Gathercole, Willis, and Adams (2004), who investigated the organization of working memory and cognitive skills in children 4 to 6 years of age. They examined three complex memory span tasks, chosen to represent the central executive component of working memory, including backwards digit recall, counting recall, and sentence completion and recall. Three measures to represent the phonological loop included digit recall, word recall and nonword repetition. Finally, the episodic buffer was represented by two versions of a sentence repetition task, which differed based on active versus passive sentence construction. Two phonological awareness tasks (i.e., detection of rhyme and initial consonant in words), as well as two non-verbal tasks (i.e., block design and object assembly) were also examined. Factor analysis was used to examine the goodness of fit for a variety of theoretical models, ranging in complexity, to identify the best model associated with the supporting cognitive systems. The researchers concluded that the model that most closely resembled Baddeley’s (2000) working memory model, a five-factor model with separate factors representing the central executive, episodic buffer, and phonological loop with separate phonological and non-verbal skill provided the best fit in 4 to 6 year old children. In addition, non-verbal ability was reported to be separate from the central executive component, supporting a domain specific model.

An alternative view of working memory systems is offered by Bayliss, Jarrold, Gunn, and Baddeley (2003), who examined both processing efficiency and storage capacity in children and adults in two experiments to assess which components predict performance on complex span tasks. For the purposes of this literature review, only the first experiment, which examined processing and storage in children, will be presented. Complex span tasks measure working memory performance, and require participants to process information while simultaneously holding components of this information to be used or produced in recall. While Conway and Engle (1994) support that performance in complex span tasks (i.e., working memory capacity) reflects performance of a general executive ability, Bayliss and colleagues (2003) contend that individual differences in processing or storage of complex span tasks are independent of the general executive capacity. They examined complex span performance of 7 to 9 year old children using verbal and visuospatial *processing* tasks and verbal and visuospatial *storage* tasks. In addition, measures of verbal and visuospatial processing *efficiency* and storage *ability* were also taken to assess the extent to which processing and storage components varied in complex span performance. To accomplish this, processing efficiency was measured based on identical processing components as those found in the complex span task, but with no storage component. Storage ability was measured based on storage requirements similar to those in the complex span tasks, but with no processing component.

Analysis of variance of processing domain by storage domain revealed main effects for processing, storage, and the processing and storage interaction. Bayliss and colleagues (2003) concluded that the significant interaction suggests that complex span task functioning depends on the specific mix of storage and processing components. Significant simple effects were also found for storage domain with verbal, but not visuospatial processing. In addition, a significant effect for processing with verbal, but not visuospatial storage was also reported. The researchers concluded that combining processing and storage within the verbal domain is especially challenging, but less so for visuospatial processing. This is consistent with the main effects, which show that the processing demands for visuospatial material were less taxing than the demands for verbal processing.

Analysis of variance with processing efficiency task (i.e., verbal and visuospatial) and set size as factors revealed that the reaction times in the verbal processing were slower than the visuospatial processing task. Bayliss and colleagues (2003) then examined the slope of the lines for the two types of processing tasks to determine if the slopes differed to assess similarities in processing requirements. Because the average slope value across set size for the visuospatial task was significantly different from zero, but the slope value for the verbal task was not, the researchers stated that the two tasks have different processing requirements. No significant difference was found when analyzing storage tasks, however, and the researchers concluded that this lack of difference indicates a similar performance across verbal and visuospatial storage tasks in children approximately 7 to 8 years of age.

Finally, to assess underlying structure of the processing, storage, and complex span components, the researchers performed an exploratory factor analysis. They found that the three factors that were preserved represented 72% of the total variance. Factor 1 emphasized a general processing component, independent of visuospatial processing. Factor 2 reflected a verbal storage component, and Factor 3 emphasized visuospatial storage. Load patterns for each of the three factors led Bayliss and colleagues (2003) to conclude that complex span performance derives from two separate resource regions: a domain-general resource pool for processing and a domain-specific resource pool for storage. This finding was further supported when the researchers examined the unique contributions made by processing efficiency and storage capacity to complex span performance. Through a series of hierarchical multiple regression analyses for each complex span task, they found that storage made unique contributions to both verbal and visuospatial complex span performance, independent of contributions made by processing. However, while processing was found to make independent contributions beyond that of storage for verbal span tasks, no additional contribution by processing was seen for visuospatial span measures. This, according to Bayliss and colleagues further supports their earlier conclusion that visuospatial processing is not as demanding as verbal processing in span tasks, and that demands differ for storage capacity and processing efficiency, which are subject to the level of processing demand inherent in the complex span task.

*Role of working memory in typically developing children.*

Seigneuric et al. (2000) examined working memory in 48 fourth grade native French children (M = 9 years, 9 months of age) and compared their working memory scores to their reading comprehension, vocabulary and decoding skills. Five working memory tasks were assessed, including two verbal (sentence and word based), two numerical (single and paired digits), and one spatial (line placement), and were stated to be similar in processing and capacity demands to Daneman and Carpenter's (1980) sentence span test (Seigneuric et al., 2000). Task reliability ranged from 0.67 to 0.81 and was described as generally satisfactory.

The mean scores (standard deviations) for each task were as follows: sentences 22.1 (6.4), words 15.3 (6.0), digits 26.4 (6.0) numbers 14.2 (4.4), and lines 17.2 (7.0). Pearson's correlations revealed that all working memory measures, except spatial, were highly correlated with reading comprehension. Further, vocabulary, decoding skills, and verbal and numerical working memory tasks were found to be significant predictors of reading comprehension. Specifically, the working memory word task was the strongest predictor of reading comprehension. Their findings provided support for the single domain (symbolic) capacity model hypothesis, which describes the relationship between working memory and cognitive functioning as specific to a single domain of processing.

Recently Cain and colleagues (2004) examined higher level language skills, including inferencing, metacomprehension skills, text structure knowledge, and verbal working memory skills to determine what impact, beyond the basic level skills, these higher level skills have on reading comprehension. In this longitudinal study, children were examined three times (i.e., at 8, 9, and 11 years of age) for reading ability (including word reading accuracy and reading comprehension), vocabulary, verbal ability (including measures of word meanings, general knowledge, and reasoning skills), working memory (including storage and processing of digits and the final word in sentences), inferencing and integration skills, comprehension monitoring, and knowledge of story structure. Children who were identified as poor readers or exceptional readers (i.e., those whose word reading skill level was more than two years above their chronological age) were excluded from the study.

Analyses conducted at each time period revealed significant correlations between reading comprehension and component skills and the sentence-span working memory task. The digit working memory task only correlated with reading comprehension at Time 2 when the children were 9 years of age. The researchers attributed the difference in correlation patterns to a difference in the working memory tasks: unlike the digit task, the sentence working memory task included a comprehension component, whereas the digit task did not. The inferencing measure was not correlated with the working memory tasks at Time 1, but was correlated at Times 2 and 3. This change across time was attributed to the fact that the Time 1 inferencing tasks differed from the inferencing task at Times 2 and 3. The inferencing task at Time 1 was from Oakhill's (1982) constructive integration task, in which children were required to listen to a series of three line vignettes and assess if given statements were present in the vignette. Three types of statements were presented: those that reflected literal information, those that were true inferencing statements, and those that were false inferencing statements. To account for the possibility of a "false memory" paradigm, the inferencing task at Times 2 and 3 was adopted from a previous study by Cain and Oakhill in which children read three short stories and answered six questions: two that reflected literal information, two that required inferencing across two sentences, and two that required inferencing based on general knowledge and information provided in the text.

Based on a three fixed order multiple regression analysis at each time period, Cain and colleagues (2004) concluded that working memory did account for a significant variance in reading comprehension beyond that of the basic word reading and verbal acuity skills. In addition, after controlling for decoding, vocabulary, and verbal skills, inferencing, metacomprehension skills, and story title knowledge made an independent contribution to reading comprehension, beyond that of verbal and lexical skills. A final multiple regression analysis revealed that inferencing skill and metacomprehension skills significantly contributed to the variance in reading comprehension after accounting for the contribution made by working memory. The researchers concluded that inferencing and metacomprehension skills make independent contributions to reading comprehension, outside of working memory, and beyond that attributed to basic verbal skills.

*Working memory in children with impaired language processes.*

Children with good reading skills have been shown to outperform children with poor reading skills on tasks of working memory (Engle, Carullo, & Collins, 1991; Leather & Henry, 1994; Oakhill, Yuill, & Parkin, 1988; Siegel & Ryan, 1989). For example, Oakhill, Yuill, and Parkin used a variation of Daneman and Carpenter’s 1980 sentence span task when examining 7 to 10 year old children who showed good and poor reading comprehension on a standardized reading comprehension test. Both groups were presented with a series of two to four number sets. Children read the series of numbers aloud before repeating each of the final numbers in the set. While scores from the two digit set were similar for both groups, both the three and four digit set scores were significantly worse in the children with poor reading comprehension skills. They concluded that working memory plays an important role in reading comprehension, but could provide no evidence based on the nature of their study as to the extent of that role.

Wass and Riley (2003) examined working memory skills in 9 to 18 year old children with fetal alcohol syndrome and compared them to typically developing peers based on verbal IQ and age. Three tasks of working memory were administered: numerical, letter, and word processing. Results from the multivariate analysis of variance showed comparable performance on each task for both groups. Selective problems were noted, however, specifically on the numerical processing task in children with fetal alcohol syndrome. In the numerical processing task, children were instructed to add two digits together, and then at the end of each set, recall only the answers to the equations. The number of equations in each set varied, but the children were not informed how many equations were in each set. The children with fetal alcohol syndrome were less accurate at providing the correct responses to the addition problems, but did not have difficulty recalling their incorrect responses in correct order. Due to the fact that no significant difference was found between the groups on these working memory tasks, Wass and Riley concluded that no evidence for a global working memory deficit was evident.

The verbal working memory skills of children with specific language impairment (SLI) and typically developing age-matched peers have been assessed to determine if differences between these groups exist. Ellis Weismer et al. (1999), using the Competing Language Processing Task (CLPT; Gaulin & Campbell, 1994), found that children age 5;8 to 9;7 (mean = 7;8) with SLI performed as well as their age-matched peers while answering simple true/false questions, but performed significantly poorer than these controls when recalling the last word in each true/false question set. These results were found even when the researchers controlled for non-verbal cognition. In addition, Ellis Weismer and colleagues found that within the SLI group, non-verbal cognition scores were significantly correlated with CLPT scores, but not with standardized language comprehension or mean length of utterance scores. Within the age-matched peer group, however, language comprehension scores were significantly correlated with CLPT scores, but not with non-verbal cognition or mean length of utterance scores.

Ellis Weismer et al. (1999) concluded that the difference found between children with SLI and their typically developing peers in word recall skill supports a processing capacity limitation in the SLI population. In addition, the lack of association between working memory and language skills for the children with SLI may be interpreted within an abnormal dissociation realm. Specifically, because CLPT scores were not significantly correlated with standardized language scores in children with SLI, deficits in working memory may be independent of language disorders in this population. They do note that the lack of correlation may be due to the standardized measures used, and the syntactic (i.e., MLU), as opposed to semantic, analysis. These researchers state that a more exhaustive analysis of the language assessments and the psycholinguistic abilities within the experimental tasks are required to fully test this hypothesis.

*Theoretical constructs of narrative comprehension, production, and working memory difficulties in children with LLI.*

One theory that accounts for the difficulty children with LLI have in narrative comprehension, production, and working memory skills is defined in terms of a limited processing capacity (Engle, Cantor, & Carullo, 1992; Golden & Rumelhart, 1991; Graesser & Clark, 1985; Leonard, 1998; Spiro & Myers, 1984). Processing capacity reflects the amount of cognitive resources available to complete a specific task. Learning new tasks requires all conscious resources to be engaged, which results in a strain on working memory. Through practice and repetition, the new tasks become more automated, resulting in both an increase in efficiency of cognitive processing and of processing capacity (Baddeley, 1986; Just & Carpenter, 1992). Limited capacity is defined within three processing modalities: space, energy, and/or time (Kail & Salthouse, 1994; Roediger, 1980; Salthouse, 1985). Limitations based on space are described as a decrease in the size of allotted memory necessary to complete a task. Energy restrictions reflect an inadequate supply of mental power necessary to finish a cognitive task. Finally, time restrictions are defined in terms of limitations based on rate of processing speed. Information that is not processed within a specific amount of time will be subject to decay or interference from competing or incoming information. These categorizations are not mutually exclusive, and may occur in combination (i.e., inefficient word recall and retrieval are defined in terms of time and energy processing capacity limitations as described by Leonard, 1998).

Several linguistic and non-linguistic difficulties found in children with specific language impairment (SLI) and LLI are attributed to processing capacity limitations, including problems in pragmatics, phonology, morpho-syntax, comprehension (including inferencing) (Leonard, 1998) and word decoding skills specific to text based reading (Spiro & Myers, 1984). As discussed previously, Ellis Weismer (1985) found that children with language disorders (LD) performed similarly to language comprehension age-matched children (LC) while answering inference and factual questions based on three-item stories presented orally or pictorially. The children with LD also performed as well as children matched by non-verbal cognition scores (COG) on factual based questions in the pictorial mode, but significantly worse than COG peers on inference based questions in the same mode. In addition, Bishop and Adams (1992) used longer orally presented and picture based stories and found that children with SLI answered fewer inferencing based questions than factually based questions correctly than their comprehension age-matched peers in both presentation modalities. Leonard (1998) stated that limited processing could account for these findings in two ways. First, children with SLI answer inferencing questions correctly in short stories in the pictorial mode (Ellis Weismer, 1985), but when a greater amount of information was required to be stored and recalled, as in the case when longer stories were employed (Bishop & Adams, 1992), the task was more difficult. Second, answering inferencing questions correctly is more difficult than answering factually based questions due to the fact that additional processing is required to connect ideas that are not explicated stated (or visually represented) in the text (or story pictures) (Leonard, 1998, pp. 240-241).

Other researchers dispute limited processing capacity as an explanation for the poor performance of children with language difficulties (Nation et al., 1999; Seigneuric et al., 2000). In a series of three experiments, Nation and colleagues examined the memory competency of ten year old children with good and poor reading comprehension who were matched for non-verbal ability and decoding skill ability. They found that poor comprehenders were similar to good comprehenders in serial recall for common concrete words and non-words, but recalled fewer abstract words than good comprehenders. In addition, poor comprehenders were found to perform as well as good comprehenders on a spatial working memory task, but not as well as good comprehenders on a working memory listening span task. The researchers concluded that the working memory deficit found in poor comprehenders is specific to the verbal memory domain, which reflects the mechanisms that support speech production, perception, and comprehension (Hulme, Maughan, & Brown, 1991; Hulme, Roodenrys, Schweickert, Brown, Martin, & Stuart, 1997; Martin & Lesch, 1996; Walker & Hulme, 1999).

This domain specific hypothesis states that the basis of the problem of poor comprehenders lies in their weak verbal skills. In a typical language system, both the phonological and semantic representations of words are activated when a list of words is heard. The semantic representations act to reinforce the phonological tracings of a word, which in turn assist in retrieval, reintegration, and/or phonological output (Poirer & Saint-Aubin, 1995; Walker & Hulme, 1999). Because poor comprehenders have normal phonological skills but poor semantic skills, their recall performance is based only on their phonological representations, without semantic aid to assist in refreshing the tracings of the word. That, according to the researchers, explains why poor comprehenders had more difficulty with words that were abstract (words that would require aid from semantic knowledge) than concrete (familiar constructions and therefore less need for semantic aid). In addition, poor comprehenders were not as successful at completing the verbal working memory task due to their poor listening comprehension skills. Because the poor comprehenders performed equally well on the spatial memory task, however, the researchers concluded that the area of deficit is specific to the verbal skills realm, and is therefore not a global limited capacity problem. They conclude that further research utilizing multiple measures of verbal and non-verbal working memory is required to further test their hypothesis.

In summary, the limited processing capacity theory holds that deficiencies in working memory, language comprehension, and production stem from inefficient processing that encompasses several cognitive resources. While attempting to comprehend and produce linguistic or non-linguistic information, cognitive resources become taxed due to limitations in space, energy, and/or time necessary to complete the task. This results in inferior output and/or less elaborate mental representations. Alternatively, other researchers (Nation et al., 1999; Seigneuric et al., 2000) state that deficiencies in language comprehension, production, and working memory are domain specific and can be traced to problems in the verbal skill area of processing.

### *Description of Proposed Study and Research Questions*

The purpose of this study is as follows: 1) confirm and expand upon the results of Wright and Newhoff’s (2001) study by providing a more detailed story grammar analysis of children’s recalled narratives using stories that are more representative of a typical elementary level story, and by providing a more extensive description of children's inferencing skills using a greater number of questions based on these longer stories; 2) assess syntactic differences among children with LLI, their CA- and LA-matched peers using longer stories; 3) assess the effect of input modality (heard versus read) on story grammar and syntactic complexity in children with LLI, and their CA- and LA-matched peers, 4) assess verbal and non-verbal working memory skills to assess differences among children with LLI, and their CA and LA peers in working memory skills and to determine what association, if any, exists between verbal and non-verbal working memory and story grammar, syntactic complexity, and inferencing skill, and 5) assess multiple measures of working memory in children with LLI to gain insight into the extent to which different processes are impacted. These findings will be discussed in reference to the global limited processing capacity or the single domain verbal processing disorder.

In this study the following questions will be addressed:

1. Do children with LLI differ from CA- and LA-matched peers in the number of story grammar components and the level of syntactic complexity produced during narrative recall of stories that were initially heard or read? It is hypothesized that children with LLI will produce fewer story grammar parts than their CA- and LA-matched peers. In addition, children with LLI will recall more complete story grammar parts in the heard condition while children in the CA and LA groups will recall more story grammar parts in the read condition as seen in Wright and Newhoff (2001). It is further hypothesized that the children with LLI will produce narratives of less syntactic complexity than their CA- and LA-matched peers, based on the results of Gillam and Johnston (1992).

2. Do children with LLI differ from their CA- and LA-matched peers in their ability to correctly respond to inferencing questions based on stories presented in a heard or read modality? It is hypothesized that children with LLI will answer fewer inferencing questions correctly than their CA- and LA-matched peers as seen in Wright and Newhoff's study. In addition, it is hypothesized that a hierarchy of skills will emerge within the taxonomy of inferencing questions. Children with LLI will correctly answer more informational inferencing questions, followed by value inferencing questions, then logical inferencing questions.
3. Do children with LLI perform as well as their CA- and LA-matched peers on measures of verbal and spatial working memory? It is hypothesized that children with LLI will score lower than their CA- and LA-matched peers on measures of verbal memory tasks, but as well as their CA and LA peers on spatial memory tasks (Nation et al., 1999; Seigneuric et al., 2000).
4. Do verbal and/or spatial working memory scores correlate positively with scores of story grammar, syntactic complexity, and inferencing skill in children with LLI, CA-matched peers, and LA-matched peers? It is hypothesized that positive correlations will be found for verbal working memory and story grammar recall, syntactic complexity recall, and inferencing scores. Finally, based on the work of Seigneuric and colleagues (2000), no correlation will be found for spatial working memory scores and any of the previously mentioned language measures.

# CHAPTER III

## Method

*Participant Recruitment*

A letter of introduction that described and requested permission to conduct the research study was provided to thirty-three elementary, intermediate, and middle school principals in the Knox County, Blount County, and Maryville City school districts, accompanied by a Letter of Cooperation which stated the expected role of the principals, and a Fact Sheet which outlined the study. A total of nine signed Letters of Cooperation were returned. After receiving signed Letters of Cooperation from the school principals, teachers and speech-language pathologists from each of the participating schools also were sent Letters of Cooperation and Fact Sheets. Eight letters of cooperation were returned from the speech-language pathologists, and one letter was returned from the teachers. Parent contact letters, Consent Forms, and Fact Sheets were given to the participating teacher, principals, and speech-language pathologists to distribute to the parents of potential participants. Parents who provided signed consent were contacted by phone to discuss the study and answer any questions. A questionnaire regarding their child's health and academic history and the parents' current occupations and level of education (see Appendix A) was completed and returned by mail or in person by the participant.

*Participants*

Three groups of ten children (LLI, CA, and LA) participated in the study. The LLI group consisted of ten second to fifth grade children who ranged in age from 9;0 to 12;11 (M = 11;2 years), and had received a diagnosis of language-learning impairment. A summary of health, medical, area of deficit, and educational status from the parental report for children of the LLI group is provided in Table 1 (see Appendix B for complete summary for all groups). Based on parental report, nine of the ten children had received speech and language services in the past, and all ten were currently enrolled for language therapy. Five of the children's parents reported behavior problems and noted that their child would lose his or her temper easily and become aggressive, although no outburst or irrational behavior was noted during any of the sessions in the current study. Two children (#3 and #10) experienced ear infections, which led to the placement of pressure equalization tubes at 4 years and 8 years, respectively. No impact on hearing acuity was reported, and no further difficulties with ear infections since that time were reported. Parents of the LLI participants reported no history of seizures or neurological impairment, and no current health or medical concerns were noted.

Parents of three children reported a family history of speech and/or language problems (child #5, #6 and child #10). English was reported as the only language spoken in all of the homes. One child (#10) was noted to speak Southern Appalachian English. All of the children in the LLI group were reported to have successfully passed each grade, but four of the families elected to send their child for a year of junior primary following kindergarten (child #1, #4, #5, and #9), and one family (child #7) chose to have their child repeat first grade, even though she successfully completed the grade. All of the

Table 1

Summary of Parental Report for Area of Deficit, Health, and Education for Participants in the Language-Learning Impaired (LLI) Group

| Subject | Past SLP services | Current SLP services | Parents' major concern | Health /medical | Current grade | Each grade passed | Additional services[3] |
|---|---|---|---|---|---|---|---|
| LLI1 | yes | yes | learning, social skills | none | 2 | yes[1] | none |
| LLI2 | yes | yes | remembering | none | 4 | yes | none |
| LLI3 | yes | yes | processing | none | 5 | yes | none |
| LLI4 | yes | yes | language | none | 4 | yes[1] | none |
| LLI5 | no | yes | comprehension | none | 5 | no[1] | none |
| LLI6 | yes | yes | comprehension | none | 5 | yes | none |
| LLI7 | yes | yes | memory | none | 5 | yes[2] | math |
| LLI8 | yes | yes | expression | none | 5 | yes | none |
| LLI9 | yes | yes | articulation, comprehension | none | 5 | yes[1] | none |
| LLI10 | yes | yes | basic speech, language | none | 5 | yes | none |

Note. SLP = Speech-Language Pathology.

[1]Participant completed Junior Primary, [2]Participant repeated year at parents' request;

[3]Services received in addition to SLP and Resource.

children in the LLI group were receiving resource services for reading, and child #7 received additional services for memory and math. Resource services did not include direct instruction of inferencing or story grammar. Parents of all participants reported normal or corrected visual acuity for reading.

The CA group consisted of typically developing children, recruited from the same school system as their LLI peers, and were matched to the LLI group by chronological age (+/- 2 months), with a range of 8;11 to 12;0 (M = 11;2 years). Because socioeconomic status (SES) is known to influence language skills (Snow et al., 1976), SES was assessed for the participants in the LLI and CA groups using the Hollingshead Four Factor Index of Social Status (Hollingshead, 1976). This index reflects four components of social living, including parents' marital status, educational level, occupation, and sex. To calculate social status score, occupation and education levels are first converted to a scale value. Scale values for occupation and education carry a weight of 5 and 3, respectively. Each weight is multiplied by the scale value, and then summed. Scores are then coded one through five based on a range of social status score values; a code of one reflects professional level, and a code of five reflects unskilled laborers. For two income households, both parents' occupations and education levels are calculated independently, and then averaged together before being coded. A summary of all Hollingshead scores and corresponding codes are provided in Table 2. Attempts were made to match the LLI and CA groups based on social status. Three pairs of children (LLI3 & CA21, LLI6 & CA23, and LLI9 & CA30) were not a direct match, but were included because they did meet the age criteria (i.e., +/- 2 months), and attended the same

Table 2

Summary of Hollingshead Scores and Corresponding Codes for LLI and CA Participants

| Subject | CA | Hollingshead | Code | CA-matched subject | CA | Hollingshead | Code |
|---|---|---|---|---|---|---|---|
| LLI1 | 9;0 | 42 | 2 | CA24 | 8;11 | 37 | 2 |
| LLI2 | 11;1 | 42 | 2 | CA26 | 11;2 | 43 | 2 |
| LLI3 | 10;8 | 59.5 | 1 | CA21 | 10;10 | 35.3 | 3 |
| LLI4 | 11;5 | 47 | 2 | CA22 | 11;4 | 44.5 | 2 |
| LLI5 | 11;11 | 43 | 2 | CA27 | 12;0 | 49.5 | 2 |
| LLI6 | 11;1 | 27 | 4 | CA23 | 10;11 | 50 | 2 |
| LLI7 | 11;3 | 53 | 2 | CA28 | 11;1 | 53 | 2 |
| LLI8 | 11;11 | 40 | 2 | CA29 | 11;11 | 50.5 | 2 |
| LLI9 | 11;11 | 40 | 2 | CA30 | 11;11 | 55 | 1 |
| LLI10 | 11;6 | 37 | 3 | CA25 | 11;6 | 38.5 | 3 |

Note. Hollingshead refers to the Hollingshead Four Factor Index of Social Status; LLI = Language-learning impaired; CA = Chronological age.

school. A paired t test revealed no significant difference between the groups based on Hollingshead scores ($t(9) = -.659$, $p = .53$).

All CA participants were in fifth or sixth grade, with the exception of child #24 who was enrolled in third grade. A summary of health, medical, area of deficit, and educational status from the parental report for children of the CA group is provided in Table 3 (see Appendix B for complete summary). All of the children had successfully passed each grade, but child #27 repeated kindergarten at her parents' request. None of the children in the CA group were receiving special services, but three of the children had received speech therapy in the past for speech sound production errors (i.e., child #24, #27, and #28). Seven of the ten children have a history of ear infections, but none recently, and none of the children were experiencing ear infections at the time of the study. No history of seizures was noted. Three of the children were taking medication for allergy/asthma related difficulties (child #23, #26, and #27), and one (child #29) was taking medication for migraine headaches. No other health or medical problems were reported. Three children reported a family history of speech and/or language problems (child #23, #26, and child #27). English was reported as the only language spoken in all of the homes. One child (#24) was noted to speak Southern Appalachian English. Parents of all participants reported normal or corrected visual acuity for reading.

The LA group consisted of typically developing children, matched to the LLI group based on language age (LA), as determined by the combined raw scores of the Listening Comprehension and Oral Expression subtests of the Oral and Written Language Test (OWLS, Carrow-Woolfolk, 1995). No significant difference was found between

Table 3

Summary of Parental Report of Area of Deficit, Health, and Education for Participants in the Chronological Age (CA) Group

| Subject | Past SLP services | Current SLP services | Parents' major concern | Health /medical | Current grade | Each grade passed | Special services |
|---|---|---|---|---|---|---|---|
| CA21 | no | no | n/a | none | 5 | yes | none |
| CA22 | no | no | n/a | none | 5 | yes | none |
| CA23 | no | no | n/a | asthma | 5 | yes | none |
| CA24 | yes | no | articulation | none | 3 | yes | none |
| CA25 | no | no | n/a | none | 6 | yes | none |
| CA26 | no | no | n/a | none | 5 | yes | none |
| CA27 | yes | no | articulation | none | 5 | yes[1] | none |
| CA28 | yes | no | articulation | none | 5 | yes | none |
| CA29 | no | no | n/a | asthma | 6 | yes | none |
| CA30 | no | no | n/a | asthma | 6 | yes | none |

Note. SLP = Speech-language pathology; n/a = not applicable.

[1]Participant repeated year at parents' request.

OWLS raw scores for the LLI (M = 124, SD = 5.52, range of 114 to 131) and the LA (M = 123.8, SD = 6.0, range of 118 to 134) groups ($t(18) = .45$, $p = .50$). A summary of OWLS scores is provided in Table 4. No attempt was made to match children according to SES because they were already matched according to language age.

Children in the LA group ranged in age from 8;1 to 9;5 (M = 8;4 years) and were enrolled in second to third grade. A summary of health, medical, area of deficit, and educational status from the parental report for children of the LA group is provided in Table 5 (see Appendix B for complete summary). All of the children had successfully completed each grade, and no child received resource services. One child in the LA group was reported to have received speech services in the past for speech sound production distortions (child #12) and one child is currently receiving speech services for remediation of /r/ production (child #14). Parents reported no other speech or language concerns. One parent reported behavior problems in her child (child #19) but no outbursts were observed during the sessions in this study. Four children in the LA group were noted to experience seasonal ear infections, but all of the children were reported to be free of infections at the time of this study. Use of prescription medication was limited to seasonal allergy use, with no other health or medical problems noted. One parent reported a family history with speech sound production impairment (child #12). English was the only language reported to be spoken in all of the homes, and all of the children in the LA group spoke a SAE dialect. Parents of all participants reported normal or corrected visual acuity for reading.

Table 4

Summary of Oral and Written Language Scales (OWLS) Combined Raw Scores for LLI and LA Groups

| Subject | Language age | OWLS score | LA-matched group | CA | OWLS score |
|---|---|---|---|---|---|
| LLI1 | 8;2 | 118 | LA11 | 8;0 | 118 |
| LLI2 | 8;2 | 121 | LA12 | 8;3 | 120 |
| LLI3 | 8;3 | 114 | LA17 | 8;0 | 122 |
| LLI4 | 8;10 | 128 | LA14 | 8;8 | 134 |
| LLI5 | 8;0 | 123 | LA18 | 8;1 | 118 |
| LLI6 | 8;9 | 131 | LA15 | 8;8 | 124 |
| LLI7 | 8;4 | 122 | LA20 | 8;3 | 121 |
| LLI8 | 8;0 | 121 | LA13 | 8;1 | 119 |
| LLI9 | 8;7 | 131 | LA19 | 8;2 | 131 |
| LLI10 | 9;1 | 126 | LA16 | 9;1 | 131 |
| Means (SD) | 8;4 | 124(5.52) | Means (SD) | 8;4 | 123.8(6.00) |

Note. LA = Language age; LLI = Language-learning impaired; CA = Chronological age, OWLS score = combined raw scores on Listening Comprehension and Oral Expression Subtests.

Table 5

Summary of Parental Report of Area of Deficit, Health, and Education for Participants in the Language Age (LA) Group

| Subject | Past SLP services | Current SLP services | Parents' major concern | Health /medical | Current grade | Each grade passed | Special services |
|---|---|---|---|---|---|---|---|
| LA11 | no | no | n/a | none | 2 | yes | none |
| LA12 | yes | no | n/a | none | 2 | yes | none |
| LA13 | no | no | n/a | none | 2 | yes | none |
| LA14 | no | yes | Articulation | none | 3 | yes | none |
| LA15 | no | no | n/a | none | 3 | yes | none |
| LA16 | no | no | n/a | none | 3 | yes | none |
| LA17 | no | no | n/a | none | 2 | yes | none |
| LA18 | no | no | n/a | none | 2 | yes | none |
| LA19 | no | no | n/a | none | 2 | yes | none |
| LA20 | no | no | n/a | none | 2 | yes | none |

Note. SLP = Speech-language pathology; n/a = not applicable.

*Procedure*

*Pre-experimental testing.*

Each participant attended pre-experimental sessions with the primary investigator to determine if he or she qualified to participate in the study. Sessions lasted no more than 90 minutes and took place after school in a quiet room at the participant's school. The majority of children completed all pre-experimental testing in two sessions. An additional session was scheduled for those children who were slower in responding or required more breaks. All participants had an opportunity to ask questions before signing an assent form to participate in the study. In addition, at the beginning of each pre-experimental and experimental session, the tasks to be completed were described and all participants provided verbal assent before participating.

During the first pre-experimental session, all participants passed a bilateral hearing screening at 20 dB HL at 500, 1000, 2000 and 4000 Hz (American Speech-Language Hearing Association, 2002) and demonstrated fully intelligible speech in conversation with the primary investigator. In addition, children in the LLI group were administered the Test of Language Development-Intermediate:3 (TOLD-I:3, Hammill & Newcomer, 2003) to determine current level of language performance. Children who earned a composite score at or below 81 (i.e., -1.25 SD or greater) of their age group mean qualified for the LLI group. This cut-off point was selected based on the good agreement shown by speech-language pathologists for the presence of a language disorder for composite scores at or below this level (Records & Tomblin, 1994; Tomblin et al., 1997). A summary of TOLD-I:3 composite quotient scores for the LLI group is provided in Table 6.

Table 6

Means and Standard Deviations (SD) of all TOLD-I:3 Composite Quotients for Participants in the Language-learning Impaired (LLI) Group

| Subject | CA | Spoken* | Listening* | Speaking* | Semantics* | Syntax* |
|---|---|---|---|---|---|---|
| LLI1 | 9;0 | 82 | 87 | **79** | 87 | **79** |
| LLI2 | 11;1 | 83 | 91 | **79** | 91 | **76** |
| LLI3 | 10;8 | 87 | 94 | 83 | **81** | 96 |
| LLI4 | 11;5 | **78** | 83 | **76** | **81** | **81** |
| LLI5 | 11;11 | **78** | 91 | **68** | 89 | **70** |
| LLI6 | 11;1 | **64** | **72** | **61** | **66** | **68** |
| LLI7 | 11;3 | 82 | 94 | **72** | **79** | 87 |
| LLI8 | 11;11 | **63** | **68** | **64** | **68** | **64** |
| LLI9 | 11;11 | **71** | **79** | **68** | **76** | **70** |
| LLI10 | 11;6 | **67** | **66** | **72** | **76** | **61** |
| Means (SD) | 11;2 | 76 (8.61) | 83 (10.72) | 72 (7.08) | 79 (8.32) | 75 (10.82) |

Note. Bolded scores indicate scores that fell –1.25 SD (i.e., 81) or greater below the mean.

*Subtest of the Test of Language Development-Intermediate:3.

Six of the children in the LLI group had at least one composite quotient score above 81, but qualified for the study because at least one of their composite quotient scores fell at 81 or below. The majority of children scored an 81 or below on the Speaking, Syntax, Semantics, and Spoken composites. However, less than half of the children scored below 81 on the Listening composite. These scores indicated that the children in the LLI group had expressive or expressive-receptive deficits. Specifically, the majority of children had difficulty creating grammatically correct sentences, especially when required to use conjunctions, and in distinguishing sentences as grammatically correct or incorrect. The majority of children also showed poor word understanding, including basic vocabulary knowledge, and was unable to apply their knowledge of words to create word categories and detect sounds in words that alter word meanings.

Because the TOLD-I: 3 does not yield language-age equivalent composite scores, the OWLS was administered to match children in the LLI and LA groups and to assure that the CA and LA groups had expressive and receptive language skills within +/-1.0 SD (i.e., standard scores between 85 and 115) of their age group means. Children in the LLI group earned similar scores on both the TOLD-I:3 and the OWLS: at least one composite score on the TOLD-I:3 and one or both subtests on the OWLS fell 1.25 SD below the mean or greater. A summary of the combined OWLS standard scores for the LA and CA groups is provided in Table 7. Reading language abilities and decoding skills were assessed for all children regardless of group during the pre-experimental session using the Word Attack, Word Comprehension, and Passage Comprehension Subtests of the

Table 7

Standard Scores, Group Means, and Standard Deviations (SD) of LA and CA Participants' Oral and Written Language Scales (OWLS)

| Group | CA | Standard Score |
|---|---|---|
| LA11 | 8;00 | 98 |
| LA12 | 8;03 | 97 |
| LA13 | 8;01 | 102 |
| LA14 | 8;08 | 105 |
| LA15 | 8;08 | 98 |
| LA16 | 9;01 | 99 |
| LA17 | 8;00 | 100 |
| LA18 | 8;01 | 98 |
| LA19 | 8;02 | 109 |
| LA20 | 8;03 | 98 |
| Means (SD) | | 100.4 (3.86) |
| CA21 | 10;10 | 106 |
| CA22 | 11;04 | 93 |
| CA23 | 10;11 | 97 |
| CA24 | 8;11 | 92 |
| CA25 | 11;06 | 108 |
| CA26 | 11;02 | 110 |
| CA27 | 12;00 | 101 |
| CA28 | 11;01 | 98 |
| CA29 | 11;11 | 100 |
| CA30 | 11;11 | 104 |
| Means (SD) | | 100.9 (6.10) |

Note. LA= Language age, CA= Chronological age.

Woodcock Reading Mastery Tests-Revised/Normative Update (WRMT-RNU, Woodcock, 1998). All participants scored at a minimum of a second grade reading level, or commensurate with the highest reading level of the experimental stories (i.e., 2 years, 7 months), in order to participate. A summary of individual scores for pre-experimental testing is provided in Table 8. Within the LLI group, three children (#2, #3, and #7) earned reading scores that fell within –1.25 to +1.75 SD on all of the WRMT-RNU subtests. In addition, three of the children in the LLI group (#1, #5, and #6) scored 1.25 SD below the mean on the Word Attack subtest, one child (#4), scored more than 1.25 SD below the mean on the Word Comprehension subtest, but five of the children (#4, #6, #8, #9, and #10) scored more than 1.25 SD below the mean on the paragraph comprehension subtest. Therefore, the majority of the children did not appear to have word decoding or difficulty with synonyms, antonyms, or analogies, but half of the children did struggle with reading comprehension, as seen in the Paragraph Comprehension subtest scores. Based on these subtest scores, seven of the children in the LLI group would be classified as reading impaired, with both word recognition and comprehension deficits noted (Catts & Kamhi, 1999). All of the children in the CA and LA groups earned scores that fell between +/- 1 SD on all the subtests.

Finally, all participants' non-verbal intelligence was screened using the Matrices subtest of the Kaufman Brief Intelligence Test (K-BIT; Kaufman & Kaufman, 1990) to ensure normal non-verbal intellectual function. Scores were considered within normal range as they fell within +/- 1 SD (standard score of 85 to 115). All of the children, regardless of group, earned scores that fell within this range (see Table 8 for a summary of individual scores).

Table 8

Woodcock Reading Mastery Test/Revised-Normative Update (WRMT-RNU) and Kaufman-Brief Intelligence Test (K-BIT) Individual Scores for Language-learning Impaired (LLI), Chronological Age (CA), and Language Age (LA) Groups

| Group | WRMT-RNU:WA[1] | WRMT-RNU:WC[2] | WRMT-RNU:PC[3] | K-BIT |
|---|---|---|---|---|
| LLI1 | 73 | 98 | 87 | 100 |
| LLI2 | 105 | 98 | 85 | 101 |
| LLI3 | 99 | 89 | 90 | 110 |
| LLI4 | 87 | 71 | 72 | 92 |
| LLI5 | 79 | 94 | 91 | 96 |
| LLI6 | 78 | 84 | 81 | 98 |
| LLI7 | 107 | 92 | 84 | 95 |
| LLI8 | 83 | 91 | 73 | 96 |
| LLI9 | 87 | 90 | 78 | 90 |
| LLI10 | 93 | 88 | 79 | 104 |
| LLI Mean (SD) | 89 (10.82) | 90 (11.63) | 82 (7.81) | 98.2 (5.78) |
| LA11 | 104 | 106 | 110 | 104 |
| LA12 | 104 | 112 | 92 | 103 |
| LA13 | 112 | 107 | 98 | 104 |
| LA14 | 100 | 113 | 102 | 104 |
| LA15 | 99 | 103 | 90 | 107 |
| LA16 | 105 | 115 | 108 | 96 |
| LA17 | 109 | 100 | 100 | 106 |
| LA18 | 102 | 113 | 100 | 107 |
| LA19 | 109 | 109 | 113 | 108 |
| LA20 | 106 | 114 | 102 | 100 |
| LA Mean (SD) | 105 (4.14) | 109.2 (5.07) | 101.5 (7.35) | 103.9 (6.99) |
| A21 | 106 | 115 | 106 | 107 |
| CA22 | 109 | 97 | 100 | 104 |
| CA23 | 102 | 100 | 100 | 99 |
| CA24 | 92 | 103 | 98 | 103 |
| CA25 | 101 | 100 | 101 | 101 |
| CA26 | 100 | 100 | 100 | 111 |
| CA27 | 102 | 101 | 104 | 89 |
| CA28 | 100 | 101 | 99 | 108 |
| CA29 | 102 | 114 | 104 | 105 |
| CA30 | 101 | 111 | 100 | 107 |
| CA Mean (SD) | 101.5 (4.38) | 104.2 (6.55) | 101.2 (2.57) | 103.4 (6.15) |

[1]WA = Word Attack Subtest; [2]WC = Word Comprehension Subtest; [3]PC = Paragraph Comprehension Subtest.

*Experimental sessions: Practice stories.*

Participants completed a series of practice and experimental tasks during two to three experimental sessions. A third session was scheduled for four of the children because they required more time to complete the tasks. No session lasted more than 90 minutes and took place during after school hours. All experimental sessions were audio recorded. Participants received a small prize (e.g., candy bar, small paper tablet, pens, erasers, etc.) after each pre-experimental and the first experimental session, and received a larger prize (e.g., arts and crafts kits, popular kids videos, games, etc.) at the end of the last experimental session. Three children who did not qualify for the study after the pre-experimental sessions or who failed to complete the two experimental sessions still received a small prize after each session but did not receive the larger prize. In addition, approximately thirty children who were not selected to participate in the study also received a small prize.

Before hearing or reading the first experimental story, participants completed two practice stories (one heard, one read) at the beginning of the first experimental session, and one practice story (heard) at the beginning of the second experimental session. During the first experimental session, participants listened to one story, retold it, and then responded to a total of three short-answer inferencing questions (one logical, one value, and one informational inferencing question) based on the classification system described below. Participants then read aloud a second story, retold it, and answered three inferencing questions. Children were not told the topic of the stories before reading or hearing them. During both practice stories, participants were encouraged to tell as much of the story as possible, and were provided with cues such as, “Is that all?” and “What happened next?" Three short answer inferencing questions were asked after they indicated they were finished telling their story. If participants missed a practice question, they were provided with the correct response embedded in a choice of two possible responses. None of the practice question responses were scored, and the correct answer was provided if they missed the forced-choice question (practice stories, inferencing questions, and choice responses are listed in Appendix C).

*Experimental sessions: Experimental tasks.*

During experimental sessions one and two, participants in each group were presented a total of 8 short stories (4 stories per session). Four stories were presented in the story heard condition. The remaining four stories were presented in the story read condition. No cues or story titles that might activate prior knowledge regarding the story topic were provided before participants read or heard the story. Participants were instructed to read the stories aloud to ensure that: 1) the participants did read the stories and 2) no components of the stories were overlooked that may alter the story (e.g., skip a line of story text). Stories were randomly ordered and randomly assigned to the heard and read conditions across participants to control for fatigue effects and for differing degrees of story complexity. Therefore the presentation condition and order of presentation of the stories was different for each participant.

After completing the practice items, the participants were asked to listen to or read a story, then re-tell the story. They were reminded to remember as much of the story as possible, because they would not be allowed to listen or to read the story again before re-telling it. During story recall, no prompts or cues were provided. After the participant stopped re-telling the story or stated, “The end” or “That’s all,” the experimenter made sure the participant had completed the task by asking, “Is that all?” No other prompts were provided. After each story recall, five short-answer questions from each inferencing sub-type (a total of 15 questions) were asked based on the classification system of Warren et al. (1979). Each participant was asked a total of 120 questions (8 stories x 5 questions x 3 question categories).

In the story read condition, participants had as much time as necessary to read the text, but were not allowed to return to the text after completing the story. All stories in the read condition were read aloud to assure that the child read the story and to check for decoding difficulties. Children were not corrected in their reading productions unless their production changed the facts or nature of the story. Inferencing questions were randomly presented (experimental stories and corresponding inferencing questions are provided in Appendix D). If participants responded to the question with an answer that reflected a lack of understanding of the question, they had the opportunity to respond to the question again. For example, when asked to indicate what meal had just been completed before the main characters went to bed, one child replied, “fish sticks,” when the desired response was “dinner.” The second presentation of the question was followed by a choice of two possible responses (e.g., “breakfast” or “dinner”).

After the second, fourth, and sixth stories were recalled and the inferencing questions had been answered, each child completed one of three working memory tasks. The items within each task were randomized before being presented. These tasks included two verbal working memory tasks (letter and digit recall) and a spatial working memory task (mental rotation) described below (letter, digit, and spatial working memory tasks and scoring sheets are provided in Appendix E).

Both experimental sessions were recorded using two independent Sony recorders to allow for a reserve copy of the taped sessions. Sony tie clip microphones were placed approximately 10 inches from the participant's mouth. Sound meter levels were monitored at various times during the session to make sure recording devices were functioning properly. After the experimental sessions were completed, each recalled story was transcribed by the primary investigator on a word-by-word basis, then coded using random numbers to blind the investigator during analyses to group or story presentation modality.

*Measures*

*Story design.*

The two practice and eight experimental stories (see Appendices C & D) that were used in this study were initially developed for use in a feasibility study of Narrative Based Language Intervention (NBLI) for 7-8 year old children with SLI (Swanson, Fey, Mills, & Hood, 2003). NBLI is designed to specifically target children's difficulties with story generation, and syntactic and morphologic skills. Each story targets specific syntactic components that are embedded within the story text (e.g., subordinating conjunctions, coordinating conjunctions, complex verbs, post-modification of nouns). All stories contain each of the narrative components: setting, characters, problem, resolution, complication, and ending. For the purposes of this study, eight stories with the following components were utilized: three stories that target post modification of nouns, three stories that target coordinate clauses and conjunctions, and two stories that target subordinate clauses and subordinators. The stories were modified in order to develop the fifteen inferencing questions for the purposes of this study (e.g., removal of a word that explicitly states the goal, task, etc.). Modifications to the stories did not result in a reclassification of the grammatical targets of the stories. Story titles were also omitted because some titles provided too much information that would have negated the need to infer information in the story. For example, in "Two Golfing Nuts," the story was modified to eliminate all direct references to the sport so that the child would have to infer golf based on the other referenced cues provided in the story (e.g., Tiger Woods, reference to playing on a course, using clubs to play, etc.). Other titles were less descriptive and would not have provided any cues (i.e., "Rollerblading" and "Time to Tell"). Therefore, in order to eliminate any possible inferencing aids the titles might provide, all titles were removed from the stories.

All of the modified stories were assessed for two dimensions of readability: reading ease and grade level equivalency. The Flesch Reading Ease score (Flesch, 1974) was used to determine reading ease. This widely used US Department of Defense measure computes readability based on the average number of syllables per word and the average number of words per sentence. Critics of this measure question the use of this "readability" measure, as random strings of multisyllabic words score within the difficult range, with no accounting for content meaning or grammatical correctness. However, given the fact that the stories that were used in this study were designed for elementary school children and contain grammatically correct sentences and complete story grammar, this concern did not appear to apply.

The Flesch Reading Ease scale is based on a 100-point scale. Higher scores reflect text that is more easily understood and lower scores reflect more difficult texts. The formula used to compute reading ease is: 206.835 – (1.015 x ASL) – (84.6 x ASW) where ASL reflects average sentence length and ASW reflects average number of syllables per word. The range of Flesch Reading Ease scores for all the stories was 91-100 (M = 95.28).

Grade level equivalency was determined by calculating a Flesch-Kincaid Grade Level score. The text is rated based on an American reading level grade. A score of 3.0 indicates a third grade level document. The grade level score is calculated using the following formula: (.39 x ASL) + (11.8 x ASW) – 15.59. Flesch-Kincaid Reading Level scores ranged from 1.1 to 2.7 (M = 2.09). Both reading ease and grade level equivalency scores were computed automatically using the Spelling and Grammar Tools component in Microsoft Word Version 9.0. Total number of words, reading level, and reading ease scores are listed in Table 9.

To determine if there was a significant difference in the complexity of the modified stories based on reading ease and total number of words, the stories were categorized from 1-3 based on grade level: “easy”= (1), “moderate”= (2) and “difficult”= (3). Stories categorized as “1” include: “Skipping School,” “Time to Tell,” and “Shop ‘Till They Drop.” Stories categorized as “2” include “Bad Haircut” and “Rollerblading.” Finally, “Save the Spiders,” “Sawing Logs,” and “Two Golfing Nuts” were categorized as “3.” An Analysis of Variance (ANOVA) was performed to determine if the stories significantly differed based on reading ease or total number of words (see Table 10). A summary of the pairwise comparisons is provided in Table 11. A significant difference

Table 9

Flesch Reading Ease, Flesch-Kincaid Grade Level, and Total Number of Words by Story Target for All Experimental Stories

| Story Title | Story Target[1] | Reading Ease[2] | Grade Level[3] | TNW[4] |
|---|---|---|---|---|
| Save the Spiders | CCC | 91.0 | 2.7 | 254 |
| Sawing Logs | CCC | 92.4 | 2.5 | 279 |
| Two Golfing Nuts | CCC | 93.6 | 2.7 | 326 |
| Skipping School | PMN | 100 | 1.1 | 339 |
| Shop ‘Till They Drop | PMN | 97.5 | 1.7 | 294 |
| Time to Tell | PMN | 98.1 | 1.5 | 326 |
| Bad Haircut | SC | 96.4 | 2.1 | 327 |
| Roller Blading | SC | 93.2 | 2.4 | 323 |
| Means (SD) | | 95.28 (3.17) | 2.09 (0.60) | 308.5 (29.63) |

[1]Story Target: CCC = Coordinating clause conjunctions, PMN = Post modification of nouns, SC = Subordinating clauses; [2]Reading ease = Flesch Reading Ease score; [3]Grade level = Flesch-Kincaid grade level; [4]TNW = Total number of words.

Table 10

Analysis of Variance of Reading Ease and Total Number of Words by Story Category

| Variable | df | F value | p |
|---|---|---|---|
| Reading Ease | 2 | 12.22 | .012* |
| Total Number of Words | 2 | 1.59 | .291 |

Note. Reading Ease reflects the Flesch Reading Ease Score. Story Categories were based on a scale from 1-3: “easy” = (1), “moderate” = (2) and “difficult” = (3).

*indicates significance at the $p < .05$ level.

Table 11

Pairwise Comparisons of Reading Ease and TNW for All Story Categories

| Variable | Story category | Story category | Mean difference | Standard error | p |
|---|---|---|---|---|---|
| Reading Ease[a] | 1 | 2 | 3.733 | 1.409 | .045* |
| | | 3 | 6.200 | 1.260 | .004* |
| | 2 | 1 | -3.733 | 1.409 | .045* |
| | | 3 | 2.467 | 1.409 | .140 |
| | 3 | 1 | -6.200 | 1.260 | .004* |
| | | 2 | -2.467 | 1.409 | .140 |
| TNW | 1 | 2 | -5.333 | 25.011 | .840 |
| | | 3 | 33.333 | 22.371 | .196 |
| | 2 | 1 | 5.333 | 25.011 | .840 |
| | | 3 | 38.667 | 25.011 | .183 |
| | 3 | 1 | -33.333 | 22.371 | .196 |
| | | 2 | -38.667 | 25.011 | .183 |

Note. 1 = easy, 2 = moderate, and 3 = difficult; Reading Ease = Flesch Reading Ease Score; TNW = total number of words.

*indicates significance at the $p < .05$ level.

was found for reading ease ($F(2, 5) = 12.26$, $p = .012$) but not for total number of words ($F(2, 5) = 1.59$, $p = .291$). Pairwise comparisons show that stories categorized as "easy" were significantly less difficult to read than the stories categorized as "moderate" and "difficult." No significant reading ease difference was found between the "moderate" and "difficult" stories. However, because there were significant differences in the reading difficulty of the "easy" versus the "moderate" and "difficult" stories, stories were randomized by presentation order and condition to negate story difficulty and fatigue effects.

*Inferencing design.*

Warren and colleagues (1979) developed inferencing question categories based on the chain of events in a narrative. The categories of questions represent three types of information, referred to as logical inferences, informational inferences, and value inferences. In the present study, short answer inferencing questions were developed based on story grammar categories (i.e., setting, initiating event, internal response, plan, attempt, consequence, resolution or reaction, and ending), consistent with the procedure utilized by Wright and Newhoff (2001). Five logical inferencing questions represented the motivation of an event and the physical and/or psychological causes, and answered "Why" and "How" questions (i.e., "How did the chicken cross the road?"). Five informational inferencing questions represented the people, places, things, and general context of the event, and answered the "Who," "What," "When," and "Where" questions (i.e., "Where did the chicken go?"). Finally, five value inferencing questions represented an individual’s ability to apply his or her own world knowledge to make sense of the story’s content (i.e., “Why would the chicken want to cross the road?”).

To assure that the inferencing questions were comprehensible, practice experimental sessions with two typically developing sixth grade students were conducted. Half of the stories were read and half were heard before the questions were presented to the students. The questions were reported to be comprehensible with 100% consistency prior to proceeding with the study. Therefore, no modifications were necessary.

*Working memory tasks.*

Three measures of working memory were administered (see Appendix E). The letter recall and digit tasks were developed based on guidelines by Wass and Riley (2003). The letter recall task consists of a series of consonants that vary between five, seven, and nine in length, with three sets of each length (i.e., three sets of five letters, three sets of seven letters, and three sets of nine letters). Each participant was presented with two practice items and nine experimental items. One practice item was demonstrated for the participant and the second practice item was completed independently. The practice items were repeated until the participant could complete the task independently. Individual letters were presented on an eight and a half by eleven-inch paper for approximately two seconds each. After each set was presented, participants were asked to recall the final three letters. Participants were not told how many letters were in each set, and the sets were randomly presented. Participants were encouraged to mentally rehearse the last three letters as each letter was presented. The participants were told that they must recall the letters in correct order to receive credit. Between sets, the participant was informed that a new set was beginning, and they were instructed to recall the last three letters of the new set, not the previous set. The letter task was designed using a random numbers table. Each consonant was paired with a number, and chosen to be included in a set using the following guidelines: 1) no two consonants can be placed together if they naturally fall together in the alphabet, 2) no two letter combination can be repeated (i.e., a "C" can only follow a "D" one time during the entire task), and 3) no letter can be used twice in one set.

The digit task consists of a series of two number addition pairs using numbers one through eight (e.g., 3+4). Participants were presented with one practice set and six experimental sets. The practice set was repeated if the child did not understand the task, but it was not scored. Only numbers whose sum does not exceed nine were paired. Two to seven addition pairs per set were presented, but the participants were not told how many addition pairs were included in each set. Three trials of each set were randomly presented (i.e., three trials of two addition pairs, three trials of three addition pairs, etc.). Participants were instructed to sum each pair as they were presented individually on an eight and a half by eleven-inch paper, to state the answer aloud, then recall each summed number at the end of each set. Therefore, participants recalled between two and seven numbers at a time. Participants were required to recall the answer they provided, even if it was not the correct answer. Participants were instructed that they must recall the summed answers in correct order to receive credit for the task. This reminder was only given one time, when necessary. Between each set, participants were instructed to recall the answers from each new set, not the previous answers. The digit task was developed using a random numbers table. Paired digits (numbers one through eight whose sum did not exceed nine) were assigned to a number and selected to be part of a set using the following guidelines: 1) no two-digit pair could be repeated within a set, and 2) no two-digit pairs that, when summed, equaled the same answer, could be included within the same set (e.g., 2+6 and 4+4).

The spatial task was adapted from the spatial working tasks of Seigneuric et al. (2000). Borrowing from the popular children's tic-tac-toe game, grids of 3x3 squares were presented one at a time to participants on an eight and a half by eleven-inch paper, with two of the three winning dots supplied. The dots on each grid were the same, but differed in placement and color from grid to grid. Participants were instructed to take the correct colored dot and place it in the square that would make a winning line, while remembering the positions of the previous winning lines for each set. After each set, the children were given colored lines that corresponded to the colored dots, and a blank grid to place, in order, the winning lines from that set. One practice set and four experimental sets were presented. The practice set consisted of two grids, and the experimental set ranged from two to five grids. Three trials at each level were randomly presented. Participants were instructed to recall the colored lines in correct order to receive credit for the task. This reminder was only given one time, when necessary. Between each set, participants were instructed to recall the line placement from each new set, not the previous set. The spatial task was created using a random numbers table. Each square on the 3x3 grid was assigned a number one through nine (i.e., the first upper left corner square was marked "1," and "2" through "9" followed across each row, left to right, until each square was assigned a number). Spaces were selected as the "winning square" for each set using the following guidelines: 1) no winning square could be selected in the same set, and 2) squares would only be used once within sets.

*Story Analyses*

*Story grammar.*

Prior to analyzing the participant's story productions, each of the eight stories were segmented into propositions and coded into story grammar type, consistent with Stein and Glenn (1979). The primary investigator's initial story grammar segmentation and classification were compared with an independent analysis of segmentation and classification for each of the stories, conducted by the primary investigator's major faculty advisor. Discrepancies between the two analyses were discussed and changes were made to the primary segmentation and classification until consensus was reached. A second faculty member who was not directly associated with this project but was familiar with Stein and Glenn's segmentation and classification protocol completed a second independent analysis. Discrepancies were analyzed, and in each case the second faculty member agreed with the primary segmentation and classification. The total percentage of each story grammar component was then calculated for each story (see Appendix F for the percent story grammar categories for each story).

Participants' recalled stories were analyzed based on story grammar, consistent with Wright and Newhoff's (2001) study. The current study expanded upon Wright and Newhoff's analysis by including an examination of all parts of story grammar, including: setting (introduces time, place and characters), initiating event ("complication" that sets story in motion), internal response (feelings regarding goal of protagonist to solve), plan (idea that might fix the problem), attempt (action taken to solve problem), consequence (event(s) causally linked to attempt), and resolution or reaction (final situation resulting from initiating event). The total story grammar score reflects the sum of all seven components, averaged within conditions.

The coded narrative files were separated into propositions that corresponded with the original story propositions. Propositions were judged to be recalled correctly if they embodied the semantic content of the statement found in the presented story (Wright & Newhoff, 2001). For the purposes of this study, incorrect or irrelevant information contained within the narrative recall was disregarded and was not scored. Propositions were then classified into story grammar components. For each component, the total number of propositions was summed (e.g., total number of settings, initiating events, internal responses, etc. per story). Because each story had a different number of story grammar components, the story grammar score for each of the components reflects the percentage of correctly recalled story grammar components per story, averaged within conditions (e.g., total percent of setting components recalled in the heard condition).

*Syntactic complexity analysis.*

Each coded narrative file was first separated into utterances. A single utterance consisted of single sentences or shorter units of communication separated by other utterances by a drop in pitch, a pause, and/or a breath that signaled a new idea (Owens, 1991). Transcription files were converted to text files and formatted for Developmental Sentence Score (DSS; Lee, 1974) analysis using the CORPUS and LARSP matrices in Computerized Profiling (version 9.4.1) (Long, Fey, & Channell, 2002). DSS scores were then calculated for each coded file using the DSS matrix in Computerized Profiling. DSS provides a grammatical complexity score based on the presence and level of tokens in a sentence. Tokens were scored only if they were represented by eight specific structural categories (i.e., indefinite pronoun/noun modifiers, personal pronouns, main verbs, secondary verbs, negatives, conjunctions, interrogative reversals, and wh-questions).

*Inferencing analysis.*

Responses to the inferencing questions were scored on a three-point basis developed by Bishop and Adams (1992). Two points were assigned for complete and accurate responses, 1 point for a partial response, and 0 for no response or an incorrect response. Scores for each participant were averaged within each presentation type for comparison purposes. If participants responded to the question with an answer that reflected a lack of understanding of the question, they received a score of “0” and were given the opportunity to respond to the question again. The second presentation of the question was followed by a choice of two possible responses. This second attempt was scored based on the same three-point system described above. Children therefore received two scores for each inferencing category: with cues provided and without cues provided. The total number of possible points that could be earned for each type of inferencing question per story was ten.

*Working memory analysis.*

One point for each correctly recalled set was awarded for each of the working memory tasks. Sets had to be recalled in the correct order in order to be awarded a point. Practice sets were not scored. All participants completed each of the working memory tasks without interruption. Task instructions were re-read to the participants during the practice items to teach the task, and during the set trials when necessary (i.e., if a participant altered his or her task strategy that altered the working memory task). Total number of possible points that could be earned for the letter, digit, and spatial tasks was nine, eighteen, and twelve, respectively.

Based on the low spatial working memory scores, the initial scoring protocol was determined to be too stringent and not representative of non-verbal working memory skills. Therefore, the spatial task was re-scored, allowing one point for each correct tic-tac-toe grid recalled. This scoring protocol increased the total amount of possible points for the spatial task to 47. Scores for all working memory tasks were then converted to percentages in order to compare group performance across tasks.

*Reliability*

A graduate student was selected to participate in reliability procedures. Before training, the student signed a pledge of confidentiality. The student was trained in language sample transcription, utterance and proposition segmentation, identification and categorization of story grammar components, DSS, and the scoring of inferencing tasks. Scoring sheets were developed as guidelines to use in scoring inferencing questions, providing example responses to rank answers appropriately (see Appendix G for a sample scoring sheet).

Reliability was based on an independent analysis of 10% of the total number of transcription files for transcription, DSS, story grammar classification, and inferencing measures. The student randomly selected twenty-four coded narrative files, transcribed them, and completed each type of analysis. A summary of each of the reliability measures follows. For all reliability measures, scores calculated by the graduate student were compared to the original file scores calculated by the primary investigator. Reliability was considered acceptable as the compared scores evidenced 90% agreement or better. Discrepancies were analyzed, and the investigator and the graduate student reached consensus regarding correct scoring procedures. No changes to the original files were made. The mean (SD) percent agreement score for the transcription, DSS, story grammar, and inferencing measures was 97.42 (2.3), 96.55(2.4), 97.04(3.52), and 97.67(3.37), respectively.

*Transcription.*

Transcription files were compared based on segmentation and word agreement on a point-by-point basis. In order to agree, each utterance had to be comprised of the same words. Words that were not included in the original analysis, including mazes, asides, and unintelligible words, were not calculated in agreement measures.

*DSS.*

Files were compared using the "compare files" component in the DSS matrix. Scores reflect percent agreement based on correct grammatical classification, assignment of score within grammatical classification, and assignment of sentence point. For each comparison, the primary investigator's file was denoted as the authority.

*Story grammar classification.*

Percent agreement was based on the correct classification of story grammar components for each proposition. In some instances, children would summarize or simplify several of the same story grammar components into one proposition. Agreement was then based on the correct assignment of the story grammar component. For example, if the child produced one setting proposition for what was originally three setting propositions, credit was given if the child's proposition was correctly classified as setting within one of the three original propositions.

*Inferencing.*

Questions from each of the twenty-four randomly selected story files were scored using the scoring sheets provided by the primary investigator. Each question could possibly receive a "0," "1," or "2" as a score, but sample answers were not included for all scores, nor for all possible replies, in order to maintain the integrity of independent scoring. Rather, sample responses depicting a range of scores were provided to aid in appropriate scoring and consistency of scoring. Scores had to be the same in order to be credited as "in agreement."

# CHAPTER IV

# Results

## *Story Re-telling Task*

### *Story grammar*.

For each group, means and standard deviations for each story grammar component are listed in Table 12. Because the groups significantly differed in nonverbal cognitive K-BIT Matrices scores ($F(2,27) = 2.5$, $p = .045$), repeated measures ANCOVAs were performed of group (LLI, CA, LA) by presentation condition (story heard, story read) for each story grammar score based on the percentage of recalled story grammar components, with K-BIT scores included as the covariate. While K-BIT scores significantly contributed to setting ($F(1,26) = 4.71$, $p = .04$) and initiating event ($F(1,26) = 7.97$, $p = .009$), no other significant contribution of K-BIT scores was found for the remainder of story grammar components (all $p$s >.05). Therefore, K-BIT scores were removed as a covariate and ANOVAs were completed for each of the remaining story grammar components. No significant difference in presentation condition was detected within or across groups for any of the story grammar components (see Table 13 for individual $p$ values). Group differences were detected for plan ($F(2,27) = 4.8$, $p = .02$), consequence ($F(2,27) = 3.82$, $p = .04$), and total story grammar parts ($F(2,27) = 3.70$, $p = .04$). Pairwise comparisons for LLI versus CA and LA peers show that the LLI group recalled a lower percentage of plan, consequence, and total story grammar components than the CA- and LA-matched peers (all $p$ values < .05, comparisons are listed in Table 14). In addition, children in the LLI group recalled a lower percentage of internal

Table 12

Means and Standard Deviations (SD) of Story Grammar Scores for All Groups by Presentation Condition

| Presentation | Story Grammar Part | Groups | | |
|---|---|---|---|---|
| | | LLI | LA | CA |
| Heard Condition | Setting | 47.41 (17.06) | 59.16 (15.37) | 63.85 (13.14) |
| | Initiating Event | 59.52 (25.07) | 64.63 (15.77) | 67.89 (14.43) |
| | Internal Response | 30.00 (33.05) | 44.25 (26.03) | 41.88 (27.80) |
| | Plan | 43.46 (16.88) | 61.44 (14.39) | 64.64 (11.29) |
| | Attempt | 32.25 (16.55) | 45.40 (13.58) | 44.38 (14.79) |
| | Consequence | 39.53 (24.88) | 49.11 (15.83) | 45.91 (10.22) |
| | Resolution/Reaction | 33.32 (30.41) | 48.78 (18.13) | 47.10 (17.92) |
| | Total | 41.50 (16.02) | 53.71 (10.42) | 55.30 (11.13) |
| Read Condition | Setting | 43.26 (21.73) | 57.29 (15.58) | 58.16 (13.11) |
| | Initiating Event | 59.91 (18.72) | 69.58 (15.63) | 72.20 (14.46) |
| | Internal Response | 28.13 (25.73) | 58.13 (11.80) | 40.63 (22.29) |
| | Plan | 47.29 (22.28) | 57.13 (11.57) | 59.66 (11.51) |
| | Attempt | 31.77 (24.44) | 41.92 (13.13) | 42.48 (13.16) |
| | Consequence | 38.50 (13.59) | 56.31 (12.23) | 59.18 (15.01) |
| | Resolution/Reaction | 48.03 (26.56) | 37.13 (18.29) | 55.97 (26.88) |
| | Total | 42.71 (15.71) | 53.48 (9.45) | 55.14 (9.94) |

Note. LLI= Language-learning impaired; LA= Language age-matched peers; CA = Chronological age-matched peers.

Table 13

Repeated Measures Analysis of Variance of Group by Presentation Condition for Story Grammar

| Story Grammar | Source | Source Type | df | F value | p |
|---|---|---|---|---|---|
| Setting[1] | Group | LLI, LA, CA | 2 | 1.45 | .25 |
| | Condition | Heard, Read | 1 | .597 | .48 |
| | Group * Condition | Score | 2 | .22 | .81 |
| Initiating Event[1] | Group | LLI, LA, CA | 2 | .31 | .73 |
| | Condition | Heard, Read | 1 | 1.26 | .27 |
| | Group * Condition | Score | 2 | .39 | .68 |
| Internal Response | Group | LLI, LA, CA | 2 | 3.13 | .06+ |
| | Condition | Heard, Read | 1 | .38 | .54 |
| | Group * Condition | Score | 2 | .79 | .46 |
| Plan | Group | LLI, LA, CA | 2 | 4.8 | .016* |
| | Condition | Heard, Read | 1 | .40 | .53 |
| | Group * Condition | Score | 2 | .96 | .40 |
| Attempt | Group | LLI, LA, CA | 2 | 2.05 | .148 |
| | Condition | Heard, Read | 1 | .54 | .47 |
| | Group * Condition | Score | 2 | .11 | .90 |
| Consequence | Group | LLI, LA, CA | 2 | 3.82 | .04* |
| | Condition | Heard, Read | 1 | 3.35 | .078 |
| | Group * Condition | Score | 2 | 1.37 | .27 |
| Resolution/Reaction | Group | LLI, LA, CA | 2 | 1.05 | .365 |
| | Condition | Heard, Read | 1 | .489 | .49 |
| | Group * Condition | Score | 2 | 1.98 | .158 |
| Total | Group | LLI, LA, CA | 2 | 3.70 | .038* |
| | Condition | Heard, Read | 1 | .034 | .86 |
| | Group * Condition | Score | 2 | .10 | .90 |

*indicates significance at the $p < .05$ level; +significance approaching $p = .05$ level; [1]includes K-BIT covariate

Table 14

Pairwise Comparisons Between LLI, LA and CA Groups

| Story grammar component | Subjects | Subjects | Mean difference | Standard error | p |
|---|---|---|---|---|---|
| Setting[1] | LLI | CA | -10.48 | 6.189 | .102 |
| | | LA | -7.198 | 6.281 | .262 |
| Initiating Event[1] | LLI | CA | -4.08 | 5.912 | .496 |
| | | LA | -7.387 | 6.133 | .239 |
| Internal Response | LLI | CA | -12.188 | 8.855 | .180 |
| | | LA | -22.125 | 8.855 | .019* |
| Plan | LLI | CA | -16.771 | 5.791 | .007* |
| | | LA | -13.909 | 5.791 | .023* |
| Attempt | LLI | CA | -11.420 | 6.578 | .094 |
| | | LA | -11.654 | 6.578 | .088 |
| Consequence | LLI | CA | -13.533 | 5.686 | .025* |
| | | LA | -13.698 | 5.686 | .023* |
| Resolution/Reaction | LLI | CA | -10.862 | 7.923 | .182 |
| | | LA | -2.279 | 7.923 | .776 |
| Total | LLI | CA | -13.112 | 5.253 | .019* |
| | | LA | -11.489 | 5.253 | .038* |

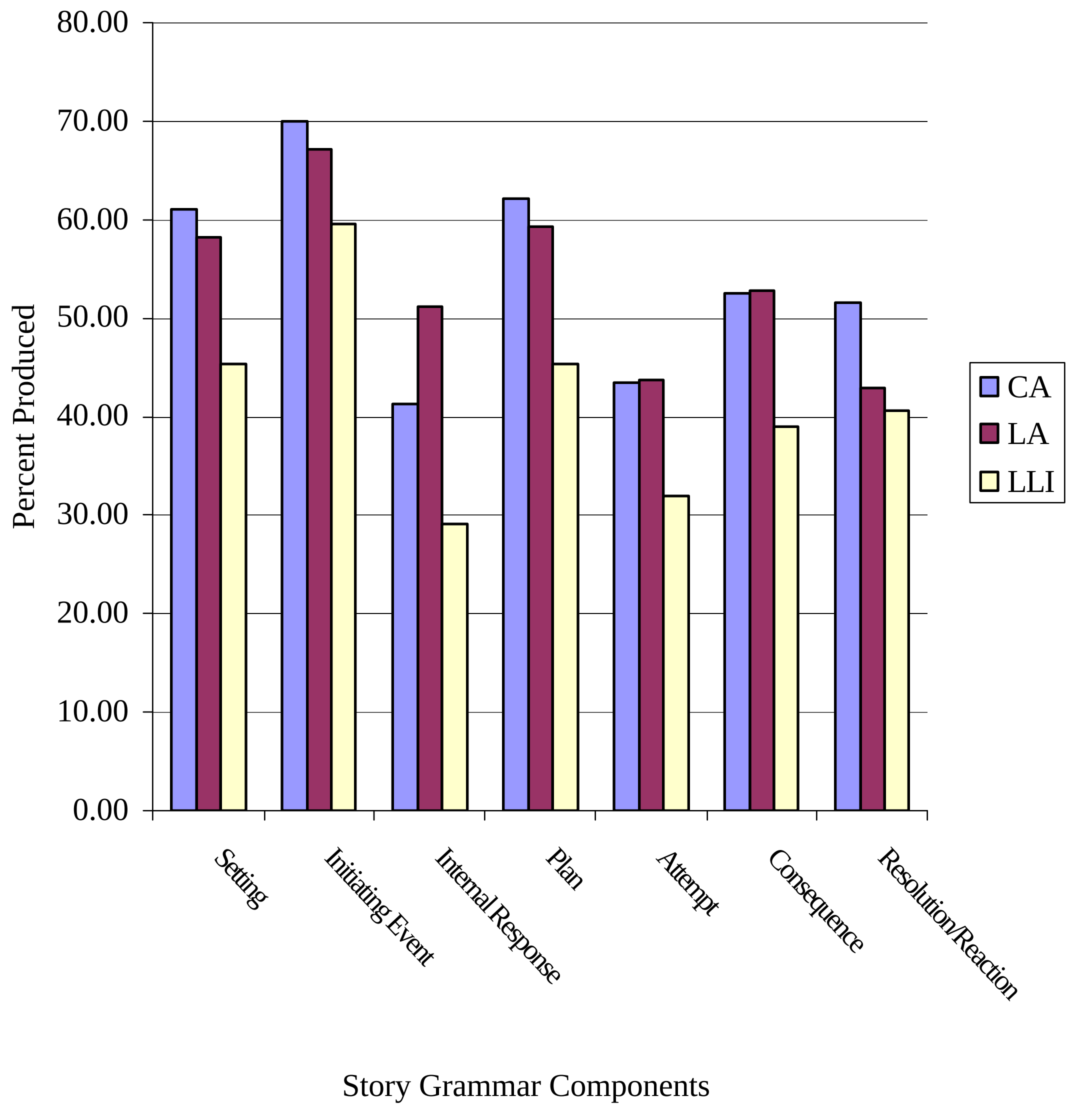
Note. LLI = Language-learning impaired; CA= chronological age; LA = language age.

[1]includes K-BIT covariate; *indicates significance at the $p < .05$ level.

response components than the LA peers ($p = .019$), but not the CA peers ($p = .180$). No other significant differences were found between LLI and LA or LLI and CA peers. No significant difference was found between CA and LA-matched peers on any of the story grammar components. The pattern of mean scores for each of the story grammar components for each group is displayed in Figure 1.

The large standard deviation for many of the story grammar components is attributed to fact that these scores represent a percent of the total number of recalled story grammar components (see Table 12). Therefore, missing one or two components results in a drastically lower story grammar score. For example, in “Save the Spiders,” there are a total of 11 setting components. A child who recalls eight of the setting components receives a score of 73%, but a child who recalls 10 of the eleven setting components receives a score of 90%. There does appear to be more variability in the percent of story grammar components recalled by the children in the LLI group than in the CA and LA groups, especially in the story heard condition. However, as previously stated, no significant difference was found for any of the story grammar measures by presentation condition.

A MANCOVA was conducted to determine which story grammar components were recalled more frequently for each group. Scores were averaged across presentation condition, as no significant differences were found for any of the story grammar measures when comparing the read versus heard condition. Means and standard deviations for each of the story grammar components are provided in Table 15. MANCOVA results are displayed in Table 16, and revealed no significant story grammar




<u>Figure 1.</u> Comparison of Group Means for Percentage of Story Grammar Components Produced.

<u>Note.</u> CA = Chronological age-matched peers; LA = Language age-matched peers; LLI = Language-learning impaired.

Table 15

Means and Standard Deviations (SD) of Story Grammar Scores across All Groups and Presentation Conditions

| Story Grammar Part | Means (SD) |
|---|---|
| Setting | 54.85 (15.19) |
| Initiating Event | 65.55 (13.61) |
| Internal Response | 40.50 (13.75) |
| Plan | 55.60 (18.85) |
| Attempt | 39.70 (14.66) |
| Consequence | 48.09 (13.41) |
| Resolution/Reaction | 45.06 (15.98) |

Table 16

Multivariate Analysis of Covariance of Story Grammar Components

| Source | | df | F value | p |
|---|---|---|---|---|
| Group | Story Grammar Component | 2 | 3.42 | .048* |
| K-BIT | Story Grammar Component | 1 | 4.31 | .048* |
| Story Grammar | Story Grammar Component | 4.98 | .436 | .804 |
| Group x Story Grammar | Story Grammar Component | 8.99 | 1.23 | .282 |

*indicates significance at the p <.05 level.

Note. K-BIT = Kauman Brief Intelligence Test.

effect ($F(6,116.93) = .436$, $p < .804$), but a significant between subject K-BIT ($F(1,26) = 4.31$, $p < .05$) and group effects ($F(2,26) = 3.42$, $p < .05$) were found. Pairwise comparisons show that the same pattern of story grammar recall was found for all groups. Initiating event was recalled significantly more often than any other story grammar component ($M$ = 70.05, 67.10, and 59.51 for the CA, LA, and LLI groups, respectively). In order of frequency from most to least recalled component, setting, plan, consequence, resolution/reaction, attempt, then internal response were then recalled (see Appendix H for all story grammar component pairwise comparisons).

*Syntactic complexity.*

Means and standard deviations for DSS for all groups in each presentation condition are listed in Table 17 (see Appendix I for individual DSS scores for each story). A repeated measures ANCOVA revealed no significant K-BIT covariant ($F(1,26) = .192$, $p = .665$). The covariant was removed and a repeated measure ANOVA was performed for both conditions (heard versus read) for all of the groups (LA, CA, LLI). Results from the repeated measure ANOVA are listed in Table 18, which revealed no significant difference in DSS scores for presentation condition ($F(1,27) = .165$, $p = .69$), or within groups by presentation condition ($F(2,27) = .733$, $p = .49$). However, a significant difference was found when comparing groups across presentation conditions ($F(2,27) = 12.62$, $p < .001$). Pairwise comparisons for the LLI versus CA and LA peers show that children in the LLI group earned significantly lower DSS scores than their LA ($p <.009$) and CA ($p < .001$) matched peers (see Table 19 for pairwise comparisons). In addition,

Table 17

Means and Standard Deviations (SD) of Developmental Sentence Scores for All Groups by Presentation Condition

| Presentation | Group LLI | Group LA | Group CA |
|---|---|---|---|
| Heard Condition | 14.56 (2.52) | 17.76 (1.42) | 20.46 (2.74) |
| Read Condition | 15.28 (2.51) | 18.05 (1.94) | 19.96 (3.94) |

Note. LLI= Language-learning impaired; LA = Language age-matched peers; CA= Chronological age-matched peers.

Table 18

Analysis of Variance of Group by Presentation Condition for Developmental Sentence Scores

| Source | | df | F value | p |
|---|---|---|---|---|
| Group | Developmental Sentence Score | 2 | 12.62 | .001** |
| Condition | Developmental Sentence Score | 1 | .165 | .69 |
| Group x Condition | Developmental Sentence Score | 2 | .733 | .49 |

**indicates significance at the $p < .001$ level.

Table 19

Pairwise Comparisons Between LLI, LA, and CA Groups for Developmental Sentence Scores

| Group comparisons | | Mean difference | Standard error | p |
|---|---|---|---|---|
| CA | LA | 2.304 | 1.056 | .038* |
| | LLI | 5.289 | 1.056 | .001** |
| LA | CA | -2.304 | 1.056 | .038* |
| | LLI | 2.986 | 1.056 | .009* |
| LLI | CA | -5.289 | 1.056 | .001** |
| | LA | -2.986 | 1.056 | .009* |

*indicates significance at the $p < .05$ level; **indicates significance at the $p < .001$ level.

Note. LLI= Language-learning impaired; LA = Language age-matched peers; CA= Chronological age-matched peers.

participants in the LA group scored significantly lower than the CA group on the DSS measure ($p < .05$). The pattern of mean scores for each of the DSS scores for each group is depicted in Figure 2.

Because significant differences were found between groups for the DSS score, further analysis was conducted. Specifically, the nine grammatical components that comprise a DSS score (i.e., indefinite pronoun/noun modifiers, personal pronouns, main verbs, secondary verbs, negatives, conjunctions, interrogative reversals, and wh-questions) were calculated for each story per child. Scores were then averaged across presentation conditions, since no significant difference was found between the heard versus read conditions. Means and standard deviations for each of the DSS components for each group are provided in Table 20. An ANCOVA revealed no significant K-BIT covariate ($F(1,26)= 1.18$, $p = .29$). The covariate was removed, and an ANOVA for each of the nine grammatical components by group was conducted (see Table 21 for ANOVA results). There are significant differences between groups in the use of indefinite pronouns/noun modifiers ($F(2,27) = 5.36$, $p = .01$), personal pronouns ($F(2,27) = 3.61$, $p = .04$), main verbs ($F(2,27) = 7.59$, $p = .002$), secondary verbs ($F(2,27) = 4.53$, $p = .02$), conjunctions ($F(2,27) = 5.86$, $p = .008$), and for the sentence point ($F(2,27) = 9.66$, $p = .001$). Pairwise comparisons for significant group differences for each DSS component show that participants in the LLI group had significantly fewer correct productions of indefinite pronouns/noun modifiers, personal pronouns, main verbs, secondary verbs, conjunctions, and earned lower sentence points than their CA-matched peers. In addition, participants in the LLI group had significantly fewer correct productions of indefinite


Figure 2. Developmental Sentence Scores for All Groups.

Note. CA = Chronological age-matched peers; LA = Language age-matched peers; LLI = Language-learning impaired.

Table 20

Means and Standard Deviations (SD) for Each Developmental Sentence Score (DSS) Component for All Groups

| DSS Component | Group | | |
|---|---|---|---|
| | LLI | LA | CA |
| Indefinite Pronoun/Noun Modifiers | 15.68 (4.60) | 24.23 (9.46) | 26.11 (7.89) |
| Personal Pronouns | 31.78 (10.96) | 44.76 (16.22) | 49.19 (16.95) |
| Main Verb | 34.83 (8.83) | 52.68 (14.22) | 58.35 (17.75) |
| Secondary Verb | 14.22 (4.19) | 21.51 (6.58) | 21.94 (7.98) |
| Negatives | 8.76 (3.93) | 10.55 (3.92) | 12.15 (6.23) |
| Conjunctions | 20.94 (5.77) | 37.85 (13.66) | 44.89 (23.56) |
| Interrogative Reversal | .68 (0.56) | 1.34 (0.82) | .87 (0.56) |
| Wh- Questions | .77 (0.94) | 1.31 (0.52) | 1.42 (0.53) |
| Sentence Point | 7.03 (0.78) | 7.77 (0.26) | 7.91 (0.11) |

Note. LLI = Language-learning impaired; LA = Language age-matched peers; CA = Chronological age-matched peers.

Table 21

Analysis of Variance of Group by Developmental Sentence Score Components

| Dependent Variable | df | F value | p |
|---|---|---|---|
| Indefinite Pronoun/Noun Modifiers | 2 | 5.355 | .011* |
| Personal Pronouns | 2 | 3.661 | .039* |
| Main Verb | 2 | 7.593 | .002* |
| Secondary Verb | 2 | 4.534 | .020* |
| Negatives | 2 | 1.241 | .305 |
| Conjunctions | 2 | 5.866 | .008* |
| Interrogative Reversal | 2 | 2.678 | .087 |
| Wh- Questions | 2 | 1.799 | .185 |
| Sentence Point | 2 | 9.658 | .001** |

*indicates significance at the $p < .05$ level; **indicates significance at the $p < .001$ level.

pronouns/noun modifiers, main verbs, secondary verbs, conjunctions, interrogative reversals, and earned lower sentence points than their LA-matched peers. Group LLI and LA comparisons for personal pronouns approached significance ($p$ = .63). No significant differences for any DSS components were found when comparing LA and CA participants. Significant pairwise comparisons are listed in Table 22 (see Appendix J for all significant and non-significant pairwise comparisons). The pattern of DSS component scores for all groups is displayed in Figure 3.

*Inferencing Task*

Means and standard deviations for each type of correctly answered inferencing question for each group in both presentation conditions are provided in Table 23. Repeated measures ANCOVAs for group (LLI, CA, LA) by presentation condition (story heard, story read) for each inferencing question type (logical, informational, value) with the K-BIT scores as a covariate revealed no significant contribution (all $p$s < .05). The covariate was therefore removed, and repeated measures ANOVAs were conducted for group (LLI, CA, LA) by presentation condition (story heard, story read) for each inferencing question type (logical, informational, value). Results indicate no significant difference for the value, logical, or information inferencing questions, presented in the heard versus read condition within or across groups. Combined ANOVA results for all of the question types are listed in Table 24. Significant differences were found for group for the value ($F(2,27) = 17.04$, $p = .001$), logical ($F(2,27) = 22.58$, $p = .001$), and information ($F(2,27) = 24.56$, $p = .001$) questions.

Table 22

Pairwise Comparisons between LLI, LA and CA Groups for All Developmental Sentence Score Components

| DSS Component | Subjects | Subjects | Mean Difference | p |
|---|---|---|---|---|
| Indefinite Pronoun/Noun Modifiers | LLI | CA | -10.43 | .005* |
| | | LA | -8.549 | .018* |
| Personal Pronouns | LLI | CA | -17.407 | .015* |
| | | LA | -12.976 | .063 |
| Main Verb | LLI | CA | -23.517 | .001** |
| | | LA | -17.848 | .009* |
| Secondary Verb | LLI | CA | -7.726 | .012* |
| | | LA | -7.292 | .018* |
| Negatives | LLI | CA | -3.391 | .127 |
| | | LA | -1.795 | .412 |
| Conjunctions | LLI | CA | -23.953 | .003* |
| | | LA | -16.913 | .026* |
| Interrogative Reversal | LLI | CA | -.190 | .524 |
| | | LA | -.661 | .033* |
| Wh- Questions | LLI | CA | -.651 | .087 |
| | | LA | -.538 | .154 |
| Sentence Point | LLI | CA | -.879 | .001** |
| | | LA | -.738 | .002* |

Note. LLI = Language-learning impaired, CA = Chronological age, LA = Language age.

*indicates significance at the $p < .05$ level; **indicates significance at the $p < .001$ level.

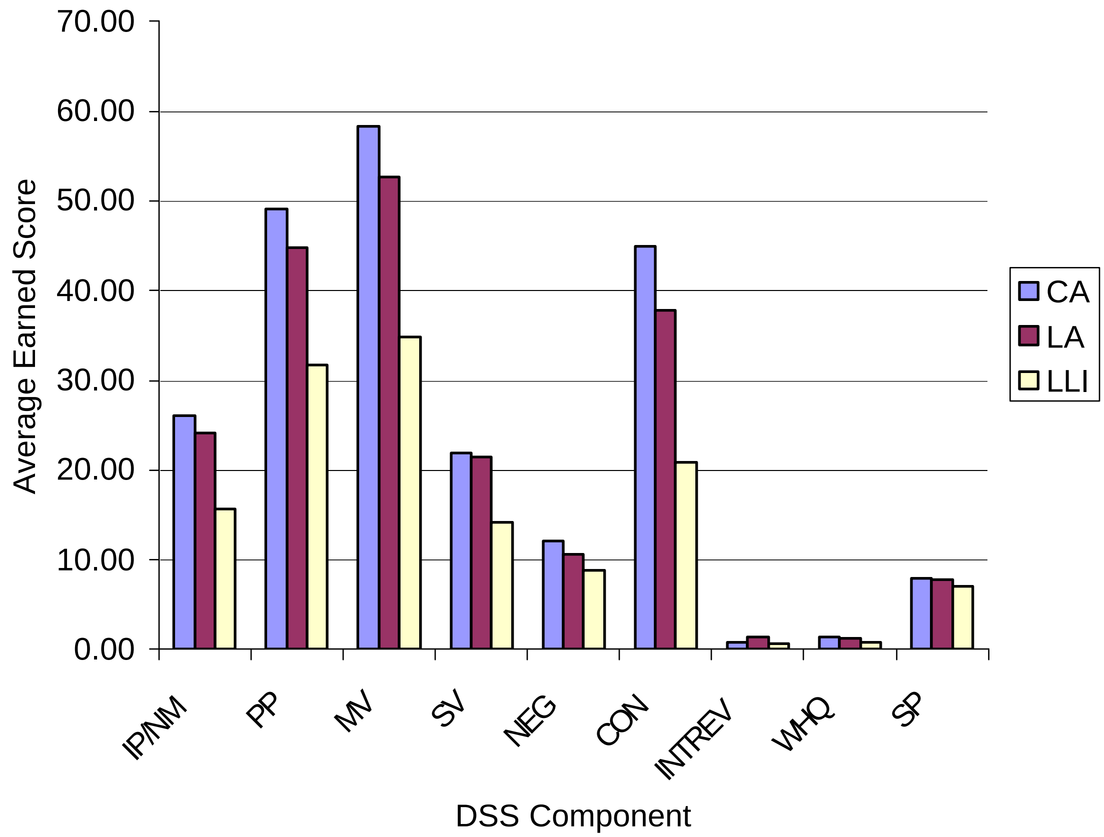



Figure 3. Mean DSS Component Score for Each Group.

Note. CA = Chronological age-matched peers; LA = Language age-matched peers; LLI = Language-learning impaired; IP/NM = indefinite pronoun/noun modifiers; PP = personal pronouns; MV = main verbs; SV = secondary verbs; NEG = negatives; CON = conjunctions; INTREV = interrogative reversals; WHQ = wh- questions; SP = sentence point.

Table 23

Means and Standard Deviations of Inferencing Question Scores for All Groups in Both Presentation Conditions

| | | Groups | | |
|---|---|---|---|---|
| Presentation | Inferencing Question Type | LLI | LA | CA |
| Heard Condition | Value | 6.20 (1.23) | 8.38 (0.64) | 8.58 (0.92) |
| | Logical | 6.00 (1.43) | 8.93 (1.16) | 8.93 (.71) |
| | Information | 6.55 (1.51) | 8.98 (0.76) | 9.40 (.46) |
| Read Condition | Value | 6.15 (1.29) | 8.30 (0.88) | 8.48 (1.33) |
| | Logical | 6.30 (1.42) | 8.65 (0.86) | 8.50 (1.36) |
| | Information | 7.15 (1.63) | 8.70 (1.43) | 9.50 (0.59) |

Note. LLI= Language-learning impaired; LA = Language age-matched peers; CA= Chronological age-matched peers. Total possible points for each question type = 10.

Table 24

Analysis of Variance of Group by Presentation Condition for All Inferencing Question Types

| Source | Question type | df | F value | p |
|---|---|---|---|---|
| Group | Value | 2 | 17.04 | .001** |
| | Logical | 2 | 22.58 | .001** |
| | Information | 2 | 24.56 | .001** |
| Condition | Value | 1 | .26 | .61 |
| | Logical | 1 | .32 | .58 |
| | Information | 1 | .25 | .62 |
| Group x Condition | Value | 2 | .01 | .99 |
| | Logical | 2 | .88 | .43 |
| | Information | 2 | .80 | .46 |

**indicates significance at the $p < .001$ level.

Pairwise group comparisons show that participants in the LLI group answered significantly fewer logic ($p < .001$), value ($p < .001$), and information ($p < .001$) questions correctly than their CA- and LA-matched peers. While the same pattern of correct responses was found for CA- and LA-matched peers (fewer logic and value answered correctly than information questions) no significant difference was found between CA- and LA-matched peers. Pairwise comparisons for significant group across condition differences are provided in Table 25 (see Appendix K for significant and non-significant pairwise findings).

To determine if a hierarchy exists among the different inferencing questions for the groups, scores for each inferencing question type were collapsed across presentation condition. Means and standard deviations for inferencing question scores within and across group are provided in Table 26. An ANOVA was conducted comparing group by inferencing question type, and showed significant differences for inferencing question types ($F(2,54) = 9.16$, $p < .001$) and group ($F(2,27) = 30.08$, $p < .001$). No significant difference was found for the group by inferencing question type interaction ($F(2,54) = .99$, $p < .42$). ANOVA results are provided in Table 27.

Pairwise comparisons of question type are provided in Table 28, and show that logic ($M = 7.88$, $SD = 1.58$) and value ($M = 7.68$, $SD = 1.45$) scores were significantly lower than information ($M = 8.38$, $SD = 1.41$) scores across all groups (all $p$ values < .001). No significant difference was found between logic and value scores ($p = .257$). In addition, pairwise comparisons of groups (see Table 29) show that participants in the LLI group ($M = 6.39$, $SD = 1.23$) scored significantly lower than their LA ($M = 8.66$, $SD = .75$) and CA ($M = 8.90$, $SD = .90$) matched peers across all question types

Table 25

Pairwise Comparisons Between LLI, LA, and CA Groups for All Inferencing Questions

| Question type | Subjects | Subjects | Mean difference | Standard error | p |
|---|---|---|---|---|---|
| Value | LLI | CA | -2.350 | .447 | .001** |
| | | LA | -2.163 | .447 | .001** |
| Information | LLI | CA | -2.600 | .388 | .001** |
| | | LA | -1.988 | .388 | .001** |
| Logic | LLI | CA | -2.563 | .447 | .001** |
| | | LA | -2.638 | .447 | .001** |

Note. LLI = Language-learning impaired; LA = Language age-matched peers; CA= Chronological age-matched peers.

**indicates significance at the $p < .001$ level.

Table 26

Means and Standard Deviations (SD) of Inferencing Question Scores for All Groups

| Question type | LLI | LA | CA | Mean across group (SD) |
|---|---|---|---|---|
| Value | 6.18 (1.16) | 8.34 (0.66) | 8.53 (1.11) | 7.68 (1.45) |
| Logical | 6.15 (1.30) | 8.79 (0.83) | 8.71 (0.79) | 7.88 (1.58) |
| Informational | 6.85 (1.23) | 8.84 (0.72) | 9.45 (0.47) | 8.38 (1.41) |
| Mean across question type (SD) | 6.39 (1.23) | 8.66 (0.75) | 8.90 (0.90) | 7.98 |

Note. LLI= Language-learning impaired; LA = Language age-matched peers; CA= Chronological age-matched peers. Total possible points for each question type = 10.

Table 27

Analysis of Variance of Group by All Inferencing Question Types

| Source | df | F value | p |
|---|---|---|---|
| Inferencing Question Type | 2 | 9.16 | .001** |
| Group | 2 | 30.08 | .001** |
| Group x Inferencing Question Type | 4 | .99 | .42 |

**indicates significance at the $p < .001$ level.

Table 28

Pairwise Comparisons Between All Inferencing Question Types

| Question type | Question type | Mean difference | Standard error | p |
|---|---|---|---|---|
| Value | Information | -.700 | .152 | .001** |
| | Logic | -.204 | .176 | .257 |
| Information | Value | .700 | .152 | .001** |
| | Logic | .496 | .176 | .009* |
| Logic | Value | .204 | .176 | .257 |
| | Information | -.496 | .176 | .009* |

*indicates significance at the $p < .05$ level; **indicates significance at the $p < .001$ level.

Table 29

Pairwise Comparisons between LLI, CA, and LA Groups for All Inferencing Question Types

| Group | Group | Mean difference | Standard error | p |
|---|---|---|---|---|
| CA | LA | .242 | .356 | .503 |
| | LLI | 2.504 | .356 | .001** |
| LA | CA | -.242 | .356 | .503 |
| | LLI | 2.263 | .356 | .001** |
| LLI | CA | -2.504 | .356 | .001** |
| | LA | -2.263 | .356 | .001** |

Note. LLI= Language-learning impaired; LA = Language age-matched peers; CA= Chronological age-matched peers.

**indicates significance at the $p < .001$ level.

(both ps < .001). No significant difference was found between CA and LA peers ($p$ = .503). The pattern of inferencing responses for all groups is displayed in Figure 4.

*Working Memory*

Means and standard deviations for each working memory score are provided in Table 30 (see Appendix L for individual participant working memory scores for each task). A MANCOVA for all working memory tasks by group with K-BIT scores as the covariate was performed and results showed no significant covariant contribution (all ps > .05). The covariant was removed, and a MANOVA for all working tasks by group revealed significant differences between groups for the letter ($F(2,27) = 12.69$, $p = .001$) and digit ($F(2,27) = 9.76$, $p = .002$) tasks, but not for the spatial ($F(2,27) = .204$, $p = .817$) task (see Table 31). Pairwise comparisons for all groups and each task are contained in Table 32. For the letter task, the LLI group scored significantly lower than the CA group ($p < .001$), but not significantly lower than the LA group ($p = .561$). In addition, the LA group scored significantly lower than the CA group ($p = .001$) on the letter task. On the digit task, all groups scored significantly different from each other: the LLI group scored significantly lower than the LA group ($p = .032$), who scored significantly lower than the CA group ($p = .039$). No significant MANOVA group differences were found between groups for the spatial task scores ($p = .82$). The pattern of working memory scores for all groups is displayed in Figure 5.

Finally, correlations between the letter, digit, and spatial memory task scores and story grammar, DSS, and inferencing question scores are listed in Table 33. Significant

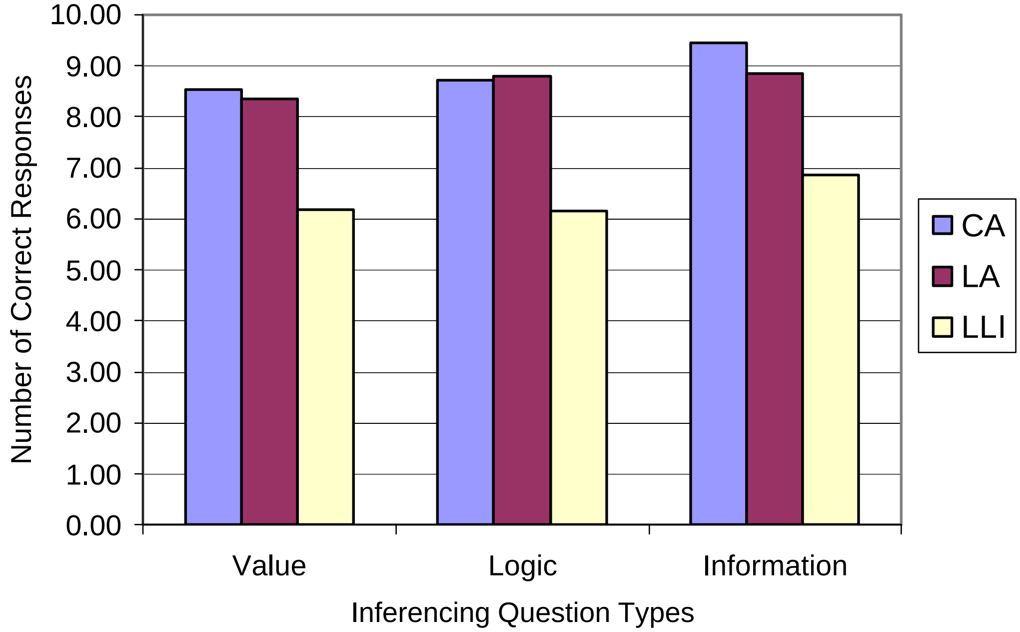



Figure 4. Mean Number of Correct Inferencing Question Responses for Each Question Type.

Note. CA = Chronological age-matched peers; LA = Language age-matched peers; LLI = Language-learning impaired. Total number of possible points = 10.

Table 30

Percentage Means and Standard Deviations (SD) for the Letter, Digit, and Spatial Memory Tasks

| | Groups | | |
|---|---|---|---|
| Tasks | LLI | LA | CA |
| Letter task | 28.70(15.05) | 33.10(13.90) | 63.40(20.49) |
| Digit task | 36.00(12.62) | 48.80(9.87) | 61.10(15.02) |
| Spatial task | 42.20(12.61) | 46.70(20.82) | 45.60(14.73) |

Note. LLI = Language-learning impaired; LA = Language age-matched peers; CA = Chronological age-matched peers.

Table 31

Multivariate Analysis of Variance for Group by Working Memory Tasks

| Source | df | F value | p |
|---|---|---|---|
| Letter | 2 | 12.76 | .001* |
| Digit | 2 | 9.76 | .001* |
| Spatial | 2 | .204 | .82 |

*indicates significance at the $p < .001$ level.

Table 32

Pairwise Comparisons for All Working Memory Tasks for LLI, CA, and LA Groups

| Working memory task | Group | Group | Mean difference | p |
|---|---|---|---|---|
| Letter | CA | LA | 30.30 | .001** |
| | | LLI | 34.70 | .001** |
| | LA | CA | 30.30 | .001** |
| | | LLI | 4.40 | .561 |
| | LLI | CA | 34.70 | .001** |
| | | LA | 4.40 | .561 |
| Digit | CA | LA | 12.30 | .039* |
| | | LLI | 25.10 | .001** |
| | LA | CA | 12.30 | .039* |
| | | LLI | 12.80 | .032* |
| | LLI | CA | 25.10 | .001** |
| | | LA | 12.80 | .032* |
| Spatial | CA | LA | 1.10 | .882 |
| | | LLI | 3.40 | .647 |
| | LA | CA | 1.10 | .882 |
| | | LLI | 4.50 | .545 |
| | LLI | CA | 3.40 | .647 |
| | | LA | 4.50 | .545 |

Note. LLI = Language-learning impaired; LA = Language age-matched peers; CA = Chronological age-matched peers.

*indicates significance at the $p < .05$ level; **indicates significance at the $p < .001$ level.

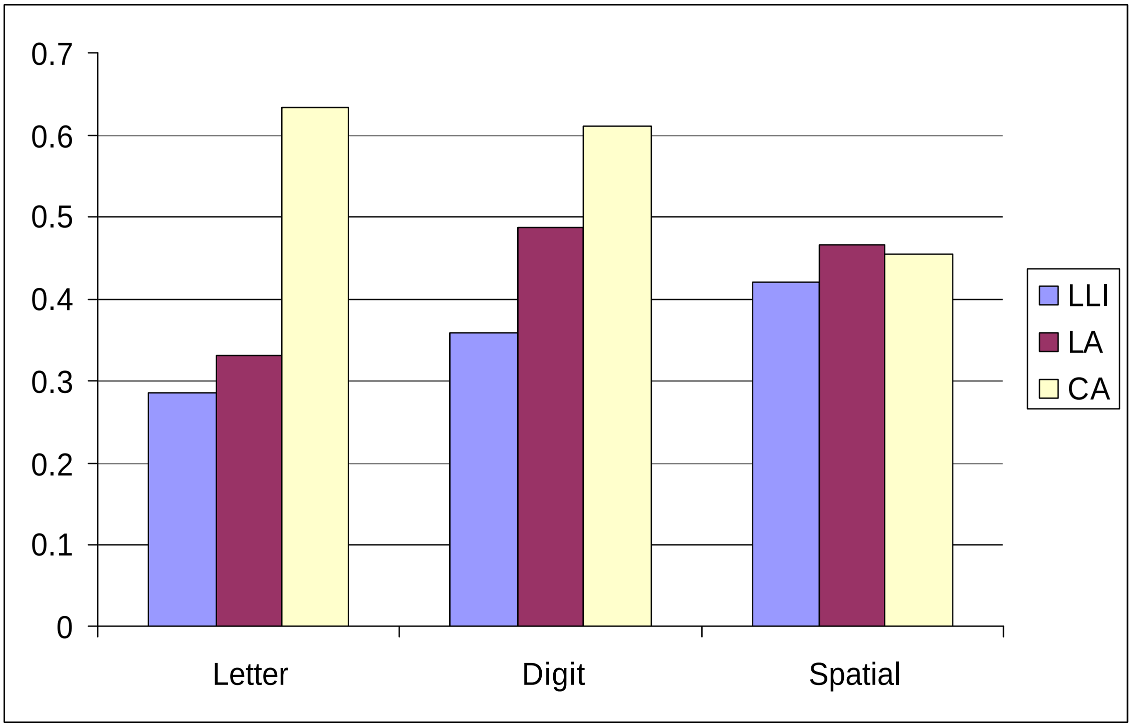



Figure 5. Percentage Score for Letter Recall, Digit Recall, and Spatial Working Memory Scores for Each Group.

Note. LLI = Language-learning impaired; LA = Language age-matched peers; CA = Chronological age-matched peers.

Table 33

Correlations Between Working Memory Measures, Story Grammar Scores, Developmental Sentence Scores, and Inferencing Scores for Both Presentation Conditions

| | Working Memory Tasks | | |
|---|---|---|---|
| Condition | Letter task | Digit task | Spatial task |
| <u>Heard Condition</u> | | | |
| Story Grammar | .326 | .294 | .221 |
| Developmental Sentence Score | .542** | .486** | .254 |
| Logical Inference | .374* | .358 | .234 |
| Informational Inference | .375* | .418* | .217 |
| Value Inference | .421** | .433* | .181 |
| <u>Read Condition</u> | | | |
| Story grammar | .310 | .454* | .223 |
| Developmental Sentence Score | .566** | .517** | .325 |
| Logical Inference | .233 | .376* | .307 |
| Informational Inference | .332 | .443* | .161 |
| Value Inference | .355 | .400* | .252 |

*indicates significance at the $p < .05$ level; **indicates significance at the $p < .001$ level.

correlations were found for at least one of the verbal working memory tasks (i.e., letter, digit) and the total story grammar score in the read condition, DSS scores in the heard and read conditions, and value, logic, and informational inferencing question scores in both the heard and read condition. No significant correlations were found between the non-verbal working memory task (i.e., spatial) and any of the language variables.

Because there were no differences between the heard and read conditions for any of the variables, each score was collapsed across presentation condition. A second Pearson's correlation (see Table 34) was conducted for all working memory tasks and all language variables. Significant correlations were found for one or both of the verbal working memory tasks (i.e., letter, digit) and ten of the twelve language components. No significant correlation was found for the verbal memory tasks (i.e., letter, digit) and the setting ($\underline{r}$ = .261, $\underline{r}$ = .281, respectively) or the internal response ($\underline{r}$ = .124, $\underline{r}$ =.088). Again, no significant correlations were found for the spatial task and any of the language variables.

Table 34

Correlations Between Working Memory Measures, Developmental Sentence Scores, Inferencing Question Scores, and Story Grammar Component Scores

| Variable | Letter | Digit | Spatial |
|---|---|---|---|
| Developmental Sentence Score | .590** | .534** | .308 |
| Inferencing: Value | .400* | .430* | .226 |
| Inferencing: Information | .403* | .490** | .215 |
| Inferencing: Logic | .331 | .396* | .290 |
| Setting | .261 | .280 | .240 |
| Initiating Event | .391* | .371* | .129 |
| Internal Response | .124 | .088 | .062 |
| Plan | .222 | .378* | .168 |
| Attempt | .316 | .435* | .204 |
| Consequence | .309 | .432* | .271 |
| Reaction/Resolution | .446* | .361* | .243 |
| Story Grammar Total | .333 | .389* | .232 |

*indicates significance at the $p < .05$ level; **indicates significance at the $p < .001$ level.

# CHAPTER IV

## Discussion

There were four specific objectives of this study. The first objective was to compare children with LLI to CA- and LA-matched peers on the number of story grammar components and the level of syntactic complexity produced during oral narrative recall. Children with LLI are known to be similar to LA- but delayed in comparison to CA-matched peers in the number of story grammar components produced (Fey, Catts, Proctor-Williams, Tomblin, & Zhang, in press; Wright & Newhoff, 2001) and delayed in comparison to both CA- and LA-matched peers in syntactic complexity of their narratives (Fey et al., in press; Gillam & Johnston, 1992). The specific nature of these delays remains unclear. It was hypothesized that children with LLI would recall narrative stories with fewer story grammar parts and less syntactic complexity than their CA- and LA-matched peers. Using stories that are multi-episodic would tax the children's storage and processing capacity during narrative recall, and these challenges would reflect differences in story grammar and grammatical productions in children with LLI and their CA- and LA-matched peers.

Second, this study assessed the ability of participants (children with LLI, CA- and LA-matched peers) to answer inferencing questions based on the stories that were presented. Because inferencing is a complex comprehension skill based on information that is not explicitly stated in the text, it was hypothesized that children with LLI would perform more poorly than their CA-matched peers when responding to inferencing questions, but on par with their LA-matched peers.

In this study, inferencing skill level was based on responses to three types of inferencing questions: value, information, and logic. It was hypothesized that inherent within these three types of inferencing questions lies a hierarchy of skills based on the type of information the question taps. An additional area of interest, therefore, regarding the inferencing question type, is whether children with LLI demonstrate the same pattern of response as their CA- and LA-matched peers when answering these three types of inferencing questions. Because information inferencing questions, or those that tap the “who”, “what”, “when”, and “where” information, include analysis of information that is more concrete in nature than the more abstract “how” or “why” (i.e., logic) questions, it was predicted that all children would answer more information inferencing questions correctly. The third type of inferencing question, value question, tap previously learned information, and require the reader to apply his or her world knowledge skills to accurately infer information in the text. Research has shown the application of previously learned knowledge is difficult for children with reading disabilities (Oakhill, 1996; Westby, 1999). It was hypothesized that all children, especially those with LLI, would answer fewer value inferencing questions correctly than information or logic questions.

Third, stories in this study were either heard or read to determine if recall of story grammar components, syntactic complexity, and inferencing question responses were influenced by presentation condition. Presentation condition has not been shown to be a distinguishing factor among children with LLI and their LA- and CA-matched peers with regard to story grammar recall (Wright & Newhoff, 2001). Wright and Newhoff, however, only analyzed the three most commonly recalled components of story grammar (i.e., setting, initiating event, and direct consequence). A more detailed analysis including all story grammar components (including internal response, plan, attempt, and resolution/reaction) was predicted to distinguish children with LLI from their CA- and LA-matched peers based on presentation condition. It was hypothesized that children with LLI would produce fewer story grammar components within less syntactically complex narratives than their CA- and LA-matched peers regardless of presentation condition, but especially in the read condition, where simultaneous decoding and processing demands are believed to be greater (Wright & Newhoff).

In the read condition, decoding and processing demands were hypothesized to negatively impact the inferencing skills of children with LLI, resulting in fewer correctly answered questions compared to the heard condition. Decoding and processing demands have not been shown to impact inferencing skills in typically developing children for reading material that is at or below reading skill level (Wright & Newhoff, 2001). Therefore, the LA- and CA-matched peers were predicted to respond to inferencing questions equally well in both presentation conditions.

Finally, this study examined verbal and non-verbal working memory skills in children with LLI and their CA- and LA-matched peers to determine what extent working memory skills aid narrative recall and the formulation of inferences. Previous researchers report significant impairments in the working memory skills of children with LLI compared to their CA-matched peers (Ellis Weismer, Evans, & Hesketh, 1999), and have further found that working memory is one factor that distinguishes good versus poor readers (Engle, Carullo, & Collins, 1991). Therefore, it was hypothesized that children with LLI would score significantly lower on verbal, but equally as well on non-verbal working memory tasks, compared to their CA- and LA-matched peers. This difference in verbal versus spatial working memory performance supports a domain specific theory of processing, which maintains separate functions for verbal and non-verbal processes.

Working memory has been found to contribute to various language-based skills, including comprehension (e.g., inferencing) (Yuill, Oakhill, & Parkin, 1989) and narrative production (Seigneuric et al., 2000). Significant positive correlations were hypothesized between story grammar components, measures of syntactic complexity, and inferencing scores with verbal (but not spatial) working memory tasks. Such correlations would further support the domain specific hypothesis, indicating task specific areas for processing verbal and non-verbal information. No correlation was predicted for language measures and spatial working memory measures because of domain specificity.

### *Story Re-telling Task*

#### *Story grammar.*

In the current study, children in the LLI group scored significantly lower than their CA- and LA-matched peers on recalled story grammar components, specifically for plan, consequence, and total story grammar measures. In addition, the internal response component differed significantly for LLI and LA-matched peers ($M$ = 29.06 and 51.09, respectively), but not for LLI and CA-matched ($M$ = 41.25) peers. No significant differences were found between CA- and LA-matched peers on any of the components. The significant difference between LLI and LA peers may be attributed to the amount of information processed in multi-episodic stories. An increase in the amount of information processed might place an increased burden on storage capacity. Children with LLI are known to process information more slowly (Gillam & Carlile, 1997); an increase in storage capacity demands might further burden the integration of information and thereby distinguish children with LLI from their LA-matched peers. Further study is recommended to compare less and more complex stories to support this notion.

An increase in storage and processing demands does not explain the lack of significant differences between CA- and LA-matched peers. If the increase in the amount of information in the stories were sufficient to distinguish LA and LLI groups, then one would expect to find significant differences between all of the groups (i.e., children with LLI performing significantly poorer than the LA group, who perform significantly poorer than the CA group). In fact, differences would have been expected given the differences in the working memory skills of the LA and CA groups, and the significant correlations between working memory skills and story grammar recall. In addition, reading comprehension skills were within +/- 1 SD of age group means for both LA and CA groups; therefore the CA group should have outperformed the LA group. While working memory correlated with story grammar components, other factors that explain more of the variance than that attributed to working memory may contribute to narrative recall success. Because the children were asked only to recall rather than generate the stories, this may have been less taxing for simultaneous storage and processing. In addition, similar non-verbal scores on the K-BIT between the LA and CA groups might account for the similar scores between the LA and CA groups. Future studies should examine the specific components of working memory, including measures of memory storage capacity and the episodic buffer within a multiple regression analysis modeled after Cain et al. (2004) to determine the extent of the variance in narrative recall that might be attributed to memory, non-verbal cognition, and language skills.

Similar performance by the LA and CA groups in their recall of story grammar components and responses to inferencing questions suggests like skill levels in creating complete and accurate situational models of the narratives. Situational models store not only factual information about the narrative (e.g., characters, setting, objects, etc.), but also incorporate how the information included in the model is tied together (e.g., temporal, causal, etc.). The accuracy of these ties in a situational model impacts comprehension, specifically inferencing skill (Bower & Rinck, 1999). In fact, Trabasso and Magliano (1996) found that third graders' ability to make explanatory inferences, or inferences that answer why questions and link actions and events in a story, reflects their ability to link story propositions. According to these researchers, these links are stored in working memory, and aid children in answering comprehension questions and recalling story grammar components. Similar inferencing and story grammar recall would therefore be expected for the CA and LA groups.

A similar pattern of recalled story grammar components was also found among the groups when the components were organized by frequency of recall (i.e., highest to lowest). The groups only differed in the number of recalled components. The stories used in the current study included multiple episodes (e.g., multiple plan-attempt-consequence sequences). The similar pattern of story grammar components recalled for each of the groups suggests that children with LLI probably reduced the number of episodes that were recalled, as opposed to recalling only portions of each episode. In fact, Graybeal (1981) reported that children with language impairment recalled fewer story grammar components than their age-matched peers, but were similar in accuracy, organization, and temporal ordering. The increase in story grammar components in the current study, therefore, did not seem to negatively impact children with LLI in their ability to develop a situational model of the narrative, only in their ability to develop a robust situational model that accurately reflected all of the story episodes.

Children in the LA and CA groups produced at least 50% of all of the story grammar components, with the exception of the attempt components. Children in the LA group were more likely to exclude attempts and resolution/reactions, but children in the LLI and CA groups more likely to exclude attempts and internal responses. According to Westby, resolution/reactions are more indicative of later elementary age level productions; so younger children would not be expected to recall them. This supports why the (younger) children in the LA group more frequently omitted resolutions/reactions in their narrative recall. Plans, attempts, and internal responses are usually seen in early elementary age level productions, but develop more fully in the later elementary years. It was unexpected to find that the CA group recalled fewer internal response components than the LA group. Children in the LA group might have produced more internal responses than the CA group because as younger children, they were more engaged in the story re-telling task than the older children (Wigglesworth, 1997), and they had an easier time identifying with the protagonist in some of the stories. One of the practice stories, Lemonade Luck, referenced the protagonist as a second grader, and all of the children in the LA group were in second or third grade. In addition, several of the LA children commented that they had recently engaged in activities similar to those highlighted in the stories, such as selling lemonade, rollerblading, camping, or going to the circus or amusement park. One child even referenced his personal experience of missing a fun field trip because of his illness before recalling the narrated story, Skipping

School, and included in his recall how his personal experience differed from the original story. Children in the LLI group were predicted to recall a low percent of internal responses, as children with LLI often have difficulty interpreting characters' feelings and motivations, and are known to produce fewer internal responses than typically developing children (Montague, Maddux, & Dereshiwsky, 1990).

*Syntactic complexity.*

Findings from the present study are consistent with results of Gillam and Johnston (1992), who found that children with LLI produced fewer grammatically correct complex T-units than typically developing peers. In the current study, children with LLI produced narratives with significantly fewer complex sentences, as seen by DSS scores, than their typically developing (CA and LA) peers. CA-matched peers also produced significantly more complex sentences than the LA-matched peers. Further analysis of the individual DSS components revealed significant group differences for use of indefinite pronouns/noun modifiers, personal pronouns, main and secondary verbs, conjunctions, and the sentence point.

The DSS scores of the children in the LLI group are not surprising given their Syntax composite on the TOLD-I:3. Children in the LLI group earned an average score of 75 (SD = 10.82) on the Syntax composite, with a range of 61 to 96. Even the pattern of DSS component scores is consistent with normal grammatical development: no significant difference was expected for use of negatives or wh- questions, as these are earlier developing grammatical forms (Reich, 1986). The significant difference in use of conjunctions, too, is not a surprising difference, given that children with poor comprehension skills have been found to use fewer connective ties (including “and” and “because”) than children with stronger comprehension skills (Yuill & Oakhill, 1991). Cain (2003) examined skilled (M = 7;7 years), less skilled (M = 7;7 years), and comprehension matched (M = 6;6 years) children to assess the effect story starters and picture prompts have on children’s use of connectives and the coherence of story event structure during narrative production. The story starters included topic prompts (i.e., titles), and directed title prompts (i.e., titles which suggest the outcome of the narrative). Picture prompts consisted of six picture sequences with a title. Cain found that the less skilled comprehenders used connectives, including the conjunctions “and,” “but,” and “because,” less often than typically developing peers when creating their own narratives using story title prompts. They improved in their use of “but” and “because” connectives with directed title and picture prompts. The skilled and chronological age-matched peers were similar in their use of connectives, regardless of prompt. Cain concluded that providing more informative story starters (i.e., topic title prompts and picture aids) resulted in an increased use of connectives due to a reduction in processing load, and an activation of story schema, which allowed them to create an accurate situational model of the story. Story starters and picture prompts may also aid narrative recall of stories with multiple episodes by reducing processing and storage capacity loads and allowing for a more accurate situational model of the story. No story titles were used in the current study, because several of the original titles were too descriptive, and provided too much literal information that might have significantly aided inferencing or negated the need to infer. Further research is warranted to determine if story starters and pictures significantly aid story grammar recall, syntactic complexity, and inferencing skills while recalling simple versus complex stories.

Children in the LLI group may have performed more poorly than their LA-matched peers in terms of syntactic complexity due to the additional storage demands the recall component added. Perhaps as in story grammar production, their syntactic complexity scores would have been more similar if less complex stories had been utilized. It is important to note that DSS component scores reflect the correct use of these grammatical forms, and that no specific form was obligatory. Sentence points were earned if the child's production was grammatically correct. Therefore, children in the LLI group produced sentences that were less grammatically complex (as evidenced by the low DSS component scores) and less correct (as evidenced by the lower sentence point scores).

*Inferencing*

Similar to the findings for story grammar components and syntactic complexity, children with LLI answered significantly fewer value, logic, and information inferencing questions correctly than their LA- and CA-matched peers. No significant difference was found between LA- and CA-matched peers in inferencing responses. As found when comparing the present study's story grammar findings with those of Wright and Newhoff's study (2001), the two investigations differ in regards to the accuracy of inferencing question responses between LLI and LA groups and CA and LA groups. Wright and Newhoff found no differences in inferencing responses between LLI and LA groups. In the current study, no significant differences in inferencing question responses were found between CA and LA groups, but the LA group answered more questions correctly than the LLI group. Again, the increase in storage and processing demands resulting from the additional information included in the stories in the present study may account for the difference in the pattern of responses between LLI and LA groups. Children in the LLI group may have been unable to develop complete story schemas, as suggested by their reduced story grammar recall, which impeded their ability to comprehend the story.

Differences in the level of inferencing question difficulty also may have contributed to the differences found between Wright and Newhoff (2001) and the current study. Both studies based the inferencing questions on the story grammar components, and both used the same inferencing model (i.e., Warren, Nicholas, & Trabasso, 1979), however, neither study classified the inferencing questions according to the amount of information inherent to them. For example, inferences can be made on information presented within sentences (i.e., anaphoric), between sentences (i.e., intersentence), and across text. While research does support that children with poor reading comprehension skills have difficulty generating all types of inferences (Cain & Oakhill, 2003), it is unknown whether there is a hierarchy of inferencing based on this type of classification. If such a hierarchy exists, the need to control for the *amount* of information included in the inferencing question may be just as important as the *type* of information included in the inferencing question.

Yet another factor to consider in inferencing questions is found in Cain and Oakhill (1998) who compared poor comprehenders, comprehension age-matched peers and skilled comprehender peers on gap filling and intersentence inferencing questions that were made based on *explicit* and *implicit* information in the text (see pp. 15-16 in the current study for a review of their study). Recall that gap filling inferencing questions require the reader to tap and apply his or her own knowledge base to implicit information presented in a text. Intersentence inferences are made based on explicit information presented over several sentences in a text. Presentation of the information to be inferred, therefore, may also impact inferencing ease. Cain and Oakhill found that skilled comprehenders answered more gap filling inferencing questions correctly than the less skilled and comprehension age-matched peers, but both comprehension age-matched peers and skilled comprehenders outperformed the less skilled comprehenders on intersentence inferencing questions. Differences among the groups dissolved when the children who answered intersentence questions incorrectly were given the opportunity to review the text. Differences persisted, however, among the three groups for gap filling questions, even after the children who missed the questions reviewed the text. It was only after the researchers asked questions to activate children’s general knowledge pertinent to the gap-filling inferencing question that the children then answered these questions correctly.

While in the current study the amount of information and the nature of presentation (i.e., explicit or implicit) was not controlled for across inferencing questions, a hierarchy of inferencing skill was found to emerge within the inferencing taxonomy. Specifically, all children answered more information inferencing questions correctly, followed by logic inferencing, and value inferencing questions. Mean logic scores across groups were slightly higher than mean value scores across groups, but no significant differences were found between value and logic questions. Wright and Newhoff (2001) reported similar results, but they found significant differences between each question type. The difference in findings may be attributed to differences in scoring procedures. Inferencing questions in Wright and Newhoff's study were calculated based on a binary system and only correct responses were considered. Therefore, children in Wright and Newhoff's study may not have received credit for responses that were incorrect, even if they knew the answer and misinterpreted the question. In the present study, cued responses were also calculated into each score.

The hierarchy of inferencing skill level is consistent with the development of concepts in language acquisition. The order of acquisition for comprehension of wh-questions reflects the level of difficulty associated with the concept expressed (Miller & Paul, 1995). Recall that information inferencing questions reflect information about characters, events, times, places, and objects. Logical inferencing questions represent the causes, motivations, and conditions in a text and answer the "why" and "how" questions. Value inferencing questions reflect information about learned and integrated world knowledge. Information inferences represent information that is more concrete (e.g., objects, places, people) are learned before those that are abstract (e.g., feelings, concepts of time, etc.). Logical and value inferencing questions are more abstract, and therefore more taxing on working memory processes.

The majority of children with LLI in the current study were found to have poor semantic skills, based on the Semantic Composite score of the TOLD:I-3, which may have contributed to their inability to make informational inferences. Often, when the meaning of a word is unclear or can be assigned more than one meaning, readers will use contextual cues in a sentence in order to extract the meaning of a word (Cain & Oakhill, 2003). Children with poor comprehension skills have been found to have difficulty in extracting the meaning of a word based on sentence context (Oakhill, 1983). Oakhill states that poor comprehenders may be less likely to comprehend text for information that must be semantically inferred.

Logical inferencing questions reflect information that is central to the understanding of character's goals and motivations. This information is critical to the development of causal ties in the text between the internal response, plan, attempt, and consequence. Researchers have found that interpreting characters' feelings and motivations are more difficult skills, especially for individuals with language impairment (Paul, 2001; Westby, 1991).

Value inferencing questions, or those that tap one's individual knowledge base, contribute to our understanding of a narrative. According to Graesser, Singer, and Trabasso (1994):

> Most background knowledge structures are meaningful and contextually rich. That is, they are grounded in experience with content organized by meaningful relations, for example, a script of eating at a restaurant. These rich structures furnish much of the content needed to interpret, explain, predict, and understand narrative events. (p. 374)

Poor comprehenders' inability to use their relevant general knowledge base to make inferences has been attributed to deficits in working memory (Oakhill, 1996). Narrative skills in poor comprehenders are adequate enough to develop a partial representation of the text, as supported by their ability to identify inconsistencies and assimilate information over short portions, but not long portions, of a text. These poor representations are not adequate enough, according to Oakhill, to allow for an integration of information from different parts of the text, and may contribute to difficulties with the merging of their background knowledge base. Borrowing from Baddeley's model, during inferencing, components of the central executive and phonological loop would be tapped in order to hold and process information as inferences are drawn, but the episodic buffer would also contribute in bridging information from learned knowledge and past experience, and in developing a hypothetical model for the structure of the narrative text (Baddeley & Wilson, 2002). Given Oakhill's (1996) conclusions regarding the poor representations of text built by children with LLI, and the evidence to support poor working memory systems in children with LLI (Ellis Weismer et al., 1999), inferences drawn by children in this population would be built upon an incomplete hypothetical model of the narrative text structure and an inefficient system to process this information, and would result in inaccurate inferencing.

Anecdotal observations from the children's narrative recall in the current study support this idea. Children in LA and CA groups were noted to draw more inferences, almost as asides, in their story recall, and to provide inferred information as fact; whereas the majority of children in LLI group were more likely to only provide factual information that was given in the text. More of the LA and CA children added to their stories components from their real life, or their reactions to the character's actions, reflecting their ability to automatically draw information from their personal lives and previously learned knowledge, as well as interpret the character's feelings. For example, children in the LA and CA groups were more likely to draw conclusions regarding why they thought the characters would behave in a particular manner (e.g., "Lisa loved to tell stories because she was probably Native American and story-telling is highly valued in their culture.”), or tried to identify with the characters (e.g., “Luke chose to learn about turtles instead of spiders because he hated spiders and I would have picked turtles, too, because I hate spiders, too.”), or commented on the character’s behavior (e.g., “When Matt’s mother told him he would have to clean the house if he stayed home, he decided to go to school, because he, like every boy, hates to clean.”).

*Presentation Condition*

By including both a heard and read presentation condition, it was possible to assess differences in children’s narrative recall based on their reading comprehension versus listening comprehension skills. Reading comprehension skills are based on children’s ability to decode textual information, and comprehend meaning within and across the text (Cain & Oakhill, 2003; Oakhill, 1996). The focus of this study was not to assess ability to comprehend based on decoding skills, or on information that was more complex than the child’s established reading level. In fact, children’s decoding, word understanding, and passage comprehension were assessed to assure they could accurately decode and comprehend information that was consistent with or more advanced than the reading level of the experimental stories. In this study, reading comprehension reflected the child’s ability to comprehend and recall stories that were at or below their reading level. However, in giving the children the opportunity to read the stories silently, there was no guarantee that the entire story would be read. If children said they were reading silently but actually skipped words or sentences in the text, their scores would not reflect their actual comprehension and production abilities. Therefore, participants were instructed to read the stories aloud in order to ensure the stories were read completely and accurately.

Wright and Newhoff (2001) found no presentation condition differences among LLI, CA, and LA children for the three most commonly recalled story grammar components, but did find significant differences among their groups regarding presentation condition for inferencing skill levels. Children with LLI could infer information more accurately when the text was heard but their CA- and LA-matched peers answered more questions correctly in the read condition. Because no presentation condition differences were found among groups for the story grammar recall, perhaps it is possible that the children in the LLI group in Wright and Newhoff's study read the stories to themselves only closely enough to recall the main story grammar components, but not precisely enough to comprehend or infer all of the information that is not explicitly stated in the text. Wright and Newhoff addressed this issue when they suggested that one reason the children in their LLI group did not perform as well as their LA peers on inferencing question responses was due to a deficit in decoding skills. The LLI group may have been, "spending more time decoding the text and less time extracting content from the text (p. 315)." They discounted this as a complete explanation for two reasons: a) they would have expected overall lower inferencing scores than were found if the LLI children did not read the text accurately (M = 5.8 out of 8 possible points), and b) no differences were found in story grammar recall across the read and heard conditions, which would have been expected if decoding was a major issue. Observations by the current investigator, however, support that children in all of the groups skipped lines or words in the narrative that, had they not been cued to re-read the line or word, may have impacted their ability to understand the text sufficiently enough to correctly answer inferencing questions. By requiring the children to read aloud, the degree to which the child read the story (e.g., skimmed versus word by word decoding) is not in question. However, no significant differences between the heard and read condition were found in the current study for any of the variables (i.e., DSS, story grammar, and inferencing). Asking the children to read the stories aloud instead of silently to themselves may have negated any presentation condition effects due to the children "performing" for the primary investigator. Because the children were reading aloud for a stranger, they may have worked harder to read the stories accurately, which may have improved their comprehension and negated any presentation condition effects. Observations by the primary investigator during the read condition support this idea. Some children were noted to be self-aware when they knew they had to read aloud, and they were very careful and deliberate while trying to read every word precisely and accurately.

Asking the children to read aloud may have also negated any presentation effects due to the fact that the children were both seeing the printed words and hearing themselves read the story. Reading aloud may result in more efficient and accurate comprehension skills due to the fact that the information is presented in two modalities, as opposed to a single modality when reading silently. This dual modality reading may have also decreased the simultaneous storage and processing demands found when reading silently sufficiently enough to negate any presentation effects.

It could be argued that children in the LA group would have been expected to perform better for stories that were heard than read because of their relative lack of experience in reading text compared to the CA peers. Children in second and third grade would not be expected to possess completely automatized reading skills for first to second grade level reading material; they would still be classified in the alphabetic stage, meaning they continue to use sound-letter correspondences to decode novel words (Kamhi & Catts, 1999). The process of simultaneously decoding and comprehending would therefore also be challenging for the LA group, although not to the same degree as found for the LLI group. However, children were allowed to take as much time as they needed in order to read the text before re-telling the story in both studies. Not restricting time to read the stories may have removed any presentation condition effect differences between LA and CA groups.

*Working Memory*

The CA group scored significantly higher than the LLI and LA groups on the letter task, but no difference was found between the LLI and LA groups. The digit task, however, revealed significant differences among all of the groups. The CA group outperformed the LA group, which performed better than the LLI group. These findings are consistent with previous researchers who compared verbal working memory skills in children based on reading comprehension skills (e.g., Cain & Oakhill, 1996; Nation et al., 1999) or language proficiency (e.g., Ellis Weismer et al., 1999). In all cases, children with good reading comprehension or language proficiency outperformed children with poor reading comprehension or LD on verbal working memory measures.

While the letter and digit tasks are both considered simultaneous storage and processing tasks, the letter task may have been only a storage task for some of the children. The design of the letter task is intended to require the participant to recall only the last three letters in a set of unknown length, which requires them to drop from storage the first letter in the string each time a new letter is presented. Children are supposed to be juggling four letters at a time in their working memory: the three to recall and the one to drop, while maintaining the correct order of letters. All but one of the participants in the current study were noted to name each new letter aloud as they were presented, but instead of dropping one letter from a set of three as a new letter was presented, children were heard to memorize the entire string of letters, then recall the last three at the end of the set. This was not always successful, as sets were five, seven, or nine letters in length, and the child never knew how many letters were in a set. This may explain why the average scores for the letter task were lower than the average digit scores, and why the groups did not have a similar pattern of responses for the letter and digit tasks (i.e., LLI and LA groups were significantly lower than CA group on the letter task, but all groups were significantly different from each other on the digit task: CA>LA>LLI).

Lack of a significant difference among groups for the spatial working memory task lends support for the single domain theory of processing deficiency. As reported by Nation and colleagues (1999), the working memory deficit found in children with LLI was specific to the verbal memory domain. In addition, the spatial working memory task was not significantly correlated with any of the language measures, which also lends support for separate subsystems to independently store and process spatial and causal information (Friedman & Miyake, 2000; Shah & Miyake, 1996). These findings are also consistent with Seigneuric and colleagues (2000) who found that verbal, and not non-verbal, working memory tasks were significantly correlated with reading comprehension.

It is important to note, however, that two to three children in each group may have utilized a technique to complete parts of the spatial task that may have re-classified this task as a verbal task. These children were heard at times to verbally rehearse the location of the lines according to their location (e.g., “left vertical” and “diagonal upper right”). The rest of the children did not verbalize the technique they used to complete the task, so it is unclear if more of the children adopted this verbal strategy or not. If all the children did utilize this strategy, however, a significant difference among the groups would have been expected, given the results of the other verbal tasks and the verbal impairment of the LLI group. In fact, researchers have found that children with language impairments do not perform as well as normal language age controls on spatial tasks when verbal strategies are adopted (Colozzo & Johnston, 2004). In addition, similar results among groups for the spatial working memory task in the current study are consistent with other studies that examined children with SLI (Moser & Johnston, 2004), and reading comprehension difficulties (Nation et al., 1999). Both studies reported similar nonverbal working memory skills between children with good and poor language or reading comprehension skills.

The current study also corroborates with the findings of Cain and colleagues (2004), who reported significant correlations between reading comprehension and verbal working memory skills (i.e., sentence completion and digit recall) in typically developing children at 8, 9 and 11 years of age. While these researchers found a greater number of significant correlations between their sentence, as opposed to their digit, working memory task and reading comprehension, the current study found a greater number of correlations between the digit, as opposed to letter, working memory task and the narrative comprehension and production measures. This difference may be attributed to the previously discussed difficulties with the letter task in this study.

The nature of the working memory tasks may provide an alternative explanation. The sentence task used by Cain and colleagues (2004) included a comprehension component: participants were required to provide a word that completed a sentence, then recall only the provided words at the end of each set. The letter task in the current study did not include a comprehension component. Participants were only required to recall the last three letters in a string of letters. The digit task used by Cain and colleagues required the participant to read several strings of numbers and recall the last number in each string at the end of the set. The digit task in the current study included a comprehension component by requiring the participant to sum a string of two number equations, then recall all of the provided answers at the end of each set. The results of the two studies differed in that Cain and colleagues only found significant correlations between their digit and reading comprehension measures during one testing time, whereas significant correlations were found between their sentence task and reading comprehension at all three testing times. In the current study, the digit task was correlated with ten of the twelve language variables, but the letter task only correlated with two of the twelve language variables. Cain and colleagues concluded that correlations were predicted for their sentence and not their digit task and reading comprehension, as the sentence task was language based, whereas the digit task is numerical. Perhaps a greater number of correlations were found in the current study because the digit task also included a comprehension component, which might relate more to reading comprehension than Cain and colleagues' digit recall task. In fact, the letter task in the current study more closely resembled the digit task in Cain and colleagues' study, as both included a storage and processing, then recall component, and both were less related to reading comprehension than working memory tasks that included a comprehension component. Additional research is necessary to determine whether digit and sentence based working memory tasks differ in their relation to reading comprehension based on the categorization of tasks as storage and processing versus storage, processing and comprehension.

One or both of the verbal working memory tasks were significantly correlated with the DSS measure, all of the inferencing questions, and five of the seven story grammar components (not including the total story grammar measure). Recall that Ellis Weismer and colleagues (1999) found only a modest positive correlation between their standardized working memory test and mean length of utterance (MLU) in children with SLI and children with normal language skills (see pp. 36-37 in the current document). However, because their standardized working memory instrument utilized a simple sentence structure, the authors hypothesized that the syntactic skills of the children might not have been tapped. MLU reflects the average number of morphemes in a child's expressive output, and is less sensitive than DSS in analysis of the complexity of specific grammatical forms. Therefore, the DSS measure may have been a more sensitive measure to use to determine the relationship between working memory and complexity of syntactic expression.

In the current study, no correlations were found for two of the story grammar components, setting and internal response. This may be due to the relationship between the story grammar components. The initiating event of a story sets into motion a series of events described by the plan, attempt, consequence, and resolution and reaction that are more closely linked than the setting and internal response: the initiating event provides the desire for a plan, which leads to the attempt, of which the consequence results in a resolution/reaction. Setting and internal response do not appear to be as directly linked as the other components. Including all of these components would therefore rely more on working memory skills to assure the facts are presented (i.e. storage component) and presented in a logical format (i.e., processing component). General support for this idea was found during the narrative recall task. Children with LLI and their LA peers were more likely to recall individual story components, but not in the correct order, whereas children in the CA group were observed to recall items in a sequential fashion. Children were given credit for the story grammar components regardless of the order in which they were presented, but a re-analysis of the narrative recall task might show that the groups significantly differed in their ability to tell the stories in correct sequential order.

Children in the CA group scored significantly higher on working memory measures than children in the LA group, yet both groups had similar story grammar and inferencing scores. Children in the LLI group, however, scored significantly lower than children in the CA and LA groups on working memory measures, story grammar, and inferencing skills. This suggests that the relationship between language proficiency, working memory, and narrative comprehension and production is dynamic: children with poor language skills may depend on working memory to a greater extent for a longer period of time than children without language impairment. In addition, for all children, additional factors may impact narrative proficiency over time. For example, Cain and colleagues (2004) found that working memory did account for a significant amount of variance in reading comprehension beyond that of basic verbal skills in typically developing children at 8, 9, and 11 years of age, but other factors, such as metacognitive skills, also contributed above that of working memory. The differences in skills between children in the LA and CA groups for working memory, story grammar recall, and inferencing, may therefore be attributed to other factors, such as metacognitive skills. An analysis of metacognitive skills, including comprehension monitoring skills and story structure knowledge in children with LLI, and their CA and LA peers should be conducted to determine if the differences between these groups on metacognitive skills accounts for some of the discrepancies between working memory and narrative comprehension and recall performance.

### *Treatment Implications*

#### *Story grammar.*

Results from the current study support that children with LLI produce fewer story grammar components than their LA and CA peers. This has been attributed to difficulty in developing a complete situational model of the narrative due to processing demands. Instruction on the organization of story grammar structure may help children to construct a more accurate situational model. Culatta and Merritt (1998) recommend helping children identify and map story grammar components to aid children in establishing a structure for the narrative, including the setting, character, problem, the character's plans based on his or her goals, and any consequences of the character's actions. Cohesive ties among story grammar components should be highlighted to help children understand how the components are related. Culatta and Merritt also recommend asking questions regarding the theme of the story in order to activate previously learned knowledge or experiences that may support the child in creating a situational model of the narrative. Stories with fewer tokens of story grammar components and/or a less complex syntactic structure should initially be used based on the child's baseline skill level, and then progress in complexity. Narrative Based Language Intervention (Swanson et al., 2003) is one program that emphasizes story grammar and syntax to improve children's narrative skills. This program has been found to improve the narrative quality, including the story organization and content, as well as the complexity of story grammar structure, in children's narratives.

Think aloud is another relevant technique found to improve story grammar recall in children with and without reading impairment (Laing & Kamhi, 2002). These researchers examined third graders classified as average and below average readers in their ability to recall narratives and answer literal and inferential questions based on narratives that were presented in one of two conditions: listen through or think aloud. In the listen through condition, children listened to two stories without interruption. In the think aloud condition, the children listened to two stories, but were asked to state their understanding of the stories after they heard each sentence of the story. Their understanding of the stories was coded as a literal or an inferential statement. Children were asked to recall the first story in both presentation conditions and answer literal and inferencing questions based on the stories. Therefore, three components of narrative comprehension were measured: number of correct and incorrect inference statements made in the think-aloud condition, number of story propositions produced during recall for both presentation conditions, and number of correct literal and inferencing questions answered based on stories presented in both presentation conditions.

Laing and Kamhi (2002) found that the average readers produced more inferencing statements in the think aloud condition than the below average readers. In addition, more inferencing questions were answered correctly by both groups in the think aloud condition than in the listen through condition, although the average readers benefited more from the think aloud condition than did the below average readers. Finally, average readers recalled more story propositions than did the below average readers, but more were recalled for both groups in the think aloud condition. Laing and Kamhi concluded that in order to make inferences, the reader must develop a mental representation of the story that is accurate in story sequence of events, states, and actions. This mental representation is based on causal ties in the story. Utilizing the think aloud procedure helps the reader to identify causal ties in the text. Understanding these ties aids in comprehension and contributes to the development of a correct and complete situational model, which in turn results in more story grammar tokens produced during narrative recall. Below average readers were also found to fail to make inferences at the beginning of the story, which contributed to their overall lower inferencing scores. Utilizing the think aloud technique would therefore also help the teacher identify when and where the reader’s comprehension breaks down, to further pinpoint specific areas of difficulty in the reader’s story comprehension.

Metacognitive skill for reading is another important area to address during training for children who need to improve their story recall and comprehension skills, and have been shown to be impaired in children with poor reading comprehension (Cain, 1999). Metacognitive training emphasizes a reader's own understanding or awareness of their individual skill level. In a series of two experiments, Cain (1999) examined metacognitive skills for reading knowledge and reading regulation skills in less skilled, skilled, and comprehension age-matched children six to eight years of age. The first of these experiments will be discussed here, and the second will follow under the treatment section for inferencing skills. In order to control for group differences based on decoding skills, children were selected based on similar word reading accuracy. Children in the first study were assessed in their ability to determine what skill is most important in reading, skills and strategies that are important for story recall, and strategy knowledge for repair of comprehension of word to discourse level text. Results indicated that the less skilled comprehenders were similar to the comprehension age-matched children, but significantly poorer than the skilled comprehenders in their reading skill and repair strategy knowledge. Specifically, less skilled comprehenders valued word decoding over word understanding as the most important skill in reading. The less skilled comprehenders also provided fewer suggestions than skilled readers for text recall that emphasized memory for the gist of the text. Instead these less skilled readers suggested strategies that are ineffective in memory recall. Even when provided with two forced-choice option strategies designed to aid or not aid story recall, less skilled comprehenders were less likely to identify strategies that would help recall compared to skilled comprehenders. Finally, when asked to provide repair strategies for word reading, understanding of words, sentences, character's actions, and events in a story, less skilled comprehenders were less likely to provide an appropriate independent remedy than skilled comprehenders.

Results from Laing and Kamhi (2002) and Cain (1999) suggest that children with poor reading proficiency lack the skills necessary to detect when comprehension breaks down, and are inaccurate or inefficient in their understanding for appropriate "internal tools" that may improve comprehension. Children with LLI in the current study may also experience these deficits. Utilizing the think aloud procedure and training to improve metacognitive skills for reading, such as those described in Cain (1999) may therefore also prove effective in improving narrative comprehension and recall skills.

*Syntactic complexity.*

Results of this study suggest that the syntactic complexity of recalled stories by children with LLI may decline as the number of tokens of story grammar components increases, even when recalling narratives that are at or below reading skill level. In addition to story grammar component training to aid children in improving their situational model, training to identify and use cohesive devices may benefit not only reading comprehension, but also the syntactic complexity of productions. This type of training will enable the children to learn to express narrative components in terms of their temporal, causative, and relational associations. Cain and Oakhill (1996) found that children with poor comprehension produce narratives with fewer causal connectives. When provided prompts, such as a title or topic prompt, the structural quality of their narrative story productions improved. While syntactic knowledge has not shown to always predict reading comprehension (see Cain & Oakhill, 2003 for a review), training in specific syntactic components may aid production of syntactic complexity.

Gillam, McFadden, and van Kleeck (1995) assessed story content and form following Gillam and Johnston's (1992) protocol in children 9 to 12 years of age using two treatment conditions. Four children received whole language therapy that was meaning based and the other four children received language skills therapy that was form based. Children in the two groups were matched for non-verbal intelligence and degree of language disorder at the time of testing, and all children had received special services in the format of their group assignments for no less than two years.

Whole language education targeted a particular concept, content, or form through the use of a book selected by the students. Discussion to activate knowledge and predict story events based on title and pictures took place before the book was read. The selected book was read several times in different formats (e.g., aloud to students, choral reading, paired reading, etc.) to familiarize the children with the book's components, which was followed by a second book discussion, which targeted comprehension questions. Children and instructors then enacted the book using toys and prompts, and created other stories, songs, plays, and puppet shows based on the book. Teams of two children then created their own version of the story, and were instructed to focus on meaning as opposed to grammar or spelling; such editing took place after the story was created. Finally, the stories were "published" by developing a computerized version of the story, and were then printed and shared with other students. A second book was then selected, and was discussed in reference to similarities and differences with the first book.

Language skills therapy targeted language form, including grammar, spelling, and proper punctuation in workbook activities. Children completed a sequenced reading program, which required the children to read a short story and correctly answer questions regarding story grammar components before advancing to the next reading level. Oral reading was addressed, as well as dictated sentences, which were graded for accuracy, spelling, capitalization, and punctuation. Grammar, language, and spelling were focused on in paragraphs the children wrote from story starter worksheets. Decoding skills were targeted in the classroom by the teacher, and the speech-language pathologist provided some phonological awareness training targeting initial and final letter identification, segmentation by syllables, and blending sounds to form words. In addition, the speech-language pathologist addressed phonological analysis, vocabulary, grammar, and sequencing skills.

At the end of the training program, children in both groups were asked to provide two written and two spoken narratives according to Gillam and Johnston's (1992) protocol. The three measures of language content examined included number of propositions per T-unit, number of dyads, and percent of embedded dyads. Language form measures included number of morphemes per T-unit, percent of acceptable T-units, and percent of marked relationships, which reflected the correct use of connectives to join clauses. Children in the whole language group produced spoken stories with a greater number of language content measures than the language skills group. The written stories, however, were stronger for the whole language group in proportion of embedded dyads, but stronger for the language skills group in number of propositions per T-unit. No difference was found between groups in the number of problem resolution pairs in the written stories.

Regarding language form, children in the language skills group outperformed the whole language group on all measures in both spoken and written narratives. However, an additional assessment of narrative quality was performed, which ranked the stories based on the degree to which the stories captivated or entertained the reader, with one or more episodes that included twists or unexpected events or morals to the story. Children in the whole language group outperformed the language skills group on these rankings. In general, the whole language group told stories that were basic or elaborate, but wrote stories with significant organizational issues. Children in the language skills group told stories with significant organizational issues, but also wrote stories with organizational problems, with only a basic narrative plot.

Gillam and colleagues (1995) concluded that based on this limited sample, neither form of treatment was completely successful in narrative training. Compromises of form for content, and content for form, were apparent for both groups, depending on which group assignment they received. Differences were also apparent between groups based on written or spoken narratives; the whole language group was less consistent in both formats than the language skills group. The authors conclude that a hybrid approach might lessen the exchange of lost skills that is found when only targeting a specific method.

*Inferencing.*

Difficulties in inferencing skill abilities impede reading comprehension (Cain & Oakhill, 2003). The results of this study support that children with LLI possess poor inferencing skill ability in relation to their LA and CA peers. Helping children improve their awareness of story grammar structure skills, and thereby develop a more precise situational model, is important to the process of improving inferencing skills. The degree to which inferencing can take place reflects the quality and content of the situational model of the narrative.

Another important step in assisting readers to improve the development of situational models includes training in metacognitive skills, as children with poor comprehension have been shown to have a poor understanding of their own comprehension breakdowns (Yuill & Oakhill, 1988), and knowledge about reading and reading regulation skills (Cain, 1999). Training in metacognition to monitor comprehension is similar to the think aloud technique: readers are taught to ask themselves a series of questions regarding the information presented in the text to improve understanding of implicit information. Questions target, for example, information that reflects semantic knowledge (e.g., yearly appointment, brushing, flossing, cavities: Where is the boy going?), emotional responses (e.g., after he pulled her hair, her face was red and she pounded her fists: Why did she not invite the boy to her party?), and personal experience knowledge (e.g., why did she shudder when she saw the boy put ketchup on his ice cream?). Children with poor comprehension have been shown to improve narrative comprehension (as measured through standardized tests) when taught to use questions like these (Yuill & Oakhill, 1988).

In the second of her two experiments, Cain (1999) again examined less skilled, skilled, and comprehension age-matched children who had similar word reading accuracy skills. Children were assessed on metacognition for reading adaptation skills based on four different tasks: fun, skim, title, and study. Children were instructed to read eight stories and answer inferencing comprehension questions based on the stories. Children were also timed on how long it took them to read the stories based on the task instructions. In the fun and title tasks, children were instructed that it did not matter how well they answered the questions, or how long it took them to read the stories. In the fun task they were to rate how much other children would enjoy the story, and in the title task they were asked to develop a title for the story. In the skim task, children were instructed to read the story as fast as they could in order to answer a specific question. In the study task, children were told to read the story well enough so that they could answer comprehension questions. Before answering the comprehension questions, children ranked themselves based on how well they thought they would reply to the questions. Results indicated that the skilled and comprehension age-matched children answered more comprehension questions correctly in the study versus skim task, and read faster in the skim versus study task, whereas the less skilled comprehenders performed similarly in both tasks. In addition, only the less skilled comprehenders overestimated their ability to answer comprehension questions. Possible titles and rankings of story enjoyment were not significantly different among the three groups. Cain concluded that poor comprehenders' inability to adapt their reading styles to fit the task (i.e., study for comprehension versus skim for specific material) was related to their poor comprehension skills. Less skilled comprehenders were less likely to adjust their reading styles based on the goals of the task. This inflexibility and lack of control over reading style impacts reading comprehension success. Given the relationship between reading comprehension and metacognition for reading knowledge and strategies, Cain suggests that direct training in metacognition for reading adaptability would improve reading comprehension.

Results from the current study also suggest that there is a hierarchy among value, logic, and information inferencing questions. Training to monitor comprehension skills and improve inferencing skill should therefore utilize a “least to most difficult” progression (i.e., information before value and logic). In addition, use of questions described above should be incorporated not only to monitor comprehension, but also to activate previously learned knowledge to aid the reader in comprehension and development of their situational model.

*Research Contributions and Limitations*

Results from this study may contribute to the body of research in four distinct ways. First, the results confirm that during story recall, children with LLI recall fewer total story grammar components with less syntactic complexity and accuracy than LA and CA peers. Specifically, children with LLI produce fewer setting, plan, internal response, consequence and total components than their CA or LA peers. One factor that distinguishes children with LLI from their CA and LA peers during recall is the lower number of tokens of story grammar components produced; otherwise, virtually the same pattern of recall is found. Second, children with LLI also answer fewer inferencing questions correctly than their CA and LA peers. Analysis of inferencing question type reveals a hierarchy of inferencing difficulty based on inferencing question type: information inferences are easier than value and logic for both language-learning impaired and typically developing peers. Third, children with LLI perform worse on measures of verbal working memory than CA and LA peers, but similar to both groups on a measure of non-verbal working memory. Results of the verbal and non-verbal working memory tasks provide better insight into the relationship between cognition and narrative comprehension and recall. Correlation analyses support a relationship between verbal working memory skills and grammatical complexity, inferencing, and story grammar components that are causally related. These analyses of both verbal and non-verbal working memory skills across groups and in relation to the other language variables support a single-domain processing function, as opposed to a generalized limited capacity process in children with LLI.

The initial design of the study was modeled after Wright and Newhoff (2001), and included an assessment of presentation conditions to examine the effect of hearing versus reading (silently) stories that are at or below reading skill level. The decision to change this protocol to a story heard versus story read (aloud) presentation occurred after pilot testing. A child was observed to feign reading the stories and judged not to read the stories carefully enough to process all of the story form and content. This protocol change from “read silently” to “read aloud” was made to assure equal presentation of the story information to all children. This protocol modification, however, may have negated the presentation condition effect found by Wright and Newhoff in their heard versus read silently conditions.

As previously discussed, inferencing questions were only categorized based on the type of information they included, and not the amount of information reflected by them (i.e., within sentence, between sentence, or across text). Variability in the amount of information referenced in the inferencing question may have influenced the degree of question difficulty. It is important to note that the inferencing question type (i.e., value, information, and logic) would most likely dictate the amount of information included.

Informational inferences are based on concrete information, and therefore probably reflect more between or within sentence information. Value and logic are more abstract, and are therefore more likely based on information presented across a text. However, there may be some subtle differences in questions that impact difficulty level.

Several comparisons were made between the present study and studies that analyzed comprehension and production skills based on children with good and poor reading comprehension skills (Cain & Oakhill, 1996; Cain & Oakhill, 1998). These comparisons were made because reading is a language based skill (Kamhi & Catts, 1999) and language ability contributes to reading proficiency (Catts, Fey, & Proctor-Williams, 2000). However, the children in the current study were heterogeneous in their reading skills: not all of the children exhibited reading deficiencies based on the three subtests of the WRMT-RNU, and those that did differed in word decoding, word comprehension, and passage comprehension skills. Furthermore, information regarding the expressive and receptive language skills in the reading comprehension studies (Cain & Oakhill, 1996; Cain & Oakhill, 1998) was not provided. While the results of the current study and those that examined children based on reading comprehension were similar, it is important to note the differences between the impaired groups for generalization purposes.

The probability of making a Type I error increases when making pairwise comparisons for multiple groups from the same data set. In order to keep the familywise Type I error rate small, a Bonferroni inequality can be used. The probability of making at least one Type I error for story grammar component comparisons is no greater than .35 (.05 x 7 components = .35) and no greater than .45 for the DSS component comparisons (.05 x 9 components = .45). Applying the Bonferroni inequality adjusts the accepted level of significance to p = .007 (.05/7 components = .007) for the story grammar component pairwise comparisons, and p = .005 (.05/9 components = .005) for the DSS component pairwise comparisons. When applying the Bonferroni inequality, significant differences are only found between LLI and CA children for plan, indefinite pronoun/noun modifier, main verb, and conjunctions and between LLI and both CA and LA groups for the DSS sentence point. It is important to note, however, that the total story grammar comparison and the overall DSS comparison, which are not subject to Bonferroni adjustments, were significant at the $p = .038$ and $p < .001$, respectively. Given the overall significant differences, the decision was made to interpret the results without Bonferroni adjustments.

Finally, the letter working memory task may not have tapped the same skills for all children based on the individual techniques children used to complete the task. The practice items for the letter task were only four letters in length, which most children completed easily. Once confronted with the longer strings, some children varied their method to resemble more of a string recall task, and used the introduction of each new letter as an opportunity to refresh stored components.

### *Future Study*

Through the course of designing and implementing this study, questions regarding the heard versus read presentation condition (i.e., whether to allow children to read silently or aloud) dictated changes in protocol which led to the development of new questions: Does narrative production and/or comprehension differ in children with LLI, their LA- and CA-matched peers based on stories that are presented in a story heard, a story read silently, or a story read aloud condition? In assessing these three presentation conditions, it may be necessary to alter the format to assure that all information is equally presented (i.e., no information skipped or re-read). Trusting the reader to complete the given task and carefully read the material would negate the need for alterations, but given the anecdotal comments of some of the participants, it may be worthwhile to computerize the text and present information in “chunks” in which the child pushes a button to forward the narrative, similar to virtual books on a computer, but different in that the children cannot re-visit previous sections, in order to assess group differences within presentation conditions. In addition, future study should also control for reading skill differences by including a more homogeneous group, specifically for decoding, word and passage comprehension skills.

A second question that developed during the course of this study relates to the impact the number of story grammar component tokens has on narrative recall and syntactic complexity. It is hypothesized that stories with an increased number of tokens decreases working memory efficiency by affecting simultaneous storage and processing demands, resulting in an incomplete or inaccurate situational model of the narrative. During narrative recall, this additional burden results in fewer recalled story grammar components of less syntactic complexity. Processing demands may be alleviated through the use of pictures or title prompts that aid in the construction of a situational model. Further comparison of story grammar recall and syntactic complexity based on stories of equal reading difficulty level that differ based on number of story grammar component tokens and are presented in a reading, picture support, or title prompt condition should be conducted to support this hypothesis.

Results of this study support a hierarchy of inferencing questions based on the type of information inferred (i.e., inferences based on information inferencing questions are easier than value and logic based inferencing questions). However, inferences can be made based on information presented within or across sentences, across text or on explicit or implicit information. Does a hierarchy of inferencing also exist based on the amount or type of information relative to the inference? It is hypothesized that inferences based on sentence level information will be easier than multi-sentence information, which will be easier than text based inferencing. In addition, it is hypothesized that inferences based on explicit information will be easier than inferences based on implicit information (Cain & Oakhill, 1998; Oakhill, 1996). Further research examining inferencing question type based on amount and type of information should be conducted to confirm these hypotheses.

As discussed in the research limitations section, children in the current study were categorized based on their language skills, as opposed to reading comprehension skills found in other studies (Cain & Oakhill, 1998; Oakhill, 1996). Inferencing performance and working memory skill have been found to be inferior in children with SLI (Ellis Weismer, 1999) and children with poor reading comprehension skills (Cain & Oakhill, 1998; Oakhill, 1996) compared to typically developing peers. However, the children with LLI in the current study were heterogeneous in reading comprehension skills. Three of the ten children did not have reading deficits, and those that did differed in regards to decoding and comprehension. No report of language proficiency was provided in studies that examined children with poor reading comprehension skills. Future study should include a reading comprehension matched group to examine differences in language and reading impaired, versus reading or language impaired children on story grammar recall, syntactic complexity, and inferencing skill performance.

Finally, the results of this study support previous findings that verbal working memory tasks correlate with reading comprehension. However, in comparing the current study's findings to Cain, Oakhill, and Bryant (2004), a question arose regarding the impact of a "comprehension" component of the working memory tasks. Cain and colleagues found consistent correlations between their sentence-span, but not their digit task, and reading comprehension in children at 8, 9, and 11 years of age. In the current study, correlations were found between the digit task and all of the inferencing question types, as well as the DSS and five of the seven story grammar components, but fewer correlations were found for the letter task and the language components. The working memory tasks differed in regards to a "comprehension" component: the digit task utilized by Cain and colleagues required children to recall the last digits, in correct order, of several strings of numbers. In contrast, the digit task in the current study included a comprehension component, in that, children were required to sum two numbers and then provide only the equation answers, in correct order, at the end of the set. Similarly, the sentence-span task used by Cain and colleagues required the children to supply a missing word at the end of a sentence, then only recall the supplied words, in correct order, at the end of the set, whereas in the current study children were required to recall the last three letters from a string of five, seven, or nine letters. Perhaps the differences in the correlations between working memory tasks and comprehension measures reflect the differences in the components of the working memory tasks, as opposed to a semantic or numeric difference. It is hypothesized that working memory tasks that share similar comprehension components, regardless of whether they are numeric or semantic in nature, will correlate with measures of reading comprehension to a greater degree than working memory tasks that do not include this comprehension component. Further study, comparing correlations between comprehension and semantic and numeric working memory tasks with and without this described comprehension component, is warranted to support this hypothesis.

# CHAPTER VI

## Summary and Conclusions

### *Summary*

The purpose of this study was to determine if children with LLI differed from LA- and CA-matched peers in the amount and syntactic complexity of narrative story recall based on stories that were either heard or read aloud. Stories used in this study included more episodic features than previously utilized (Wright & Newhoff, 2001). Inferencing skills were assessed to determine if children with LLI differed from LA and CA peers in their ability to generate value, logical, and information inferences, and if a hierarchy exists among these inferencing question types. Finally, children with LLI were compared to their LA and CA peers to assess group differences in verbal and non-verbal working memory skills, and to determine the extent to which verbal and non-verbal working memory skills correlated with measures of narrative recall production and comprehension.

Thirty children participated in the study, with ten in each of the LLI, CA, and LA groups. A total of eight stories were presented under two conditions: four stories were read to the children, and four stories were read aloud by the children. Following story recall, children answered a total of fifteen inferencing questions. Children also completed three working memory tasks: two that tapped verbal skills (i.e., letter and digit recall) and one non-verbal task (spatial).

No presentation effects were found for any measure. Children in the LA and CA groups outperformed children with LLI on amount of story grammar recall for the plan, consequence, and overall total story grammar measures. In addition, children in the LA group produced more internal response components than the LLI group. No differences were found between CA and LA peers for any of the components. Children with LLI were found to produce narratives with less syntactic complexity than their LA and CA peers. Children in the LA group also produced narratives with less syntactic complexity than the CA peers.

Children with LLI also were found to answer fewer inferencing questions correctly than their LA and CA-matched peers. No significant difference in inferencing responses was found for CA and LA peers. A hierarchy of inferencing question type was found for the three groups: all of the children answered more information questions correctly than value and logical questions. This hierarchy is consistent with language acquisition models for concrete and abstract information.

Verbal, but not non-verbal, working memory skills were also found to be inferior in children with LLI compared to their LA and CA-matched children. Specifically, children with LLI and their LA peers scored significantly lower on the letter task than the CA peers. No significant difference was found between the CA and LA groups. In addition, the LLI group scored significantly lower than the LA group, which scored significantly lower than the CA group on the digit task. These findings concur with previous research studies that also reported inferior working memory systems in poor comprehenders compared to skilled comprehenders (Engle et al., 1991; Leather & Henry, 1994; Nation et al., 1999; Oakhill, 1996; Oakhill et al., 1988; Siegel & Ryan, 1989). Significant correlations were found between the story grammar, DSS, and inferencing question scores and at least one of the verbal working memory tasks. No correlations were found for any of the language variables and the spatial memory task. The lack of significant correlations in the current study between the non-verbal working memory task and the language tasks support the single-domain, as opposed to a generalized limited capacity, processing theory (Nation et al., 1999; Seigneuric et al., 2000). Comprehension components in the working memory tasks may contribute to the degree to which working memory and measures of narrative comprehension and production correlate: correlations with reading comprehension may be more likely to be found for working memory tasks that include a comprehension component.

Therapy techniques that concentrate on improving story grammar organization may lead to more accurate situational models, and therefore improve narrative recall and inferencing skills. Techniques that tap previous experience and learned information, and focus on character's feelings and motivations, may help strengthen these poorly developed models. Targeting cohesive devices may also improve grammatical complexity during narrative recall by aiding story structure and by supplying connections between story grammar components. Finally, teaching metacognitive skills may help children to monitor their own comprehension to improve inferencing skill ability.

*Conclusions*

Children with LLI recalled narratives with fewer story grammar details and less syntactic complexity than their LA and CA peers. Increasing the number of story grammar component tokens in a story may have further burdened the impaired working memory systems found in children with LLI, which may have exacerbated story grammar recall delays. Children with LLI produced the same pattern of story grammar components as their CA peers. This suggests that their situational model, while similar to LA and CA peers, was not as complete as the situational models of children without language impairment.

Inferencing skill was poor in children with LLI compared to their CA and LA peers. Similar to the pattern of story grammar recall, children with LLI produced a similar pattern of correct responses for value, logic, and information questions as their CA and LA peers, but children with LLI answered fewer questions correctly. This inability may reflect an imprecise situational model. However, this would not explain all of the inferencing difficulties children with LLI had, as children with poor comprehension skills have been found to correctly answer fewer inferencing questions than skilled comprehenders, even when poor and skilled comprehenders recalled the same amount of textual information (Oakhill, 1996). Factoring in their poor working memory skills may further account for the inferencing skill difficulties found in children with LLI.

Children with LLI did not perform as well as their CA and LA peers on the digit working memory task, but did perform as well as LA peers on the letter task. CA peers outperformed both groups on the letter task. Correlations between the verbal working memory tasks and the language variables supported the single domain theory of processing, which ascribes independent storage and processing components for verbal and spatial information. Working memory tasks that include a comprehension component may have greater associations with reading comprehension than working memory tasks that do not include a comprehension component.

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# APPENDICES

# APPENDIX A

## Case History Form

Please complete this form as completely and accurately as possible. All of the information you provide on this form will be kept confidential.

### PARTICIPANT INFORMATION

Child's name: ____________________________________________________

Date of birth: ___________________________ Age:____________ Sex:__________

Address: _________________________________________________________

City: _______________________ State: ___________________ Zip: ____________

Phone: __________________________

### FAMILY INFORMATION

Father's name: _________________________ Occupation: ____________________

Address (if different from above): __________________________________________

Last grade completed: _______________

Mother's name: ________________________ Occupation: ____________________

Address (if different from above): __________________________________________

Last grade completed: ________________

Does your child have any brothers and sisters? _______________________________

If yes, please list names and ages: __________________________________________

______________________________________________________________________

### PARTICIPANT HEALTH HISTORY

Communication and Social Development

Has your child received speech, language, or hearing services? __________________

If yes, at what age and for how long?_______________________________________

Does your child currently receive speech, language, or hearing services? __________

If yes, what are your child's current speech/language goals?_____________________

______________________________________________________________________

What concerns you most about your child's speech and language skills? ___________

_____________________________________________________________________________

Does your child prefer to play alone or with other children? ______________________

How does your child play with other children? _________________________________

_____________________________________________________________________________

Do you have any concerns about your child's behavior? _________________________

If yes, please describe: _____________________________________________________

How does your child get along with familiar adults? ____________________________

Unfamiliar adults? ___________________________________________________________

What activities does your child enjoy? _________________________________________

What activities does your child dislike? ________________________________________

Medical History

Does your child have a history of ear infections? ________ How often? ____________

How recently? _______________________________________________________________

How long have they lasted? _________________ Have PE tubes been placed? ________

Has your child ever had a seizure? ____________ If yes, please give date(s): _________

Is your child taking any medication regularly? __________________________________

If yes, please list and describe purpose(s):_______________________________________

_____________________________________________________________________________

Does your child experience any other health or medical concerns? ________________

If yes, please describe: _____________________________________________________

FAMILY HISTORY

Have any of your family members experienced speech, language, and/or learning difficulties?________

If yes, please describe nature of problem and relation to the child: ________________

_____________________________________________________________________________

What is the primary language spoken in your home? _____________________________

Are there any other languages spoken in your home on a regular basis? ____________

SCHOOL INFORMATION

In what grade is your child currently enrolled? ______________________________

Has your child successfully passed each grade in school? _____________________

If no, please describe: __________________________________________________

Does your child receive any special services (learning resource, supplemental or remedial class, etc) ___________________________________________________________

If yes, please describe: _________________________________________________

Person completing this form: ____________________________________________

Relationship to child: __________________________ Date: ___________________

# APPENDIX B

## Complete Case History Information for all Groups

Note. PSLP = Received speech-language services in the past, CSLP = Currently receiving speech-language services, PMC = Parents' major concern, BP = Behavioral problems, DB = Description of behavior, EI = Ear infections, IEI = Incidence of ear infections, HR = Most recent ear infection, HL = How long ear infection lasted, PET = Pressure equalization tubes inserted, S = Seizure, M = Medications, OHMC = Other health/medical concerns, FH = Family history of speech/language disorder, FM = Family member with speech or language disorder, PL = primary language, OL = Other languages, CG = Current grade, PEG = Passed each grade, SS = Special services, AOS = Area of services, LLI = Language-learning impaired, LA = Language age, CA = Chronological age, Soc = Socialization skills, Comp. = Comprehension, Express. = Expressive skills, Read = Reading skills, Artic = Articulation, ED = Easily distracted, ND = No difficulties noted, N/A = Not applicable, GOT = Gone once treated, RSS = Receiving special services.

| Subject | PSLP | CSLP | PMC | BP | DB | EI | IEI | HR | HL |
|---|---|---|---|---|---|---|---|---|---|
| LLI1 | yes | yes | Soc, learning | yes | ED | no | N/A | N/A | N/A |
| LLI2 | yes | yes | Memory | no | friendly | no | N/A | N/A | N/A |
| LLI3 | yes | yes | Processing | no | very well | yes | 1x | N/A | N/A |
| LLI4 | yes | yes | Language | yes | ED | no | N/A | N/A | N/A |
| LLI5 | no | yes | Comp. | yes | temper | no | N/A | N/A | N/A |
| LLI6 | yes | yes | Comp. | yes | ED | no | N/A | N/A | N/A |
| LLI7 | yes | yes | Memory | no | friendly | no | N/A | N/A | N/A |
| LLI8 | yes | yes | Express. | yes | aggressive | no | N/A | N/A | N/A |
| LLI9 | yes | yes | Artic, comp. | no | good | no | N/A | N/A | N/A |
| LLI10 | yes | yes | Artic | no | ND | yes | 1x | 3 yrs ago | N/A |
| LA11 | no | no | N/A | no | shy | no | N/A | N/A | N/A |
| LA12 | yes | no | N/A | no | ND | no | N/A | N/A | N/A |
| LA13 | no | no | N/A | no | ND | yes | N/A | 6 yrs ago | N/A |
| LA14 | no | yes | Artic | no | ND | yes | 2x yearly | winter | N/A |
| LA15 | no | no | N/A | no | ND | no | N/A | N/A | GOT |
| LA16 | no | no | N/A | no | ND | no | N/A | N/A | N/A |
| LA17 | no | no | N/A | no | ND | yes | 1x yearly | this year | N/A |
| LA18 | no | no | N/A | no | ND | yes | 1x yearly | last year | 3-4 days |
| LA19 | no | no | N/A | yes | tantrums | no | N/A | N/A | 7 days |
| LA20 | no | no | N/A | no | ND | yes | 2-3 yearly | 2wks ago | N/A |
| CA21 | no | no | N/A | no | ND | no | N/A | N/A | 1week |
| CA22 | no | no | N/A | no | ND | no | N/A | N/A | N/A |
| CA23 | no | no | N/A | no | fine | yes | N/A | 4 yrs ago | N/A |
| CA24 | yes | no | Read, Artic | no | great | no | N/A | N/A | N/A |
| CA25 | no | no | N/A | no | ND | yes | 2x yearly | winter | N/A |
| CA26 | no | no | Quietness | no | ND | yes | 1-2 a mo | summer | N/A |
| CA27 | yes | no | Comp. | yes | lying | yes | frequently | 6 mos ago | 2 wks |
| CA28 | yes | no | N/A | no | ND | yes | infant | 1st yr | GOT |
| CA29 | no | no | N/A | no | ND | yes | infrequent | 4 mos ago | 2-3 wks |
| CA30 | no | no | N/A | no | ND | yes | N/A | infant | N/A |

| Subject | PET | S | M | HMH | FH | FM | PL | OL | CG |
|---|---|---|---|---|---|---|---|---|---|
| LLI1 | no | no | no | none | no | N/A | English | none | 2 |
| LLI2 | no | no | no | none | no | N/A | English | none | 4 |
| LLI3 | no | no | no | none | no | N/A | English | none | 5 |
| LLI4 | no | no | no | none | no | N/A | English | none | 4 |
| LLI5 | no | no | allergies | none | yes | brother | English | none | 5 |
| LLI6 | no | no | allergies | none | yes | father | English | none | 5 |
| LLI7 | no | no | no | none | no | N/A | English | none | 5 |
| LLI8 | no | no | no | none | no | N/A | English | none | 5 |
| LLI9 | no | no | allergies | none | no | N/A | English | none | 5 |
| LLI10 | no | no | no | none | yes | aunt | English | none | 5 |
| LA11 | no | no | no | none | no | N/A | English | none | 2 |
| LA12 | no | no | no | none | yes | brother | English | none | 2 |
| LA13 | no | no | no | none | no | N/A | English | none | 2 |
| LA14 | no | no | allergies | none | no | N/A | English | none | 3 |
| LA15 | no | no | no | none | no | N/A | English | none | 3 |
| LA16 | no | no | no | none | no | N/A | English | none | 3 |
| LA17 | no | no | no | none | yes | N/A | English | none | 2 |
| LA18 | no | no | no | none | no | N/A | English | none | 2 |
| LA19 | no | no | no | none | no | N/A | English | none | 2 |
| LA20 | no | no | allergies | none | no | N/A | English | none | 2 |
| CA21 | no | no | no | no | no | N/A | English | none | 5 |
| CA22 | no | no | no | no | no | N/A | English | none | 5 |
| CA23 | no | no | allergies | asthma | yes | father | English | none | 5 |
| CA24 | no | no | no | no | no | N/A | English | none | 3 |
| CA25 | no | no | no | no | no | N/A | English | none | 6 |
| CA26 | no | no | allergies | no | yes | N/A | English | none | 5 |
| CA27 | no | no | allergies | no | yes | N/A | English | none | 5 |
| CA28 | no | no | no | no | no | N/A | English | none | 5 |
| CA29 | no | no | migraines | asthma | no | N/A | English | none | 6 |
| CA30 | no | no | no | asthma | no | N/A | English | none | 6 |

| Subject | Successfully Passed Each Grade | Receiving Special Services | Area of Services |
|---|---|---|---|
| LLI1 | added Junior Primary | yes | speech |
| LLI2 | yes | yes | speech |
| LLI3 | yes | yes | speech |
| LLI4 | yes- 2 years pre-school | yes | speech/resource |
| LLI5 | no, and added Junior Primary | yes | Title I reading, Inclusion |
| LLI6 | yes | yes | speech, learning resources |
| LLI7 | yes-family chose to repeat 1st grade | yes | speech, math, memory |
| LLI8 | yes | yes | speech, reading |
| LLI9 | added Junior Primary | yes | speech-language |
| LLI10 | yes | yes | speech-language |
| LA11 | yes | no | N/A |
| LA12 | yes | no | N/A |
| LA13 | yes | no | N/A |
| LA14 | yes | no | N/A |
| LA15 | yes | no | N/A |
| LA16 | yes | no | N/A |
| LA17 | yes | no | N/A |
| LA18 | yes | no | N/A |
| LA19 | yes | no | N/A |
| LA20 | yes | no | N/A |
| CA21 | yes | no | N/A |
| CA22 | yes | no | N/A |
| CA23 | yes | no | N/A |
| CA24 | yes | no | N/A |
| CA25 | yes | no | N/A |
| CA26 | yes | no | N/A |
| CA27 | yes- family chose to repeat kindergarten | no | N/A |
| CA28 | yes | no | N/A |
| CA29 | yes | no | N/A |
| CA30 | yes | no | N/A |

# APPENDIX C

## Practice Stories[*] and Corresponding Inferencing Questions

### Practice story #1
### A Day to Fly
By Ashley Little, Marc Fey, and Lori Swanson
Goal–Coordinate Clauses/Coordinators

Once there was a little bird named Sonia. Sonia lived in a forest, and she loved to sing. Sonia was a beautiful singer, but she couldn't fly. Sonia's momma loved Sonia's songs, but she wanted Sonia to fly. She told Sonia that flying was important, but Sonia didn't believe her.

One dark night, Sonia heard a loud boom! Flashes of light darted through the sky, and rain was pouring down. The rain got heavier and heavier. The other birds flew away, but remember, Sonia didn't know how to fly! Momma said, "Sonia this is your chance! This will be hard, but you can do it." Sonia closed her eyes and sang a song. Then, she jumped and flapped her wings. She was ready to fall, but she got a great surprise. She was flying!! She flew to a nice, safe place with her mom and all the other birds.

Finally, the rain stopped, and Sonia's family made a new nest. Momma was proud of Sonia, but most of all, Sonia was proud of herself. The End.

Inferencing Questions and Sample Answers

Logical: Why did Sonia's mother want her to fly? Because all birds fly to survive
(choices: so she could impress the neighbors, so she could help her father build a new nest)
Value: What were the flashes of light in the sky? Lightning
(choices: fireworks, flashlights)
Informational: Where did the birds build a new nest? In a tree
(choices: in a house, on the ground)

### Practice story #2
### Lemonade Luck
By Cara Prall, Lori Swanson, and Marc Fey
Goal-Postmodification of Nouns

Luke was a second grader who loved to play games. He was a hard worker, too. He earned an allowance for working hard around the house.

One day, at the video store, Luke spotted a game that he really wanted. He had $20.00, but the man who worked at the store said the game cost $40.00. Luke needed to earn twenty more dollars, fast. How could he do it?

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[*] Adapted stories used with permission.

Then, he had a great idea. The week before, the girl who lived next door had a lemonade stand. If Luke had one, he could earn $20.00 in a hurry.

So, on Saturday, Luke set up a lemonade stand in front of his house. Luckily, it was a very hot day. Almost everyone who walked by bought lemonade. One man, who had two dogs with him, bought four glasses! He bought two glasses for himself and one for each of his dogs. An old man who lived across the street bought three glasses. Even a friend who hated lemonade bought a glass. By the end of the day, Luke had earned $15.00. He was close, but he still needed five more dollars.

When Luke got inside his house, he collapsed on the couch. As he laid down, though, his hand slipped behind a cushion. Luke felt something that felt like paper. He grabbed the paper and looked to see what it was. Sure enough, it was a $5.00 bill. Luke's mom said he could keep the money. So, Luke rushed back to the store.

Luke's mom told him that he earned the game with his hard work. But Luke knew better. He earned it with a lot of hard work and a little bit of lemonade luck! The End.

Inferencing Questions and Sample Answers

Logical: Why did Luke collapse on the couch when he got home? He was tired.
(choices: He was sick, he wanted to watch TV).
Value: Why was it helpful that Luke set up his lemonade stand on a hot day? When it's hot people are thirsty and more likely to buy lemonade.
(choices: no one else would set up a stand in the heat, it's easier to set up a stand when it's hot).
Informational: After his mom said he could keep the $5, what did Luke do? He went to the store to buy the game.
(choices: called his friends to brag, took a nap).

# APPENDIX D

## Experimental Stories* and Corresponding Inferencing Questions

### Save the Spiders!
By Ashley Little, Marc Fey, and Lori Swanson
Goal-Coordinating Conjunctions

Once there was a boy, and his name was Luke. Luke was a nice boy, but he wasn't nice to everything. He wasn't nice to bugs, and he especially hated spiders! Every time he saw a spider, he squished it! He stepped on it, or he smashed it with a rock. YUCK! Luke's mom told him to leave the poor spiders alone, but Luke didn't listen.

One day in science, Luke's teacher surprised him. "Today," he said, "you have a choice. We can learn about turtles or we can learn about spiders." "Turtles!" Luke screamed, but everyone else wanted spiders. So Luke had to learn about spiders. His teacher told the class about all kinds of spiders, but Luke didn't want to listen. "I don't wanna listen and I *won't* listen," he said. He covered his ears with his hands, and he sang songs to himself. He didn't want to learn about spiders, but he learned anyway! And he learned the coolest things about spiders. Some spiders have short legs and some have *huge* legs. Some spiders are plain but others have beautiful colors. Spiders can spin a whole web really fast, and they catch bugs. They eat some really nasty bugs! "Spiders look kind of scary, but they really help us," Luke said.

On the way home from school, Luke saw a big spider with long legs. He started to step on it, but then he stopped. He didn't squish that spider. And guess what! Luke never squished another spider again. The End.

Inferencing Questions and Sample Answers

Value Inferencing
1. How do spiders help us? They kill bugs that bother us.
2. How did Luke overcome his fear of spiders? By studying them/learning about them
3. How did Like try to keep from hearing the teacher? He covered his ears and sang songs to himself.
4. How do we know that Luke did listen to the teacher? He learned about spiders.
5. How do spiders catch bugs? In their webs

Informational Inferencing
1. Where did Luke study spiders? at school
2. What was Luke doing when he decided to never kill spiders again? Walking home
3. The first time Luke didn't step on a spider, what time of day was it? Afternoon (after school)
4. Who wanted to learn about spiders? Luke's classmates
5. When Luke's Mom told him to leave the spiders alone, what did he do? He killed them.

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*Adapted stories used with permission.

Logical Inferencing
1. Why did Luke kill spiders? He was afraid of them; he didn’t know much about them; he didn’t like them.
2. Why did Luke’s mother tell him to leave the spiders alone? She didn’t want Luke to kill them.
3. Why did Luke have to learn about spiders? All of his classmates chose to learn about spiders.
4. Why didn’t Luke want to learn about spiders? He didn’t like spiders.
5. After learning about spiders, why did Luke decide to never kill another spider again? He liked them, appreciated them for how they help us.

## Sawing Logs

By Ashley Little, Marc Fey, and Lori Swanson

Goal-Coordinated Clauses

Once upon a time, there was a girl named Becky. Becky lived with her dad and her brother, Billy. Becky liked to go camping and she loved to sleep in a tent. There was one scary and funny trip Becky would always remember. Dad, Billy, and Becky were all camping and they had all just finished eating. Dad had washed the dishes, and Becky and Billy had fixed their beds. It was time for bed. Becky and Billy went to their tent, and Dad went to his own tent. At first, it was very quiet and peaceful.

Then, Becky heard something loud and scary outside the tent. “What could it be?” Becky and Billy wondered. “It might be the wind,” said Becky. “It could be a truck or it could be a car!” said Billy. “Maybe Dad left the radio on in the car,” said Becky. “But it might be a wolf, or it could even be a bear!” Billy added.

Becky quietly crept outside her tent. She looked in the car but the radio was off. She could still hear the scary noise. It was coming from her Dad’s tent! “Look out, Dad. I will save you!” Becky quickly dove into her dad’s tent. Becky didn’t find a wolf, and she didn’t find a bear. What she did find was her Dad. He was in the tent and he was snoring like the biggest, meanest bear ever.

Dad woke up, and Becky and Billy told him what had happened. Everyone pretended to snore and they all laughed! Now, when they pack their bags for a camping trip, Becky and Billy make sure to pack their earplugs! The End.

Inferencing Questions and Sample Answers

Value Inferencing
1.Where do Billy, Becky and their dad go camping? In the mountains
2. Why did Becky check to see if the radio was on? She thought it was making the noise she heard.
3. Why didn’t Becky’s dad hear the noise? He was asleep.
4. What did Billy do after Becky woke up their dad? He went into their dad’s tent, too.

5. Why did Becky think the strange noise was a wolf or a bear? It sounded like the same noise a wolf or a bear would make.

Informational Inferencing
1. Where were Billy and Becky when they heard a strange noise? In their tents
2. What meal had they finished before they heard the noise? Dinner
3. What were Billy and Becky doing when they heard the noise? They were trying to sleep.
4. Who was making the noise? Their dad was snoring.
5. Where was Billy when Becky found out what was making the noise? In his tent

Logical Inferencing
1. Why were Billy, Becky, and their dad in the mountains? They were camping, which they loved to do.
2. Why did Becky go outside the tent when she heard the noise? She wanted to find out what was making the noise.
3. Why did Becky dive into her dad's tent? She thought the thing making the noise was in her Dad's tent and he might be in trouble.
4. Why did everyone pretend to snore after Dad woke up? To make fun of Dad, show him what he sounded like
5. Why do Becky and Billy pack their earplugs when they go camping? So they won't hear their father snore.

Two Golfing Nuts
By Marc Fey and Lori Swanson
Goal-Coordinate Clauses

Once upon a time, there was a boy named Josh. Josh loved sports. Every weekend, he sat in his chair in his living room and watched Tiger Woods. Josh wanted to play like Tiger, but it cost too much money. He had no clubs, and he had no money to play.

One day, Josh had a great idea. He took his old hockey stick, and he walked over to the park. There were walnuts everywhere. Josh loaded a basket full of walnuts and carried them away from all the people. He hit one with his stick, but it didn't go far. He hit another and another, but they didn't even leave the ground. Still, Josh pretended he was Tiger Woods, and he loved his little game.

Josh played that game all summer long. After a few weeks, the walnuts started to fly. He hit them high, and they sailed over the trees. He hit them low, and they buzzed under the tree branches. They all sizzled through the air.

One day, a man was walking to the park, and he saw Josh hitting walnuts. The man came over and smiled at Josh. "Do you ever really play or do you only hit walnuts?" Josh was embarrassed, "I've got no money to play. Walnuts are fine with me."

But the man wouldn't listen. He gave Josh a set of clubs and paid for him to play on the real course. Josh practiced and learned to play just like Tiger. Soon, he was the best player his age in the whole city. Josh was proud, and so was his mom. And so was the man who gave Josh his clubs and taught him to play. That man was the coach at the high school. It's funny, because his name was Mr. Walnut. Josh and Mr. Walnut played almost every day, and they were buddies forever. The End.

Inferencing Questions and Sample Answers

Value Inferencing

1.Why is it funny that the coach's name is Mr. Walnut? Because Josh played golf with walnuts

2. Why did Josh think it was fine to play with walnuts? Because he couldn't afford real golf balls and walnuts could be hit like golf balls

3. How did Josh improve his game? Better equipment and lots of practice

4. What does "sizzled through the air" mean? It moved through the air very fast.

5. Why were Josh and his Mom proud? Because he worked hard was and the best player in his city

Informational Inferencing

1.Where did Josh see Tiger Woods play? On television

2. What game was Josh playing with a hockey stick and walnuts? Golf

3. Where did the walnuts that Josh played with come from? Trees in the park

4. Where did Josh go to play his game? In the park away from people

5. Who was Josh's hero? Tiger Woods

Logical Inferencing

1. Why did Josh use his hockey stick and walnuts to play? He couldn't afford real equipment.

2. Why didn't the walnuts go far when he first hit them with his hockey stick? He wasn't very good; needed to practice.

3. Why did Josh pretend he was Tiger Woods? He wanted to be great at golf like Tiger Woods.

4. Why was Josh embarrassed when the man asked if Josh really played? He would have to admit he couldn't afford to play.

5. Why did the man pay for Josh to play with real clubs on the course? The man could tell Josh was good and loved to play; he was a teacher and wanted Josh to learn the game because Josh was talented; he was a nice man and wanted to help Josh.

## Skipping School

By Ashley Little, Marc Fey, and Lori Swanson

Goal-Postmodification of Nouns

Once there was a boy named Jack. There were lots of things Jack liked to do. He liked riding his bike. He loved fishing. He especially liked to play video games. He played with his little brother, whom he always beat. Jack did not like work, though. And he didn't like school. "There's just too much work at school," he said. "I'd rather stay at home." So Jack liked to think of reasons to skip school. But he never really tried them.

Then one day, Jack had an idea that he really wanted to try. His little brother, Aaron, had a sore throat, and he had to stay home from school. Jack thought, "If I stay home, we can play video games all day long!" So, Jack pretended to be sick. It worked! His mom let him stay home from school. But which game should they play first? He loved the one that had a roller coaster. He always won the game that had fast cars. Finally, he chose the game that Aaron liked best. It was called Sonic the Hedgehog.

Jack called Aaron. "Come on," he said. "Let's play." But Aaron was really sick. He didn't want to play video games. He just wanted to sleep. Jack was bored to death. He spent the whole day just sitting in his room. He waited and waited for his mom to get home.

The next day at school, Jack learned something that made him really sick. The day that he had missed was a special day. All the kids in his class went on a fun field trip. They saw elephants that could dance. They watched tigers that could jump through hoops. They saw a clown who rode his bike on one wheel. And they saw another clown who lost his pants. His friends all said, "That was the best day we ever had."

And Jack had missed it all. That was a day that Jack would never forget. And you know what? He never skipped school again. The End.

Inferencing Questions and Sample Answers

Value Inferencing
1. What does "skip school" mean? Missing school with no excuse
2. Who was at home with Jack when he skipped school? His brother Aaron
3. Where did Jack play when he skipped school? His room
4. What game did Jack like best? Video games
5. Why did Jack like to play with his little brother? Jack always won.

Informational Inferencing
1. When did Jack decide to skip school? When Aaron was sick
2. What did Jack like to do? Play games
3. What did Aaron do when Jack asked him to play? Went to bed
4. Where was Jack's Mom when he skipped school? Out of the house (at work)
5. Where did Jack's classmates go when Jack skipped school? To the circus

Logical Inferencing
1. Why did Jack pretend to be sick? He wanted to play games.
2. Why did Jack decide to play "Sonic the Hedgehog?" Because Aaron liked it best
3. Why did Jack feel really sick when he went back to school? He missed the circus.
4. Why did Jack decide to never miss school again? So he wouldn't miss out on any adventures, fun with his friends
5. What could have made school more interesting for Jack? Less work, more games, more fun activities

Shop 'Till They Drop
By Marc Fey and Lori Swanson
Goal-Postmodification of Nouns

Once upon a time, there were two sisters, Susan and Stacy, who liked to shop. Every Saturday morning, Susan and Stacy loved to go to their favorite mall. But they never agreed on what to buy.

One day, the girls' mom gave them each $10 to spend. First, they went to the shoe store. Each girl saw some shoes they really wanted. Susan wanted some sneakers that had pink shoestrings. Stacy wanted some flip-flops that made funny clapping sounds. But the shoes with the pink shoestrings cost $15. The flip-flops that made the funny sounds cost $14. "We can't buy these shoes," said the girls. So, they went on to the pet store.

At the pet store, Susan found a cool turtle that only had three legs! It cost $11. Stacy found a fish and a fish bowl that she wanted. They cost $20. "These pets cost too much," the girls said. So, they went on to the clothes store.

At the next store, the girls saw two shirts that they both loved. One was blue, and the other was green. The blue shirt fit Susan, but not Stacy. The green shirt fit them both. But the shirts cost $20, so the girls left the store to find their mom.

They told their mom about the shirts they couldn't buy. Then, Mom had an idea. First, she took Susan's $10. Then, she took Stacy's $10 and put it with Susan's. The girls understood right away. "$10 plus $10 is $20! We can buy the green shirt and share it!"

So the girls bought the green shirt. Stacy wore it one week, and Susan wore it the next. Now, the girls always put their money together. They like to get the big things they both really want. The End.

Inferencing Questions and Sample Answers

Value Inferencing
1. How did the girls both win when they put their money together? They could buy bigger and better things together.
2. Why did the girls tell their Mom about the shirt? They both liked it and were hoping she would buy it for them/give them more money.
3. Why did the girls go to shopping? They love to shop.
4. Why did the girls never agree on what to buy? They liked different things, were different sizes
5. Why did Stacy wear the shirt one week and Susan the next week? They were sharing the shirt. They only bought one shirt.

Informational Inferencing
1. Where did the girls find the shirt they loved? Clothing store
2. Where were the girls when they decided to buy a shirt together? Outside the store/the mall
3. Who suggested the girls put their money together? Their Mom
4. What did they girls learn when their Mom took their money? They had more money together than separately.

5. Where was the shopping mall located? In their home town/close to their home
Logical Inferencing
1. Why did Susan and Stacy go to shopping? They loved to shop and buy new things.
2. Why didn't the girls buy the shoes they liked? Too expensive - they couldn't afford them
3. Why did the girls buy the green shirt? It fit them both and they both liked it.
4. Why did their Mom take $10 back from each girl? To show them how to pool their money together
5. Why did the girls spend their money together? So they could buy something they liked that they couldn't afford individually

Time to Tell
By Ashley Little, Lori Swanson, and Marc Fey
Goal-Postmodification of Nouns

Once there was a girl named Lisa, who loved to tell stories. At school, she told stories that were scary. She told stories that made her friends laugh. She told stories that made her friends cry. But there was a big problem. Lisa told stories that were not true!

One day, Lisa's class went to the amusement park. On the way there, Lisa told everyone a story that wasn't true. "I love to go on rides that are tall and fast," she said. Her friends thought she was very brave. But Lisa was not brave. Her story was a lie.

When they got to the park, the kids saw some rides that were not scary at all. They saw other rides that were just a little scary. But they all ran to the ride that was the scariest of all. It was called The Snake. The kids who were very brave ran to get in line. The kids who were afraid ran to watch. But Lisa just stood there. She tried, but she just couldn't move. Lisa told a lie, "I'm too tired now. I'll rest and go later."

After the ride was over, the kids who had been on the ride wanted to go again. Lisa lied again, "My foot is asleep. You go now, and I'll go later." After a great ride, the kids begged Lisa to ride with them again. Lisa shook with fear. It was finally time to tell a story that was really true. "I can't ride with you, because I'm too scared of the Snake," she said.

Lisa's friends gathered around. "We knew you were scared," they said. "We're scared, too, and that makes it fun. Come on. We'll all hold hands." So, all the kids held hands and went on the ride; even the ones who were scared; even Lisa.

Lisa always remembered that day. And from that day on, she always told stories that were true. The End.

Inferencing Questions and Sample Answers

Value Inferencing
1. Why would a ride be called "The Snake"? Because it winds and curves and is scary
2. What does "shake with fear" mean? You are so scared you are shaking; you are very scared.
3. Why did the kids run to get in line when they saw the rides? They wanted to be first; wanted to ride it, were excited to ride.

4. Why did Lisa's friends want to hold her hand while they rode the Snake? To help her to not be afraid
5. Why did Lisa tell different kinds of stories? To entertain her friends, be the center of attention

Informational Inferencing
1. Who did Lisa tell stories to? Her classmates/friends at school
2. How did the class get to the amusement park? In a school bus
3. Which rides did Lisa want to ride? The ones that weren't scary
4. When did Lisa finally tell the truth about "the Snake"? After her friends asked her to ride, too
5. How did Lisa's friends know she was lying? They could tell she was scared - too afraid to ride.

Logical Inferencing
1.Why did Lisa lie about going on scary rides? She was too embarrassed to admit the truth.
2. Why couldn't Lisa move when she saw the Snake? She was too scared.
3. Why did Lisa finally tell the truth? Her friends kept asking her to ride.
4. Why did Lisa always remember that day at the park? She learned it was better to tell the truth than lie about being scared.
5. Why did Lisa love to tell stories? She loved to entertain her friends.

Bad Haircut
By Stacey Walter, Marc Fey, and Lori Swanson
Goal-Subordinate Clauses

Once there was a boy named Matt. Matt liked to be like everyone else. He wore the same clothes his friends wore. He talked like his friends talked. He even walked like his friends walked.

One day, Matt's hair needed to be cut, so he went to get a haircut. Someone was sitting in his regular haircutter's chair, so Matt got in the next chair. When the new haircutter was finished, Matt looked in the mirror. He was shocked to see his new hairdo! It looked very funny, because it was spiked in the front and the back! Matt hated the haircut, because it was so different.

The next morning, Matt decided not to go to school. He was embarrassed by his hair, so he just wanted to hide. He said, "Mom, I'm sick, so I can't go to school." "Good," she exclaimed, "If you stay home, you can help me clean the house." Matt did not like to clean house, so he went on to school.

On the way to school, Matt got a great idea. "If I joke about my own hair, I can laugh along with the other kids." And that's just what he did. When Matt got to school, he walked right up to his friends in the hallway. Everyone seemed to stare at his hair. "Oh, you noticed my hair," Matt said. "It went wild when I saw a ghost in my room last night. Now, I just can't get it to go back to normal." Everybody started to laugh, including Matt.

Then, one of Matt's friends told him that he thought his hair was really different. He thought it was cool. So did everyone else. Everyone wanted to know who cut his hair! When Matt told them, they got their hair cut there, too. Soon, lots of kids had haircuts, just like Matt's.

After that day, Matt never worried about being different. And he never worried about a bad haircut either. The End.

Inferencing Questions and Sample Answers

Value Inferencing
1. Why did Matt want to be like everyone else? He wanted to be liked/fit in.
2. Why did everyone get their hair cut like Matt's? They liked his hair and wanted to be like him.
3. Why couldn't Matt get his hair to go back to normal? Because it was cut differently
4. After confronting his friends, why did Matt never again worry about a bad haircut? He learned that being different wasn't bad and his friends would still accept him.
5. Why did Matt get a haircut? His hair was too long.

Informational Inferencing
1. What did Matt do to try to be like everyone else? Walked, talked, and dressed like his friends
2. Where did Matt's friends go after seeing Matt's new haircut? To Matt's new hairdresser to get their hair cut like Matt's.
3. What did Matt's mother think when he told her he was sick? She thought he was lying.
4. When did Matt stop worrying about being different? When his friends wanted to have a haircut like his (be like him)
5. Who decided that Matt would go to school? Matt decided

Logical Inferencing
1. Why did Matt worry when he saw his new haircut? He was afraid he would be teased.
2. Why was someone sitting in Matt's regular haircutter's chair? Getting a haircut
3. Why did Matt say he saw a ghost? To explain why his hair was so different
4. Why did everyone laugh when they saw his hair? Because it was so different
5. Why did Matt tell his mother he was sick? So he wouldn't have to go to school

## Roller Blading
By Stacey Walter, Marc Fey, and Lori Swanson
Goal-Subordinate Clauses

Once, there was a girl named Sue. Sue's best friend, Molly, loved to roller blade. Molly was very good. When she skated through the park, she did tricks for everyone. She could even close her eyes, while she skated backwards! Sue always tried to be like Molly. She just had to skate like Molly, too.

Sue didn't have roller blades, so she saved all her money. Finally, she bought a beautiful pair of skates. "Now I can skate just like Molly," Sue thought. But when Sue tried to skate, she got a big surprise. Sue fell down again and again. She was embarrassed because she couldn't do tricks like Molly.

One day, Molly invited Sue to go roller blading in the park with all of their friends. Sue thought, "If I let my friends see me, they will laugh." So, she said, "I have to go shopping with my mom." But she didn't go shopping. Instead, while her friends were skating, Sue went behind some trees to watch.

Unfortunately, Sue got too close to the other girls. When they were skating down a big hill, Molly saw her behind the trees. Molly was very upset with Sue. "Why didn't you come skate with us?" Sue explained, "I didn't come because I can't skate very well. I fall down every time."

Molly started to laugh. "Skating is hard," she said. "When I first got my roller blades, I couldn't even stand up on them for a whole week! If you come with us, we can help you. I'll even teach you some cool tricks." After Molly told her that, Sue felt much better.

Molly helped Sue practice every day. Sue was never as good as Molly, but she always had a great time roller blading with her friends. And she never made up excuses again, because she knew her friends would always help her. The End.

Inferencing Questions and Sample Answers

Value Inferencing

1. Why did Sue try to be like Molly? Molly was Sue's best friend and very talented/ could skate well.
2. Why did Sue have to practice skating? She didn't know how to skate.
3. How did Sue try to get out of roller blading with Molly? She lied and said she had to go shopping with her Mom.
4. Why did Sue believe her friends would laugh if they saw Sue skate? Because she fell down over and over again
5. Why did Sue want to skate with Molly? Because Molly was so good and was Sue's best friend. She wanted to skate like Molly and be like her.

Informational Inferencing

1. What did Sue learn when she first tried to skate? Skating is hard.
2. Where was the tree Sue hid behind? In the park
3. When did Sue learn how to skate? After practicing with Molly
4. Where was Sue when she was caught by Molly and her friends? In the park behind a tree.
5. Who bought the roller blades for Sue? Sue did with her money she saved.

Logical Inferencing

1. Why did Sue save her money? So she could buy roller blades
2. Why did Sue lie to Molly? Because she was embarrassed that she couldn't skate
3. Why did Sue hide from her friends? So she could watch them skate

4. Why was Molly upset with Sue when she was discovered? Because Sue lied to her about going shopping
5. Why did Molly laugh when Sue confessed she couldn’t skate well? Because Molly had a hard time learning to skate, too.

# APPENDIX E

## Working Memory Tasks and Scoring Sheets

### Letter Recall Task*
### Instructions and Scoring Sheet

Open the Letter Recall Stimulus Book to the first blank page and give the following introduction to the participant (this need not be verbatim):

> "I am going to show you several letters. Sometimes I will show you a lot of letters, sometimes just a few. After you see each letter, try to remember it and the others you saw. You can say it to yourself or out loud. This will help you remember the letters, which is important because at the end of each set of letters, I'm going to ask you to remember the last 3 letters in the order you saw them. We're going to play this letter game several times with new letters each time. We are going to practice first, then I'll ask you to do the rest on your own. Ready?"

You may give additional instructions if you feel it's necessary for the child to understand the task.

Practice trials

| Letter set | Participant's response | Score |
|---|---|---|
| 1. WFDZ | ___ ___ ___ | _____ |
| 2. RMVT | ___ ___ ___ | _____ |

The practice trials may be repeated until the participant can complete the task.

| Five letters | | |
|---|---|---|
| 1. LHRBD | ___ ___ ___ | _____ |
| 2. NDVFT | ___ ___ ___ | _____ |
| 3. JTQMR | ___ ___ ___ | _____ |

| Seven letters | | |
|---|---|---|
| 1. CJLSQDR | ___ ___ ___ | _____ |
| 2. KVRXHGP | ___ ___ ___ | _____ |
| 3. FPWTMZB | ___ ___ ___ | _____ |

| Nine letters | | |
|---|---|---|
| 1. FLQXDTCBJ | ___ ___ ___ | _____ |
| 2. PDSNVHKFT | ___ ___ ___ | _____ |
| 3. MWQRZNGJF | ___ ___ ___ | _____ |

Total Score _____

---

* Based on guidelines developed by Wass and Riley (2003).

# Digit Task[*]
## Instructions and Scoring Sheet

Open the Digit Task Stimuli Book to the page marked "Practice" and give the following introduction to the participant (this need not be verbatim):

"I am going to show you some cards in this book. Each card has an equation on it like 1+3. When you see each card, I want you to tell me the answer to the equation. I want you to remember the answer. After I show you a couple of cards, I will ask you to tell me the answers to the equations. Remember to tell me the answers in the order you saw them. Once you tell me the answers, we'll start the game over with new equations."
You may give additional instructions if you feel it's necessary for the participant to understand the task.

Practice items:

| | Participant's response |
|---|---|
| 2+3=_____ | |
| 4+5=_____ | _____ _____ |

The practice trial may be repeated until the participant can complete the task.

| Two equation set | Participant's response | Score |
|---|---|---|
| 2+2=_____ | | |
| 6+1=_____ | _____ _____ | _____ |
| 4+3=_____ | | |
| 3+2=_____ | _____ _____ | _____ |
| 3+3=_____ | | |
| 1+2=_____ | _____ _____ | _____ |

| Three-equation set | Participant's response | Score |
|---|---|---|
| 4+1=_____ | | |
| 3+4=_____ | | |
| 4+2=_____ | _____ _____ _____ | _____ |
| 5+4=_____ | | |
| 1+4=_____ | | |
| 2+6=_____ | _____ _____ _____ | _____ |
| 8+1=_____ | | |
| 7+1=_____ | | |
| 1+3=_____ | _____ _____ _____ | _____ |

| Four-equation set | Participant's response | Score |
|---|---|---|
| 1+2=_____ | | |
| 3+2=_____ | | |
| 2+6=_____ | | |
| 6+1=_____ | _____ _____ _____ _____ | _____ |

[*] Based on guidelines developed by Wass and Riley (2003).

2+3=______ Participant’s response Score
5+3=______
1+1=______
1+6=______ ______ ______ ______ ______ ______

6+2=______
4+1=______
2+5=______
8+1=______ ______ ______ ______ ______ ______

Five-equation set Participant’s response Score
7+2=______
1+1=______
1+5=______
4+4=______
3+1=______ ______ ______ ______ ______ ______ ______

5+3=______
3+1=______
2+1=______
7+2=______
4+2=______ ______ ______ ______ ______ ______ ______

1+3=______
6+3=______
3+4=______
4+1=______
1+1=______ ______ ______ ______ ______ ______ ______

Six-equation set Participant’s response Score
5+3=______
8+1=______
2+4=______
4+1=______
5+2=______
3+1=______ ______ ______ ______ ______ ______ ______ ______

3+6=______
6+2=______
1+3=______
3+3=______
1+1=______
1+4=______ ______ ______ ______ ______ ______ ______ ______

4+1=_____
6+2=_____
8+1=_____
2+4=_____
3+1=_____
2+5=_____ _____ _____ _____ _____ _____ _____ _____

Seven-equation set
3+4=_____
5+1=_____
4+1=_____
7+2=_____
2+1=_____
2+2=_____
6+2=_____ _____ _____ _____ _____ _____ _____ _____ _____

3+2=_____
6+3=_____
1+2=_____
3+4=_____
3+5=_____
4+2=_____
1+4=_____ _____ _____ _____ _____ _____ _____ _____ _____

4+2=_____ Participant’s response Score
2+3=_____
4+3=_____
5+3=_____
1+3=_____
6+3=_____
1+2=_____ _____ _____ _____ _____ _____ _____ _____ _____

Total Score _____

Spatial Memory Task*
Instructions and Scoring Sheet

Open the Spatial Memory Stimuli Book to the page marked “Practice” and give the following introduction to the participant (this need not be verbatim):

* Adapted from Seigneuric and colleagues (2000).

"I am going to show you some tic-tac-toe boards in this book that have different colored dots. In each board, the winning dot is missing. When you see each board, I want you to take the right colored dot and put it on the board to make a winning line. I want you to remember where the winning line is on each board. After I show you a couple of boards, I will ask you to show me each colored winning line. Remember to show me the winning lines in the order you saw them. Once you tell me the lines, we'll start the game over with new boards."

You may give additional instructions if you feel it's necessary for the participant to understand the task.

Practice grids

1.

2.

The practice trial may be repeated until the participant can complete the task.

Two grids

1.

Score_____

2.

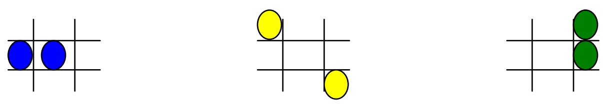
Score_____

3.

Score_____

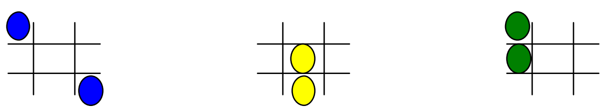
Three grids

1.



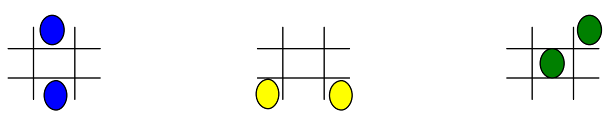
Score_____

2.



Score_____

3.



Score_____

Four grids

1.

Score____

2.

Score_

___

3.

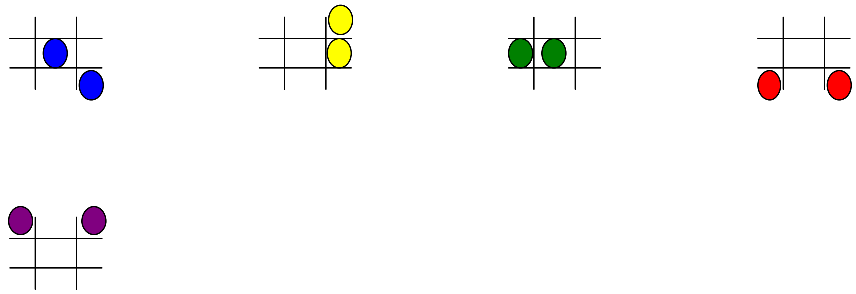
Score____

Five grids

1.

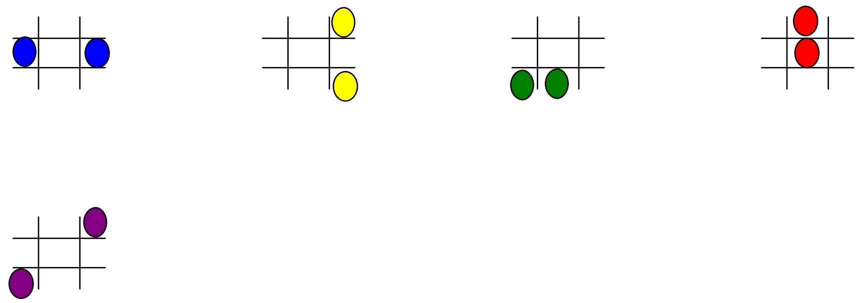
Score_____

2.



Score_____

3.



Score_____ Total Score_____

# APPENDIX F

## Experimental Stories Segmented Into Story Grammar Components

Save the Spiders

| Story Grammar Component | Total |
|---|---|
| Setting | 11 |
| Initiating Event | 7 |
| Plan | 2 |
| Attempt | 7 |
| Internal Response | 9 |
| Consequence | 7 |
| Resolution/Reaction | 1 |
| Total | 44 |

Sawing Logs

| Story Grammar Component | Total |
|---|---|
| Setting | 13 |
| Initiating Event | 3 |
| Plan | 2 |
| Attempt | 3 |
| Internal Response | 9 |
| Consequence | 5 |
| Resolution/Reaction | 6 |
| Total | 41 |

Two Golfing Nuts

| Story Grammar Component | Total |
|---|---|
| Setting | 11 |
| Initiating Event | 8 |
| Plan | 1 |
| Attempt | 12 |
| Internal Response | 3 |
| Consequence | 11 |
| Resolution/Reaction | 5 |
| Total | 51 |

Skipping School

| Story Grammar Component | Total |
|---|---|
| Setting | 9 |
| Initiating Event | 8 |
| Plan | 2 |
| Attempt | 6 |
| Internal Response | 14 |
| Consequence | 7 |
| Resolution/Reaction | 1 |
| Total | 47 |

Shop ‘Till They Drop

| Story Grammar Component | Total |
|---|---|
| Setting | 6 |
| Initiating Event | 1 |
| Plan | 1 |
| Attempt | 12 |
| Internal Response | 8 |
| Consequence | 9 |
| Resolution/Reaction | 7 |
| Total | 44 |

Time to Tell

| Story Grammar Component | Total |
|---|---|
| Setting | 9 |
| Initiating Event | 8 |
| Plan | 4 |
| Attempt | 14 |
| Internal Response | 6 |
| Consequence | 5 |
| Resolution/Reaction | 2 |
| Total | 48 |

Bad Haircut

| Story Grammar Component | Total |
|---|---|
| Setting | 6 |
| Initiating Event | 4 |
| Plan | 1 |
| Attempt | 11 |
| Internal Response | 6 |
| Consequence | 8 |
| Resolution/Reaction | 9 |
| Total | 45 |

Roller Blading

| Story Grammar Component | Total |
|---|---|
| Setting | 7 |
| Initiating Event | 6 |
| Plan | 2 |
| Attempt | 10 |
| Internal Response | 13 |
| Consequence | 6 |
| Resolution/Reaction | 4 |
| Total | 48 |

# APPENDIX G
## Sample Scoring Sheet for Scoring Inferencing Questions

Save the Spiders

| Questions | 2 points | 1 points | 0 points |
|---|---|---|---|
| How do spiders help us | They kill/eat bugs (that bother us) | | |
| How did Luke overcome his fear of spiders | learning about them | | |
| How did Luke try to keep from hearing the teacher | covered his ears and sang songs (humming) | covered his ears OR sang songs | |
| How do we know that Luke did listen to the teacher | he learned about spiders, he didn't kill spiders again | because he uncovered his ears/stopped singing | because it said he did |
| How do spiders catch bugs | in their webs | | in their den |
| Where did Luke study spiders | at school, in science class | | |
| What was Luke doing when he decided never to kill spiders again | walking home | | |
| The first time Luke didn't step on a spider, what time of day was it | afternoon, middle of the day | | morning, noon |
| Who wanted to learn about spiders | Luke's classmates, everyone but Luke | | |
| When Luke's Mom told him to leave the spiders alone, what did he do | he killed them | he didn't listen | |
| Why did Luke kill spiders | he hated them, scared of them, didn't like them | | |
| Why did Luke's mom tell him to leave the spiders alone | they help us, they don't hurt us, she liked them | | |
| Why did Luke have to learn about spiders | everyone else wanted spiders but Luke | | because he was in school |
| Why didn't Luke want to learn about spiders | he didn't like spiders | | they look ugly |
| Why did Luke decide to never kill another spider again | he liked them, appreciated them, he knew they helped | | |

# APPENDIX H

Pairwise Comparisons of all Story Grammar Components by Group

| Subject | Story grammar component | Story grammar component | Mean Difference | Significance |
|---|---|---|---|---|
| CA | Setting | Initiating Event | -9.18 | .001** |
| | | Internal Response | 19.604 | .001** |
| | | Plan | -1.239 | .676 |
| | | Attempt | 17.389 | .001** |
| | | Consequence | 8.238 | .013* |
| | | Resolution/ Reaction | 8.436 | .120 |
| | Initiating Event | Setting | 9.180 | .001** |
| | | Internal Response | 28.784 | .001** |
| | | Plan | 7.94 | .015* |
| | | Attempt | 26.568 | .001** |
| | | Consequence | 17.418 | .001** |
| | | Resolution/ Reaction | 17.616 | .001** |
| | Internal Response | Setting | -19.604 | .001** |
| | | Initiating Event | -28.784 | .001** |
| | | Plan | -20.844 | .001** |
| | | Attempt | -2.16 | .628 |
| | | Consequence | -11.366 | .034* |
| | | Resolution/ Reaction | -11.168 | .070 |
| | Plan | Setting | 1.239 | .676 |
| | | Initiating Event | -7.940 | .015* |
| | | Internal Response | 20.844 | .001** |
| | | Attempt | 18.628 | .001** |
| | | Consequence | 9.478 | .004* |
| | | Resolution/ Reaction | 9.676 | .078 |
| | Attempt | Setting | -17.398 | .001** |
| | | Initiating Event | -26.568 | .001** |
| | | Internal Response | 2.216 | .628 |
| | | Plan | -18.628 | .001** |
| | | Consequence | -9.150 | .003* |
| | | Resolution/ Reaction | -8.952 | .045* |

| Subject | Story grammar component | Story grammar component | Mean Difference | Significance |
|---|---|---|---|---|
| CA | Consequence | Setting | -8.238 | .013* |
| | | Initiating Event | -17.418 | .001** |
| | | Internal Response | 11.366 | .034* |
| | | Plan | -9.478 | .004* |
| | | Attempt | 9.150 | .003* |
| | | Resolution/ Reaction | .198 | .967 |
| | Resolution/ Reaction | Setting | -8.436 | .120 |
| | | Initiating Event | -17.616 | .001** |
| | | Internal Response | 11.168 | .070 |
| | | Plan | -9.676 | .078 |
| | | Attempt | 8.952 | .045* |
| | | Consequence | -.198 | .967 |
| LA | Setting | Initiating Event | -9.262 | .001** |
| | | Internal Response | 6.766 | .165 |
| | | Plan | -2.067 | .492 |
| | | Attempt | 14.509 | .001** |
| | | Consequence | 4.886 | .129 |
| | | Resolution/ Reaction | 14.073 | .013* |
| | Initiating Event | Setting | 9.262 | .001** |
| | | Internal Response | 16.028 | .002* |
| | | Plan | 7.195 | .028* |
| | | Attempt | 23.771 | .001** |
| | | Consequence | 14.148 | .001** |
| | | Resolution/ Reaction | 23.336 | .001** |
| | Internal Response | Setting | -6.766 | .165 |
| | | Initiating Event | -16.028 | .002* |
| | | Plan | -8.832 | .120 |
| | | Attempt | 7.744 | .102 |
| | | Consequence | -1.879 | .718 |
| | | Resolution/ Reaction | 7.308 | .232 |
| | Plan | Setting | 2.067 | .492 |
| | | Initiating Event | -7.195 | .028* |
| | | Internal Response | 8.832 | .120 |
| | | Attempt | 16.576 | .001** |


| Subject | Story grammar component | Story grammar component | Mean Difference | Significance |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| | | Consequence | 6.953 | .030* |
| | | Resolution/ Reaction | 16.140 | .006* |
| LA | Attempt | Setting | -14.509 | .001** |
| | | Initiating Event | -23.771 | .001** |
| | | Internal Response | -7.744 | .102 |
| | | Plan | -16.576 | .001** |
| | | Consequence | -9.623 | .002* |
| | | Resolution/ Reaction | .436 | .920 |
| | Consequence | Setting | -4.886 | .129 |
| | | Initiating Event | -14.148 | .001** |
| | | Internal Response | 1.879 | .718 |
| | | Plan | -6.953 | .030* |
| | | Attempt | 9.623 | .002* |
| | | Resolution/ Reaction | 9.187 | .070 |
| | Resolution/ Reaction | Setting | -14.073 | .013* |
| | | Initiating Event | -23.336 | .001** |
| | | Internal Response | -7.308 | .232 |
| | | Plan | -16.140 | .006* |
| | | Attempt | -.436 | .920 |
| | | Consequence | -9.187 | .070 |
| LLI | Setting | Initiating Event | -10.314 | .001** |
| | | Internal Response | 12.797 | .017* |
| | | Plan | -.045 | .989 |
| | | Attempt | 14.244 | .001** |
| | | Consequence | 2.168 | .515 |
| | | Resolution/ Reaction | 5.138 | .367 |
| | Initiating Event | Setting | 10.314 | .001** |
| | | Internal Response | 23.111 | .001** |
| | | Plan | 10.359 | .004* |
| | | Attempt | 24.558 | .001** |
| | | Consequence | 12.482 | .001** |
| | | Resolution/ Reaction | 15.453 | .001** |
| | Internal Response | Setting | -12.797 | .017* |
| Subject | Story grammar component | Story grammar component | Mean Difference | Significance |
| | | Initiating Event | -23.111 | .001** |
| | | Plan | -12.752 | .036* |

| | | | | |
|---|---|---|---|---|
| | | Attempt | 1.447 | .766 |
| | | Consequence | -10.629 | .061 |
| | | Resolution/ Reaction | -7.659 | .234 |
| LLI | Plan | Setting | -.045 | .989 |
| | | Initiating Event | -10.359 | .004* |
| | | Internal Response | 12.752 | .036* |
| | | Attempt | 14.199 | .001** |
| | | Consequence | 2.123 | .513 |
| | | Resolution/ Reaction | 5.093 | .373 |
| | Attempt | Setting | -14.244 | .001** |
| | | Initiating Event | -24.588 | .001** |
| | | Internal Response | -1.447 | .766 |
| | | Plan | -14.199 | .001** |
| | | Consequence | -12.076 | .001** |
| | | Resolution/ Reaction | -9.106 | .054 |
| | Consequence | Setting | -2.168 | .515 |
| | | Initiating Event | -12.482 | .001** |
| | | Internal Response | 10.629 | .061 |
| | | Plan | -2.123 | .513 |
| | | Attempt | 12.076 | .001** |
| | | Resolution/ Reaction | 2.970 | .567 |
| | Resolution/ Reaction | Setting | -5.138 | .367 |
| | | Initiating Event | -15.453 | .001** |
| | | Internal Response | 7.659 | .234 |
| | | Plan | -5.093 | .373 |
| | | Attempt | 9.106 | .054 |
| | | Consequence | -2.970 | .567 |

Note. CA = Chronological age, LA = Language age, LLI = Language-learning impaired.

*indicates significance at $p < .05$ level, **indicates significance at $p < .001$ level.

# APPENDIX I

Individual Developmental Sentence Scores for All Stories by Presentation Condition

| Subject | ST1H | ST2H | ST3H | ST4H | ST1R | ST2R | ST3R | ST4R |
|---|---|---|---|---|---|---|---|---|
| LLI1 | 11.71 | 12.41 | 13.82 | 13.89 | 16.00 | 9.00 | 16.67 | 12.28 |
| LLI2 | 13.48 | 12.94 | 14.73 | 15.82 | 15.36 | 20.52 | 18.38 | 16.75 |
| LLI3 | 21.70 | 23.24 | 14.10 | 12.15 | 22.42 | 16.06 | 24.17 | 16.67 |
| LLI4 | 12.91 | 17.78 | 17.76 | 10.70 | 11.56 | 9.84 | 12.73 | 8.05 |
| LLI5 | 14.55 | 14.21 | 17.19 | 17.31 | 14.62 | 15.07 | 14.44 | 21.11 |
| LLI6 | 8.60 | 10.11 | 11.00 | 14.67 | 17.75 | 16.50 | 10.88 | 15.00 |
| LLI7 | 13.50 | 16.67 | 16.14 | 10.18 | 16.33 | 18.00 | 11.75 | 16.33 |
| LLI8 | 5.50 | 13.46 | 14.80 | 8.82 | 18.36 | 17.18 | 9.40 | 12.90 |
| LLI9 | 11.50 | 18.17 | 21.64 | 12.50 | 19.73 | 14.12 | 11.33 | 10.22 |
| LLI10 | 14.54 | 27.06 | 14.04 | 16.89 | 16.93 | 13.17 | 16.05 | 17.73 |
| LA11 | 14.80 | 11.77 | 19.36 | 17.80 | 14.43 | 18.00 | 15.67 | 16.75 |
| LA12 | 22.19 | 15.13 | 18.12 | 18.09 | 16.62 | 21.58 | 17.69 | 18.25 |
| LA13 | 14.11 | 20.19 | 20.67 | 18.90 | 20.00 | 15.11 | 16.86 | 17.62 |
| LA14 | 21.18 | 25.56 | 17.24 | 18.15 | 20.90 | 18.33 | 15.39 | 21.00 |
| LA15 | 16.44 | 14.38 | 15.00 | 19.90 | 15.55 | 16.50 | 13.64 | 16.22 |
| LA16 | 18.45 | 22.53 | 16.75 | 19.25 | 23.76 | 16.74 | 23.10 | 18.41 |
| LA17 | 17.15 | 14.83 | 16.42 | 18.33 | 16.00 | 20.00 | 13.45 | 15.08 |
| LA18 | 14.10 | 16.52 | 22.37 | 17.32 | 23.94 | 20.40 | 21.13 | 19.52 |
| LA19 | 17.19 | 17.18 | 16.95 | 15.78 | 17.86 | 16.14 | 15.65 | 18.09 |
| LA20 | 18.08 | 16.00 | 17.89 | 18.24 | 18.07 | 20.72 | 22.25 | 15.67 |
| CA21 | 15.82 | 14.90 | 16.86 | 16.29 | 17.77 | 16.05 | 19.50 | 18.00 |
| CA22 | 20.77 | 20.82 | 24.39 | 24.25 | 22.56 | 18.00 | 24.54 | 17.00 |
| CA23 | 19.50 | 17.29 | 17.00 | 19.80 | 18.40 | 13.74 | 16.92 | 19.68 |
| CA24 | 13.28 | 17.07 | 19.08 | 17.33 | 16.69 | 10.17 | 11.77 | 9.50 |
| CA25 | 20.00 | 30.35 | 20.85 | 19.28 | 22.62 | 23.00 | 17.43 | 15.82 |
| CA26 | 26.77 | 20.26 | 19.76 | 20.19 | 21.75 | 21.13 | 20.54 | 20.85 |
| CA27 | 22.21 | 19.08 | 27.00 | 19.15 | 21.86 | 26.06 | 21.71 | 22.07 |
| CA28 | 23.14 | 15.75 | 20.50 | 19.63 | 19.76 | 19.25 | 20.29 | 20.35 |
| CA29 | 17.43 | 20.94 | 20.33 | 23.70 | 20.60 | 21.95 | 22.80 | 19.81 |
| CA30 | 24.38 | 24.43 | 28.74 | 20.19 | 24.44 | 27.10 | 26.00 | 25.67 |

Note. ST = Story, H = Heard, R = Read, LLI = Language-learning impaired, CA = Chronological age, LA = Language age.

APPENDIX J

All Significant and Non-Significant Pairwise Comparisons for Developmental Sentence Score Components

| Component | Subject | Subject | Mean Difference | Standard Error | Significance |
|---|---|---|---|---|---|
| Indefinite Pronouns/ Noun Modifiers | CA | LA | 1.876 | 3.396 | .585 |
| | | LLI | 10.425 | 3.396 | .005* |
| | LA | CA | -1.876 | 3.396 | .585 |
| | | LLI | 8.549 | 3.396 | .018* |
| | LLI | CA | -10.425 | 3.396 | .005* |
| | | LA | -8.549 | 3.396 | .018* |
| Personal Pronouns | CA | LA | 4.431 | 6.687 | .513 |
| | | LLI | 17.407 | 6.687 | .015* |
| | LA | CA | -4.431 | 6.687 | .513 |
| | | LLI | 12.976 | 6.687 | .063 |
| | LLI | CA | -17.407 | 6.687 | .015* |
| | | LA | -12.976 | 6.687 | .063 |
| Main Verb | CA | LA | 5.669 | 6.299 | .376 |
| | | LLI | 23.517 | 6.299 | .001** |
| | LA | CA | -5.669 | 6.299 | .376 |
| | | LLI | 17.848 | 6.299 | .009* |
| | LLI | CA | -23.517 | 6.299 | .001** |
| | | LA | -17.848 | 6.299 | .009* |
| Secondary Verb | CA | LA | .434 | 2.883 | .881 |
| | | LLI | 7.726 | 2.883 | .012* |
| | LA | CA | -.434 | 2.883 | .881 |
| | | LLI | 7.292 | 2.883 | .018* |
| | LLI | CA | -7.726 | 2.883 | .012* |
| | | LA | -7.292 | 2.883 | .018* |
| Negatives | CA | LA | 1.596 | 2.153 | .465 |
| | | LLI | 3.391 | 2.153 | .127 |
| | LA | CA | -1.596 | 2.153 | .465 |
| | | LLI | 1.795 | 2.153 | .412 |
| | LLI | CA | -3.391 | 2.153 | .127 |
| | | LA | -1.795 | 2.153 | .412 |
| Conjunctions | CA | LA | 7.040 | 7.188 | .336 |
| | | LLI | 23.953 | 7.188 | .003* |
| | LA | CA | -7.040 | 7.188 | .336 |
| | | LLI | 16.913 | 7.188 | .026* |
| | LLI | CA | -23.953 | 7.188 | .003* |

| Component | Subject | Subject | Mean Difference | Standard Error | Significance |
|---|---|---|---|---|---|
| Conjunctions | LLI | LA | -16.913 | 7.188 | .026* |
| Interrogative Reversals | CA | LA | -.471 | .294 | .121 |
| | | LLI | .190 | .294 | .524 |
| | LA | CA | .471 | .294 | .121 |
| | | LLI | .661 | .294 | .033* |
| | LLI | CA | -.190 | .294 | .524 |
| | | LA | -.661 | .294 | .033* |
| WH Questions | CA | LA | .113 | .367 | .760 |
| | | LLI | .651 | .367 | .087 |
| | LA | CA | -.113 | .367 | .760 |
| | | LLI | .538 | .367 | .154 |
| | LLI | CA | -.651 | .367 | .087 |
| | | LA | -.538 | .367 | .154 |
| Sentence Point | CA | LA | .141 | .215 | .517 |
| | | LLI | .879 | .215 | .001** |
| | LA | CA | -.141 | .215 | .517 |
| | | LLI | .738 | .215 | .002* |
| | LLI | CA | -.879 | .215 | .001** |
| | | LA | -.738 | .215 | .002* |

Note. CA = Chronological age, LA = Language age, LLI = Language-learning impaired.

*indicates significance at the $p < .05$ level, **indicates significance at the $p < .001$ level.

# APPENDIX K

All Significant and Non-Significant Subject Pairwise Comparisons for Inferencing Question Types

| Question Type | Subjects | Subjects | Mean Difference | Standard Error | Significance |
|---|---|---|---|---|---|
| Value | CA | LA | .188 | .447 | .679 |
| | | LLI | 2.350 | .447 | .001* |
| | LA | CA | -.188 | .447 | .679 |
| | | LLI | 2.163 | .447 | .001* |
| | LLI | CA | -2.350 | .447 | .001* |
| | | LA | -2.163 | .447 | .001* |
| Information | CA | LA | .613 | .388 | .126 |
| | | LLI | 2.600 | .388 | .001* |
| | LA | CA | -.613 | .388 | .126 |
| | | LLI | 1.988 | .388 | .001* |
| | LLI | CA | -2.600 | .388 | .001* |
| | | LA | -1.988 | .388 | .001* |
| Logic | CA | LA | -.075 | .447 | .868 |
| | | LLI | 2.563 | .447 | .001* |
| | LA | CA | .075 | .447 | .868 |
| | | LLI | 2.638 | .447 | .001* |
| | LLI | CA | -2.563 | .447 | .001* |
| | | LA | -2.638 | .447 | .001* |

Note. LLI = Language-learning impaired, LA = Language age-matched peers, CA = Chronological age-matched peers.

*indicates significance at the $p < .001$ level.

APPENDIX L

Individual Percentage Correct of Letter Recall, Digit Recall, and Spatial Working Memory Tasks

| Subject | Letter | Digit | Spatial |
|---|---|---|---|
| LLI1 | 44 | 22 | 36 |
| LLI2 | 22 | 22 | 29 |
| LLI3 | 56 | 61 | 38 |
| LLI4 | 11 | 33 | 60 |
| LLI5 | 22 | 39 | 31 |
| LLI6 | 33 | 50 | 62 |
| LLI7 | 22 | 44 | 26 |
| LLI8 | 22 | 28 | 43 |
| LLI9 | 11 | 33 | 45 |
| LLI10 | 44 | 28 | 52 |
| LA11 | 33 | 39 | 24 |
| LA12 | 11 | 50 | 70 |
| LA13 | 22 | 44 | 40 |
| LA14 | 22 | 44 | 43 |
| LA15 | 44 | 33 | 43 |
| LA16 | 22 | 50 | 90 |
| LA17 | 44 | 50 | 24 |
| LA18 | 56 | 67 | 31 |
| LA19 | 33 | 61 | 58 |
| LA20 | 44 | 50 | 44 |
| CA21 | 44 | 61 | 48 |
| CA22 | 56 | 56 | 29 |
| CA23 | 67 | 94 | 33 |
| CA24 | 56 | 44 | 26 |
| CA25 | 89 | 67 | 43 |
| CA26 | 33 | 44 | 67 |
| CA27 | 89 | 67 | 48 |
| CA28 | 44 | 56 | 43 |
| CA29 | 89 | 72 | 71 |
| CA30 | 67 | 50 | 48 |

Note. LLI = Language-learning impaired, LA = Language age-matched peers, CA = Chronological age-matched peers.

# Vita

Carren “Carrie” Eby Mills was born and raised in Maryville, Tennessee. She graduated with a B.S. degree in Psychology from Guilford College in Greensboro, NC in 1992 and worked with the Bonner Scholars Foundation and the Residential Life program at the college for two years before returning to Tennessee in 1994 to pursue her Master’s degree. She earned her M.A. in Speech-Language Pathology from The University of Tennessee, Knoxville in 1997. After working two years in the private sector, Carrie returned to UT-K to begin doctoral study in Speech and Hearing Sciences. During the course of her doctoral career, Carrie completed studies examining adult and child swallowing patterns, twin and singleton speech and language characteristics, Narrative-Based Language Intervention, and phonological awareness skills in Head Start children. Her other areas of interest include child language development and literacy, Landau-Kleffner Syndrome, Velo-Cardio-Facial Syndrome, and conflict-resolution and mediation. Her degree will be conferred in December 2004.