EXPOSITORY WRITING SKILLS IN ELEMENTARY SCHOOL CHILDREN FROM THIRD THROUGH SIXTH GRADES AND CONTRIBUTIONS OF SHORT-TERM AND WORKING MEMORY

By

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A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

2006

ACKNOWLEDGMENTS

This dissertation is dedicated to my family, especially my sisters Sandra Coelho and Sylvia deSouza, who never stopped believing in me and to my dearest friends H. S. Uday Kumar and Rajat Mittal who decided it was their responsibility to keep me emotionally and intellectually together-this might not have been possible without them.

I thank my committee members, in particular Dr. Linda J. Lombardino and Dr. Lori J. P. Altmann, who have mentored me through this entire process.

Finally, I would like to thank The School Board of Hillsborough County, Florida, for granting me permission to conduct this investigation and to the students, parents, and teachers who so graciously participated in this research study.

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August 2006

Chair: Linda J. Lombardino
Major Department: Communication Sciences and Disorders

The primary goal of this study was to evaluate multiple dimensions of written language in children at 4 grade levels and to explore the relationship between written language variables and short-term and working memory. Written language samples were collected from a hundred and twenty children from grades 3 through 6 using an expository text-retelling paradigm. The written language samples were analyzed for 13 microstructural elements at the discourse, T-unit, sentence and word levels.

This study was designed to address the following three experimental questions: (1) How does writing develop between grades 3 and 6 at different levels of language?, (2) Do the thirteen language variables cluster into factors that categorize the dimensions of written language?, and (3) What is the relationship between short-term memory (STM), working memory (WM) and writing?

The results of this study show that measures of text length, lexical diversity, and syntactic complexity improve steadily with age. Students in grade 3 showed poorer performance than students in grades 4, 5, and 6; students in grade 4 showed poorer performance than students in grades 5 and 6. It appears that children reach a plateau in their writing at about grade 5 similar to one described in studies examining oral language.

An exploratory factor analysis confirmed that writing is a complex process and can be categorized into four factors comprising *productivity, complexity, accuracy, and mechanics*. Consistent with previous research, WM showed a higher correlation with text generation processes and STM showed a higher correlation with transcription processes. The results of this study provide preliminary data on changes in writing of normally developing children from grades three through six and add to the existing evidence regarding the differential role of WM and STM on writing. The findings of this study have important clinical implications for both the assessment and treatment of written language disorders.

CHAPTER 1
INTRODUCTION AND REVIEW OF LITERATURE

Research on writing has lagged behind investigations of reading acquisition and cognitive processes associated with reading. As noted by Treiman and Kessler (2005), "Literacy research has concentrated on reading, but without the ability to write, a person could scarcely be called literate" (p. 120). This study investigated changes in the writing of children from grades 3 through 6 and examined the dimensionality of writing. Additionally, this study examined the contribution of short-term memory and working memory on writing because research suggests that memory plays an important role in written language skills.

The Process of Writing

Writing requires the activation and coordination of orthographic, graphomotor and several linguistic skills including, but not limited to, semantics, syntax, spelling, and writing conventions (Scott, 1999; Singer & Bashir, 2004). Writing involves three primary processes, (1) *planning*- the conception or thinking up of ideas a writer wishes to convey; (2) *translating*- encoding thoughts and ideas into meaningful words, phrases, clauses, and sentences; and finally (3) *reviewing*- reconsidering and revising what is written to the writer's satisfaction (Hayes & Flower, 1980, 1987). These processes are recursive rather than linear, meaning that they are not necessarily followed in any particular order and are continuously interacting. Writing is a skill that develops after the foundations of reading have been laid. Since writing requires the management and coordination of multiple

cognitive-linguistic processes simultaneously, it requires explicit instruction for its mastery.

Figure 1 contains a modified and simplified schematic of the Hayes and Flower (1980, 1987) model of writing depicting the three processes or stages of writing. Their model also specifies sub-processes for the planning and reviewing phases but not for the translating phase. Sub-processes for the planning phase include generating ideas to write about, setting goals for writing and organizing ideas such that writing goals are achieved. Sub-processes involved in reviewing include reading what has been written, editing and revising to ensure that the writer's goals have been met. Berninger and her colleagues (Berninger, 1999; Berninger & Hooper, 1993; Berninger et al., 1992) suggested modifications to the original Hayes and Flower (1980, 1987) model based on their cross-sectional studies of nearly 900 children from grades 1 through 9 showing that for children, the translation process involves two separate sub-components: text-generation and transcription. Text-generation refers to the process by which the writer translates his/her planned ideas into meaningful chunks of sentences, phrases, and words; while transcription refers to the actual mechanics of converting those sentences, phrases, and words into written symbols and includes spelling, handwriting, and punctuation. The Hayes and Flower (1980, 1987) model was based on mature or expert writing and assumed that writers had mastered the transcription processes of writing. While that holds true for mature or expert writers, research by Berninger and her colleagues (Berninger, 1999; Berninger & Hooper, 1993; Berninger et al., 1992) has shown that children in elementary grades have not mastered transcription skills thus affecting their writing skills

and output. Therefore, any model of writing in children must necessarily include the two sub-components of the translation stage of writing.

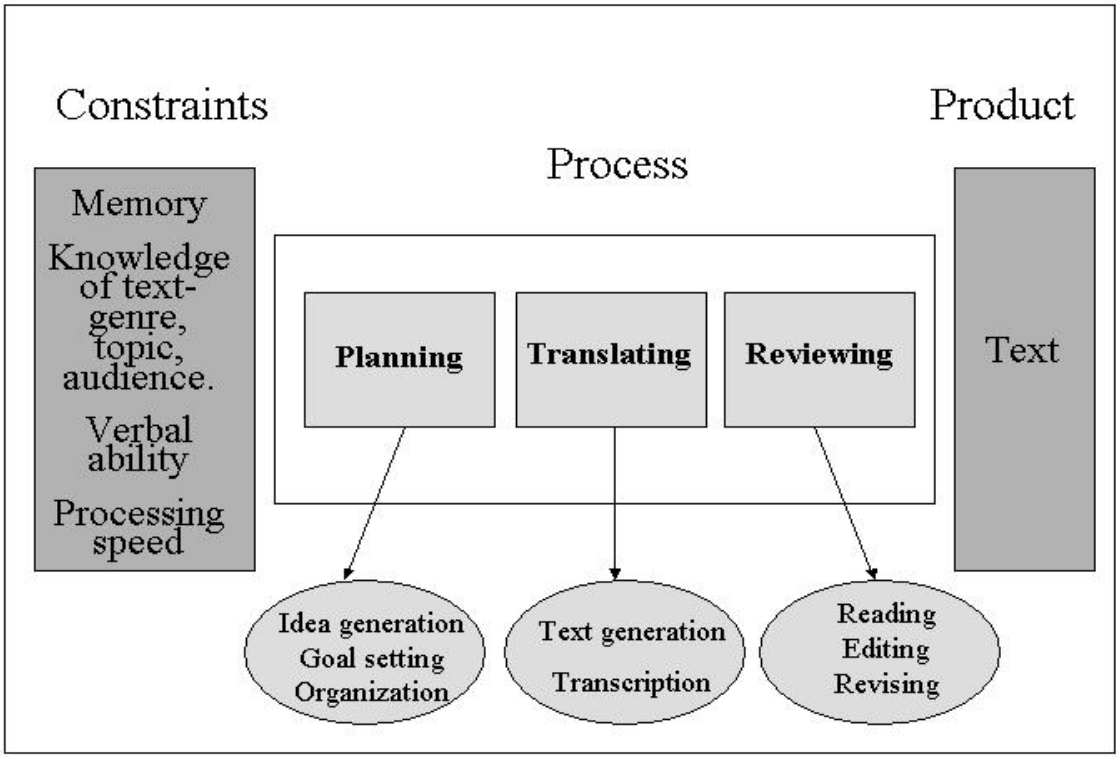

Figure 1. A simplified and modified schematic of the writing process originally based on the Hayes and Flower (1980, 1987) model.

Writing is a challenging activity for most children. The National Assessment of Educational Progress (NAEP) has been conducting ongoing national assessments in major academic subjects including writing. The NAEP has identified three achievement levels for writing, (a) the *Basic* level implies partial mastery of the prerequisite knowledge and skills that are fundamental for work at each grade; (b) the *Proficient* level represents solid academic performance for each grade assessed; and (c) the *Advanced* level signifies superior performance (U.S. Department of Education, 2003). For the year 2002, only 28% of 4th graders, 31% of 8th graders, and 24% of 12th graders performed at or above the *Proficient* level of writing (U.S. Department of Education, 2003). These data

show that a large majority of school children acquire only the very basic writing skills. Children with and without learning disabilities (LD) often experience writing difficulties and exhibit poor writing skills (Baker, Gersten, & Graham, 2003).

In an effort to estimate the prevalence of writing problems among middle school students, Hooper and Montgomery (1993) examined the writing of a large cohort of middle school students located in three different regions of the United States. Using the Spontaneous Writing portion of the Test of Written Language-2 (TOWL-2; Hammill & Larsen, 1988), Hooper and Montgomery (1993) found a high incidence of writing problems in these children who were not diagnosed with learning difficulties or in special education classes. Only about 6% of those students were receiving some special education services and none were in a full time special education classroom. If children developing normally have difficulty with writing, this difficulty is expected to be marked among children with learning disabilities. In fact, the extensive research by Graham and colleagues (Graham & Harris, 1997; Graham, Harris, & Troia, 2000) with learning disabled children has shown that most of these children struggle with some or all aspects of writing.

Several studies have examined written language samples of elementary and middle school children with LD (Houck & Billingsley, 1989; Newcomer, Barenbaum, & Nodine, 1988; Nodine, Barenbaum, & Newcomer, 1985; Taylor, 1980). A compilation of these studies is shown in appendix A. Conclusions drawn from these studies underscore that learning disabled children exhibit less lexical diversity (Morris & Crump, 1982), produce fewer sentences (e.g., Houck & Billingsley, 1989) and shorter T-units (e.g., Scott & Windsor, 2000), include fewer components in their stories (Laughton & Morris, 1989;

Newcomer et al., 1988), produce less coherent stories (Graves, Montague, & Wong, 1990; Montague, Maddux, & Dereshiwsky, 1990) and demonstrate poorer performance in writing conventions (Houck & Billingsley, 1989; Poteet, 1979) when compared to normally developing peers. Investigations into the writing of children with a history of spoken language impairment have shown that they use fewer words, make more syntax and spelling errors, and produce writing that is grammatically less complex compared to their age matched peers (Fey, Catts, Proctor-Williams, Tomblin, & Zhang, 2004; Gillam & Johnston, 1992; Mackie & Dockrell, 2004). Examination of the writing of dyslexic subjects has shown that they exhibit inferior performance when compared to age-matched peers on measures of spelling and construction of grammatical sentences (Puranik, Lombardino, & Altmann, in press).

Analyses of Writing

For many decades, speech-language pathologists (SLPs) have used analyses of spontaneous oral language samples as part of their diagnostic methods for assessing the spoken language capabilities of children with language impairments (Hunt, 1965; Loban, 1976; Paul, 2001). Comparing language-impaired children's abilities with their normally developing peers aids in (a) the identification of language impairments, (b) an understanding of the nature of these language difficulties, and (c) the formulation of intervention goals (Nelson, 1998).

Various methods are used to elicit oral language samples and range from spontaneous or casual conversations, spontaneous story generation (Nelson & Van Meter, 2002) to story retelling after listening to a story (e.g., Gazella & Stockman, 2003), and story generating while viewing pictures (Vallecorsa & Garriss, 1990) or watching video productions (Berman & Verhoevan, 2002; Scott & Windsor, 2000). Language sampling

has been used mainly with preschool and early elementary school children and a spontaneous story telling format is the most commonly used method for eliciting oral language samples.

The use of systematic language sampling procedures for identifying and documenting writing impairments has lagged behind the use of similar procedures in testing the spoken language of children. One reason that the analysis of writing has received little attention may be because the assessment of writing can be a time-consuming and tedious task. Moreover, standardized assessments for writing are scarce compared to assessment instruments for oral language and reading processes. Typically, SLPs do not assess writing and therefore generally do not address this skill when formulating intervention goals (Silliman, Jimerson, & Wilkinson, 2000). A primary reason could be that traditionally, the role of SLPs has been confined to assessing and treating disorders of oral language. Other major reasons are likely to include lack of age-appropriate sampling procedures for older children and data for determining the quality of the sample. Hux, Morris-Friehe, and Sanger (1993) suggest that the decreased use of oral language sampling with older children may be due to lack of age-appropriate guidelines. This lack of age-appropriate guidelines appears to be even more pronounced in the case of writing. With the American Speech Language and Hearing Association's (ASHA, 2001) recommendations for additional roles and responsibilities for SLPs, greater attention must be given to empirically based methods for assessing and treating written language disorders and underscores the need for establishing normative databases for evaluating written language skills.

Genre and Method for Collecting Writing Samples

It is widely accepted that type of genre (i.e., narrative, expository) and nature of the method for collecting a language sample may affect performance (Gazella & Stockman, 2003; Scott, 1989, 1999). One remarkable finding from the literature is that the progression of written language skills across different tasks and the effect of situational variables on various language measures in writing have not been documented (Hadley, 1998; Scott, 1994). On the whole, data on writing development in children with language learning disabilities is meager (Silliman et al., 2000). Most studies have investigated only a small number of variables such as mean length of T-units, total number of words, number of different words. Studies on expository texts are scant; most studies have analyzed written language samples using spontaneously generated narratives. As is often the case, writing studies employ a range of methods for collecting language samples, hence, comparisons of the performance of children across studies for clinical or educational purposes lack precision and are difficult to interpret (Scott & Windsor, 2000). Given the importance of expository writing for success in school, this lack of age-appropriate norms for writing skills underscores an educational and clinical need for data of this nature. This study was motivated by the need for expository data in school age children and was designed to examine changes in the expository writing of children from grades 3 through 6. A future goal is to standardize a text-retelling task that can be used by SLPs as an efficient and scientifically validated assessment procedure for identifying children who have deficient writing skills.

Previous investigations of written language have yielded retell data following an audio-only condition, an audio-visual condition (a video was shown at the same time that the story was heard), or following the reading of a paragraph (Gambrell, Koskinen, &

Kapinus, 1991; Gambrell, Pfeiffer, & Wilson, 1985; Morrow, 1985). Retelling has been used successfully as an instructional strategy for improving writing (Gambrell et al., 1991; Gambrell et al., 1985; Morrow, 1985). Retellings are more commonly used following reading of a paragraph or short story to assess comprehension and provide an efficient method for assessing and evaluating students' memories, reactions, and reading comprehension (Gambrell et al., 1991; Gambrell et al., 1985; Harp, 2000).

Gazella and Stockman (2003) provided several supporting arguments for using story-retelling task as a screener for assessing syntax in children's oral language. They assert that story-retelling formats allow clinicians to control the stimulus input and provide optimal potential to standardize procedures. Further, when clinicians are familiar with the stimulus input they can more reliably assess the degree of information recalled and the accuracy of propositions and inferences made. Similarly, Merrit and Liles (1989) underscored the advantages of a story retelling over a story generation task for oral language sampling. They found that retold stories are easier to transcribe and are often longer, allowing for a greater number of story grammar components to be expressed. Findings from research using retelling for oral language sampling indicate that it can be an efficient tool for amassing data on syntactic complexity and story grammar elements.

In summary, retellings could provide much needed information on how students handle text level content and hold compelling potential for assessing older children because, in school settings, children are required to listen to new information through listening to lectures and then summarize this new information in written form. The format for this study closely resembles a "typical" academic exercise in which students are

required to comprehend and demonstrate learning of material presented orally by an instructor.

Memory

Findings from various research studies suggest that memory capacity is closely linked to several academic and language skills. Memory capacity has been shown to play a vital role in reading comprehension (Swanson & Berninger, 1996; Turner & Engle, 1989), vocabulary (e.g., Dixon, LeFevre, & Twilley, 1988) and scholastic development and attainment (Gathercole, Pickering, Knight, & Stegmann, 2004; Towse, Hitch, & Hutton, 1998). Specifically, the results of several investigations have shown that memory is related to writing (Bourke & Adams, 2003; Hoskyn & Swanson, 2003; Swanson & Berninger, 1996). Evidence of the relationship between memory and writing comes not only from studies with normally developing children and adults but also from studies with children and adults who have language, reading, and learning disabilities.

Writing is a complex task, requiring the intricate activation and coordination of several cognitive-linguistic skills (e.g., Scott, 1999; Singer & Bashir, 2004). These cognitive-linguistic skills include linguistic and meta-linguistic knowledge, prior content knowledge, general thinking ability, processing speed, and short-term and working memory (see Figure 1); variables that are believed to constrain or facilitate the writing process (Hayes & Flower, 1980, 1987; Singer & Bashir, 2004). Although several cognitive skills have been identified in models of writing, in this study, the focus will be on the contribution of short-term memory (STM) and working memory (WM) to writing, and important area of inquiry because children with spoken and/or written language impairments have been shown to have deficiencies in STM and WM (de Jong, 1998; Ellis Weismer, 1996; Ellis Weismer, Evans, & Hesketh, 1999; Gathercole & Baddeley, 1990,

1993a; Gillam, Cowan, & Day, 1995; Kibby, Marks, Morgan, & Long, 2004; Montgomery, 1995; Torgesen, 1985).

Defining Short-term Memory and Working Memory

STM is that part of memory that is capable of holding little information for a limited amount of time. It refers to the ability to hold information in immediate awareness and then use it in a few seconds. It is generally thought of as a static buffer of seven plus or minus two storage units (Miller, 1956). STM requires the storage and retrieval of information and is critical for just about every human activity. For example, it is impossible to engage in a conversation without keeping in mind what one's partner has just said in order to respond appropriately. An often cited example of a STM task in everyday life includes looking up a number in the telephone book and dialing the number from memory. Similarly, while writing, STM is needed to hold a thought in mind while the writer is planning to execute thoughts through print. Finally, another function attributed to STM is that it is a quick route or a temporary store for information retrieved from long-term memory (Carpenter, Miyake, & Just, 1994).

On the other hand, WM, a term first coined by Baddeley and Hitch (1974), refers to the ability to hold information in immediate awareness while performing a mental operation on the information. A transformation or inference is required on WM tasks (Baddeley, 1986, 2003; Baddeley & Hitch, 1974; Daneman & Carpenter, 1980; Just & Carpenter, 1992; Swanson, 1993). As shown in Figure 2, Baddeley and his colleagues (Baddeley, 1986; Baddeley & Hitch, 1974) identified three important components of WM; the central executive, the phonological loop, and the visuo-spatial sketch pad. The central executive component is the most important, being responsible for regulating the flow of information within working memory, coordinating and retrieving information

from other memory systems such as long-term memory, and storing and processing information (Gathercole & Baddeley, 1993b). It is supported by two other components or "slave systems" which are responsible for the processing and temporary maintenance of material within a particular domain. Verbal information is held in a temporary, passive, phonological storage buffer called the phonological loop. The phonological loop is responsible for verbally coded information. In contrast, visuo-spatial sketchpad, the other 'slave system' is involved in the storage of visual or spatial elements. All three components of WM operating together are important for a variety of mental tasks including a wide range of linguistic skills.

To summarize, STM refers to the temporary storage or memory for information that lasts only for a few seconds after one hears or reads something or receives a stimulus, while WM refers to short-term memory when it is used to process information, solve a problem or perform a task with the information (Cowan, 1996). To illustrate, in a sentence recall task, a participant is given a short sentence and asked to repeat it. In a STM task, the subject is required merely to hold the sentence very briefly in the phonological loop before repeating it quickly. In a WM task, when the subject is asked to correct an ungrammatical sentence, he or she is required to hold that information in the phonological store (STM) while performing a mental operation (done by the central executive) to correct the syntax of the sentences.

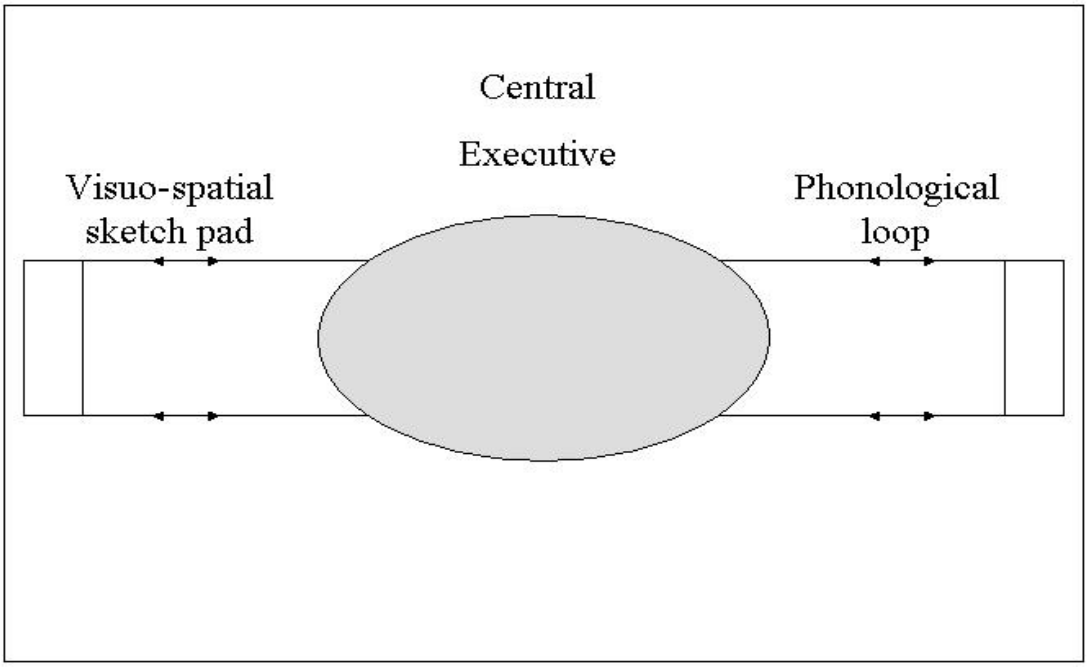

Figure 2. The three-component model of working memory proposed by Baddeley and Hitch (1974).

Tasks that Measure STM and WM

Since STM requires the storage and retrieval of information, it is typically measured on memory span tasks, i.e., reproduction of information in an untransformed fashion. Some common tasks used in research to measure STM are digit span, word span, and nonword repetition. For example, in a typical digit span task, subjects are presented with a string of numbers, which they are asked to repeat. The tasks always starts out easy, generally with two stimuli, and gets progressively harder as the number of syllables, words, or digits is increased.

WM refers to the combined storage and processing of information held in memory. Tasks commonly used to measure WM are complex span tasks and include numbers reversed, digit ordering, sentence/listening span, and reading span. In a numbers reversed task, a subject hears a string of numbers, starting with three numbers, and is required to

repeat the numbers in the reverse order. What differentiates this WM task from the above STM tasks is that the subject has to hold what he or she has heard in memory and then complete some mental processing or manipulation, in this case remember them in a reverse order. Digit ordering is similar to numbers reversed except the subject has to repeat the numbers back from the smallest to the largest number. Sentence/listening span tasks require that the subject listen to groups of sentences, provide answers to simple comprehension questions, then recall the last word of the sentence. Again, as the test progresses, the number of sentences in a group increases, increasing load on WM. Finally, reading span is similar in format to sentence/ listening span, except that the subject reads sentences rather than listens to them.

Relationship between Memory and Writing

Studies that have examined the contribution of WM and STM to writing tasks suggest that that these two memory systems operate independently of each other (Cantor, Engle, & Hamilton, 1991; Swanson, 1993). The findings of these few studies suggest that WM is correlated with higher order aspects of writing (e.g., text generation) while STM is correlated to lower-order skills (e.g., transcription). Text generation is considered a higher order process, because it involves language processing at the word, sentence, and text level, and requires translation of ideas in memory into linguistic representations. Transcription is considered a lower order process because it primarily draws on orthographic and phonological recoding processes in STM (retrieval from LTM) to translate these linguistic representations into written symbols. To produce written text, a writer has to juggle with several cognitively demanding processes- generating ideas, organizing thoughts, translating those ideas into temporally sequenced discourse, and revising his or her writing. All of these processes need to be prioritized by an executive

system prior to written output and hence, coordinating these operations is hypothesized to be supported by a WM system (Berninger, 1999). Research suggests that the storage and processing function of WM is limited in its capacity (Hitch, Towse, & Hutton, 2001; Just & Carpenter, 1992). Thus in children whose transcription processes (spelling, handwriting, and punctuation) are not yet fully automatic, greater resources consumed by STM could mean fewer resources available for the text generation processes controlled by WM. If transcription processes are fluent and automatic when writing, it may help to reduce WM load allowing for improved or better writing (McCutchen, Covill, Hoyne, & Mildes, 1994)

Even though specific writing variables analyzed by studies cited above vary, findings suggest that STM and WM correlate with different processes of writing. WM has been associated with complex components of text generation (Berninger, 1999; Hoskyn & Swanson, 2003; McCutchen, 2000; Swanson & Berninger, 1996) and text quality (Bourke & Adams, 2003). Swanson and Berninger (1996) found that WM was significantly correlated with higher-order text generation processes (i.e., number of words, number of clauses, and compositional quality) while STM best predicted lower-order transcription processes (i.e., spelling, handwriting, and punctuation). In another study, Hoskyn and Swanson (2003) examined the relationship between working memory and writing performance across three age groups (mean ages 15, 30, & 77) and found that age-related changes in text generation were moderated by limitations in WM.

A larger, replicated, and validated body of empirical work is needed to more fully understand the relationship between memory and writing and how memory impacts writing. In the majority of studies discussed above, writing samples were obtained

through spontaneous narrative generation. In this study, the objective was to investigate if the relationship between STM and WM and writing continues to hold true when genre and method for collecting the writing samples vary. Writing samples for this study were collected using a text-retell paradigm and the stimulus paragraph was expository.

To summarize, this study was designed to 1) investigate changes in expository writing using a text-retell format in the writing of children from grades 3 through 6, 2) explore the dimensionality of writing, and 3) examine the role of memory to writing. A long-term goal of this research is to provide SLPs and educators a database for assessing the writing of LD children and in developing intervention procedures for improving children's expository writing skills. Additionally, this study also examined the role of short-term and working memory to writing. This information should be instructive in providing children with disabilities additional support with writing tasks.

Experimental Questions, Hypotheses and Predictions

The following experimental questions were addressed to examine changes in expository writing of children from grades 3 through 6, to explore the dimensionalities of writing, and to evaluate the contribution of individual differences in STM and WM to children's written language samples.

1. How do writing skills change between grades 3 and 6 at the discourse, T-unit, sentence, and word level?

    a. No differences were expected on discourse, T-unit, sentence, and word level variables for children at adjacent grades (e.g., grade 3 and 4).

    b. Differences were expected for discourse, T-unit, sentence, and word level variables in children at lower grades (3-4) when compared to children at higher grades (5 - 6).

    c. Spelling and punctuation errors were expected to decrease significantly between children in lower grades (3 - 4) when compared to children in higher grades (5 - 6).

Written language samples were collected using a retelling paradigm. This procedure allows us to focus on the translating process of writing. The written language variables analyzed at the various levels of text were restricted to examination of the microstructure of writing or the product of writing. Details on the variables analyzed are provided in the next chapter.

In a cross-linguistic study of seven languages, Berman and Verhoeven (2002) found a significant effect for age between students in 4th, 7th, 11th grade and university graduate students on text length, suggesting that the amount of text produced increases with age. It is expected that total number of words will be sensitive to grade differences, although, it is anticipated that the differences in writing at the discourse level will not be significant for all adjacent grades. Significant differences were expected between lower and higher grades.

Nearly all studies that examined variables at the T-unit and sentence level have involved a comparison of the writing capabilities of learning disabled children with normally developing controls. Nelson and van Meter (2003) found no differences in number of T-units and mean length of T-units for adjacent grades. However, Berman and Verhoeven (2002) found a significant effect across grades for number of words per clause and Blair and Crump (1984) reported that syntactic density increased from grades 6, 7 and 8. In this study, it was hypothesized that sentence level variables would improve with age, while differences between adjacent grades might be too small to be considered significant.

Similarly, significant differences at the word level were not expected between all adjacent grades, but significant differences were expected between lower and higher

grades. While, Nelson and van Meter (2002) found that number of different words was sensitive to grade level, other studies of grade school children have not found significant differences in adjacent grades. Berman and Verhoeven (2002) also reported a significant increase in lexical diversity between junior high and high school students. For oral language, number of different words has been shown to increase steadily between the age of 3 and 13 (Miller, 1991). Given the rapid increase in vocabulary for this age group, significant differences are expected across grades. As expected, other studies found significant differences in spelling accuracy across grades (Moran, 1981; Nelson & Van Meter, 2002). During the elementary school years, children's phonics skills and orthographic knowledge improves rapidly, change that is expected to be reflected in their spelling accuracy.

2. Do the thirteen language variables cluster into factors that categorize the dimensions of written language?

    a. It was expected that three factors would emerge to capture the dimensions of written language: 1) *Productivity*, comprised of total number of words, number of ideas, T-units, sentences, and NDW; 2) *Complexity* comprised of number of clauses, percentage of grammatically correct sentences, sentence complexity, errors per T-unit, clause density, and mean length of T-unit; and 3) *Mechanics* comprised of spelling and punctuation.

Recently, Justice et al. (2006) examined the dimensionality of the micro-structural elements of oral narratives. Their exploratory factor analysis produced two clear factors accounting for 76% of the variance in narrative micro-structural elements. The first factor was Productivity and included the total number of words, number of different words, total number of T-units, and total number of complex T-units and to a lesser extent, the total number of coordinating and subordinating conjunctions. The second factor, Complexity consisted of the mean length of T-unit and proportion of complex T-units and subordinating conjunctions to a lesser extent. Using their factor analysis as a

guideline, written language variables were assigned to either the dimension of productivity or complexity. Since written language was analyzed in this study, a third factor, namely mechanics was hypothesized to emerge as a factor.

3. Do STM and WM correlate with writing measures at the discourse, T-unit, sentence and word level?

    a. It was expected that WM memory would be correlated with text generation processes including: (1) total number of words and ideas at the discourse level, (2) number of T-units and clauses at the T-unit level, (3) sentence complexity at the sentence level, and (4) NDW at the word level.

    b. It was expected that STM would be correlated with transcription processes at the word level including: (1) spelling, and (2) punctuation.

Differences in sentence generation and lexical retrieval are related to individual differences in writing (McCutchen et al., 1994). Results of a study by Swanson & Berninger (1996) indicate that WM was significantly correlated with text generation, which included number of words and number of clauses while STM was more closely related to transcription processes, which included spelling, handwriting and punctuation. In a study exploring the relationship between memory and oral language in young and older adults, Kemper and Sumner (2001) reported that grammatical complexity was correlated to measures of WM in young and older adults.

4. Do STM and WM contribute unique variance to writing after controlling for age and vocabulary?

    a. It was expected that WM would contribute unique variance to the text generation processes of writing after controlling for the effects of age and vocabulary.

    b. It was expected that STM would contribute unique variance to transcription processes of writing after controlling for the effects of age and vocabulary.

Language measures including reading and writing are sensitive to age and receptive vocabulary is highly correlated to oral language measures and memory tasks (Dixon,

LeFevre, & Twilley, 1988; Hoskyn & Swanson, 2003; Kemper & Sumner, 2001). Hence, it is reasonable to hypothesize that children who have larger receptive vocabularies would reflect this knowledge in greater productivity and lexical diversity in their written language. In support of this hypothesis, Hoskyn and Swanson (2003) found that WM continued to exert an influence on writing across age even after the effects of reading comprehension and vocabulary were partialed from the analysis.

CHAPTER 2
METHODS

This study was designed to: (1) examine changes in expository writing of children from grades 3 through 6 using a text retell paradigm, (2) determine if writing could be categorized to reflect the dimensions of writing, and (3) investigate how WM and STM are related to writing. The purpose of this chapter is to describe the procedures for subject recruitment and participation, describe data collection procedures and the testing protocol, and define the dependent writing variables.

Setting

Subjects were recruited from 7 schools in Tampa, Florida. The University of Florida Institutional Review Board (IRB-02) approved the procedures and consent forms for this study (see Appendix B). The consent forms described the goals of the study, tests that would be administered and potential contributions of the findings. Permission was obtained from Hillsborough County Schools to conduct research. Consent forms were distributed to children through their classroom teachers. The schools were chosen to represent children from varying socioeconomic backgrounds. Schools chosen for participation included 3 elementary schools, one with less than 25% children on free lunch, one with 50% children on free lunch, and one title one school with 75% children on free lunch. Four middle schools were chosen including 2 title one schools with 75% children on free lunch, one with less than 25% children on free lunch, and one with 50% children on free lunch.

Participants

Approximately, three hundred children returned consent forms signed by their parents giving permission to participate in the study. From this group, thirty subjects each from grades 3 through 6 were randomly selected if they were monolingual English-speaking children with no history of language or reading deficits, sensory or neurological deficits, cognitive impairments or overt behavioral deficits as determined by parent and teacher report.

Participants included an equal number of males and females at each grade. The mean chronological ages for the participants were as follows: 8.7 years (SD = 0.6) for 3rd graders, 9.7 years (SD = 0.5) for 4th graders, 10.8 years (SD = 0.7) for 5th graders, and 11.7 years (SD = 0.5) for 6th graders. The sample was ethnically diverse: 3% Asian-American, 15% African-American, 66% Caucasian, 10% Hispanic, and 3% other. Mother's level of education was used as an index of socioeconomic status and included a range: 43% college or college plus, 23% high school plus, 29% high school, and 4% less than high school.

Data Collection

Phase I

All data were collected in the spring of the school year. Data were collected in 2 phases. In phase 1, a vocabulary test was administered and a written language sample collected. Testing in phase 1 was administered to participants in groups of 3-5 children. All children were administered a modified version of the Peabody Picture Vocabulary Test-3 (Dunn & Dunn, 1997). The PPVT-3 is a test that is administered individually. To enable group administration, two versions were created, one for grades 3 and 4 and another for grades 5 and 6. The original starting point for children in 3rd and 4th grades

who are usually between 8 and 9 years of age is item number 73. The vocabulary gets progressively difficult as a child advances through the items in the original test. Since it was group administered, one needed to ensure student success and keep children who had poorer vocabulary motivated and on task. Hence the test was modified to begin with an earlier set, i.e., at item 61 and from there every second item was chosen until 50 items were obtained. Then the chosen items were randomly distributed such that easy and more difficult vocabulary words were interspersed. The same protocol was followed for the 5th and 6th grades, except that the starting point was item number 73. The modified PPVT-3 forms are shown in Appendix C. To allow for comparison of vocabulary scores between the grades, scores were recalculated based on 29 items common to all four grades.

Next, writing samples were collected from the participants. Participants were read a modified expository passage (see Appendix C) about the 'Where people live' from the Qualitative Reading Inventory (Leslie & Caldwell, 2001). The examiner read the passage to the students who were told to listen carefully because they would have to write what they remembered from memory on a piece of lined paper. Then the examiner told the student that she or he would hear the passage one more time just in case they had missed any important information during the first reading. This procedure was used to minimize memory constraints and allow for more time to commit the text details to memory. The children were given as much time as they needed to complete their written retelling of the text. Most children finished writing in 10 minutes. All testing was conducted in a quiet room at the children's school.

Phase II

In phase II, children in grades 3 and 5 were given additional memory tests. The memory for digits, a commonly used task to measure STM, was taken from the

Comprehensive Test of Phonological Processing (Wagner, Torgesen, & Rashotte, 2001). Working memory was evaluated using the Competing Language Processing Task (CLPT; Gaulin & Campbell, 1994) and a Digit Ordering task. All memory tests were administered individually and presented on audiotape.

Memory for Digits: This subtest contains 4 practice items and 21 test items. On this test, the child hears a series of numbers and is required to say the numbers back in the same order as they heard it. The number of digits presented increases systematically, starting out with 2 numbers and increasing to 8 numbers. No repetition of test items is permitted. Testing is discontinued after the participant misses 3 items in a row (see appendix C).

Competing Language Processing Task: The CLPT is an adaptation of a sentence span task originally designed by Daneman and Carpenter (1980) to evaluate verbal memory span in adults. It was modified by Gaulin and Campbell (1994) to assess verbal working memory in school-age children. In this task, children are presented with groups of 1 to 6 short sentences. Children are first required to respond *yes* or *no* to each sentence. The questions are included to ascertain comprehension and ensure that children are not focusing exclusively on the word-recall task. Sentences are divided into two groups with six different levels of difficulty. The number of sentences increases by one as the level increases, reaching a total of 6. For example, level 1 contains only one sentence per group and requires comprehension of one sentence and recall of one word. Level 6 contains six sentences per group and requires answers to 6 comprehension questions and recall of 6 words. After all the sentence/s in a group are presented to the participants, they are required to recall the last word of each sentence. All sentences contain three words, are

controlled for length and difficulty with each sentence having one of these structures-subject-verb-object, subject-verb-modifier, or subject-auxiliary-main verb. The protocol consists of 4 practice items and 42 test sentences (see Appendix C). Two types of scores are obtained, one for comprehension and one for memory.

Digit Ordering: Digit Ordering is a task commonly used to assess working memory (e.g., Altmann, Kempler, & Andersen, 2001; MacDonald, Almor, Henderson, Kempler, & Andersen, 2001). The test contains 2 practice items and 24 trial items. Each level has four items. Levels increase in difficulty starting with two digits at level 1 and increasing to 7 by level 6. Testing is discontinued when all items at a given level have been administered and participant makes two or more errors at that level (see Appendix C).

Dependent Variables for Writing

All written samples were transcribed into a computer database according to Systematic Analysis of Language Transcript conventions (SALT, Miller & Chapman, 2001). T-units were used as the unit of segmentation, as suggested by Scott and Stokes (1995) and Scott and Windsor (2002). In this study, assessment was restricted to the microstructural elements of writing. Microstructural elements are concerned with the writing product as opposed to the macrostructural elements, which are concerned with the writing process (e.g., planning, organizing, revising, and editing). Written samples were then analyzed at the discourse, T-unit, sentence, and word levels using a modified protocol developed by Nelson, Bahr, and Van Meter (2004). See Appendix D for the protocol.

Discourse Level

At the discourse level, two variables were analyzed to measure written fluency: (1) total number of words written, and (2) total number of ideas expressed. These variables have been widely used by researchers when measuring productivity in both spoken and written language (Berman & Verhoeven, 2002; Houck & Billingsley, 1989; Mackie & Dockrell, 2004; Nelson, Bahr, & Van Meter, 2004; Nelson & Van Meter, 2002; Scott & Windsor, 2000). "Text length is a consistently good predictor of holistic quality ratings of writing" (Scott, 1998, p. 249). *Total number of words* was the number of words produced in writing by the subject and calculated automatically by SALT. Words or phrases that did not pertain to the original paragraph such as "The end" or "that's all I remember" were deleted when calculating total number of words. *Total number of ideas* was calculated so as not to penalize participants who wrote concisely while reproducing ideas/propositions from the original sample. For example the original sample contained sentences such as, "People lived in different places" and "Farmers sell their crops". The first sentence was counted as one idea and the second sentence was counted as another idea. The stimulus paragraph contained a total of 25 ideas. Information produced by the participants that was not present in the original sample was not counted as an idea (see appendix D).

T-unit Level

At the T-unit level**,** five variables were examined: (1) number of T-units, (2) mean length of T-unit, (3) number of clauses, and (4) clause density and (5) errors/T-unit. *Number of T-units* and *mean length of T-units (MLT-unit)*, frequently used measures of syntactic complexity, were calculated using the formula proposed by Hunt (1965). A T-unit, which is the most common method for investigating competence in writing (Scott,

1998), is one main clause with all subordinate clauses embedded in it. Clauses that begin with the coordinating conjunctions *and, but*, or *or* are considered to comprise a new T-unit. Written samples were entered into SALT in T-units, hence number of T-units was calculated automatically by the program. MLT-unit was determined by dividing the total number of words in the writing sample by the total number of T-units in the sample.

A clause was defined as a group of related words containing a subject and a verb. The *number of clauses* in each sentence was coded in SALT. The clauses produced were summed to provide the total number of clauses produced by the subject. *Clause density*, as suggested by Scott and Stokes (1995), is another index of syntactic complexity that can be used with children and adolescents. They define clause density as "a ratio of the total number of clauses (main and subordinate) summed across T-units, and divided by the number of T-units in the sample" (p. 310). Finally, *errors/T-unit* was the ratio of the total errors divided by the total number of T-units. Descriptions of what was counted as an error along with examples are provided in the next section. The complete scoring protocol along with a written language transcript with all the codes marked is shown in Appendix D.

Sentence Level

Sentence level analyses included three variables, (1) number of sentences (2) percentage of grammatically correct sentences, and (3) sentence complexity. Just as length of T-units and clause density provide a general index of syntactic complexity, examination of sentence types provides information on subjects' sentence level skills (Nelson et al., 2002, 2004). Findings from various studies have been mixed and inconclusive regarding the effectiveness of T-units to capture syntactic complexity adequately (Scott, 1989, 1999 for a review). Therefore, writing at the sentence level was

examined as well. Unlike a T-unit, which is based on a preset definition, a sentence was counted based on child's own punctuation (i.e., the presence of a period). If a period was omitted but a new sentence was begun with a capital letter, or a change of topic in spite of lack of appropriate punctuation, it was counted as sentence. It should be noted that more than one T-unit could make up a sentence. For example, "Some people live in the city/ and some people live in the country", is one sentence but divided into 2 T-units (/ indicates division of T-unit).

Sentence codes were added after the child's written language sample was divided into separate T-units. Sentences produced by participants were divided into grammatically correct or incorrect sentences. A sentence was coded as incorrect if it contained grammatical or lexical errors. Error types analyzed included errors of verb or pronoun tense, agreement, or case, omitted or incorrect inflection, substitution of grammatical elements, and violation of word order, lack of referent, and wrong word choice. P*ercentage of grammatically correct sentences* was calculated by dividing the number of correct sentences by the total number of sentences produced by the subject.

A sentence was coded as simple if it contained only one clause and as complex if it contained two or more clauses. They were coded as simple correct or simple incorrect, complex correct or complex incorrect as shown in the examples below:

- Simple correct: Most people in the country are farmers.
- Simple incorrect: The farmers have chicken, ducks, and cow.
- Complex correct: For fun you can walk in the woods or you can find a river and go fishing.
- Complex incorrect: There are many thing to do in the country.

Finally, sentences were coded from levels 1 through 7 based on available literature of the development of complex sentences in children (Miller, 1981; Rosenberg, 1974) and the work of Rosenberg and Abbeduto (1987) with adults. The various levels are shown below (Rosenberg & Abbeduto, 1987, p. 26).

Level 1: Embedded infinitival complement with subject identical to that of the matrix clause (e.g., *Try to brush her hair. I am going to meet John*).

Level 2: *wh*-infinitive clause (e.g., *Remember where it is?*); sentence conjoined with a coordinating conjunction (e.g., *I brought candy and Peter cleaned up*); compound sentence (e.g., *John and Mary left early*).

Level 3: Object noun phrase relative clause (e.g., *The man scolded the boy who stole the bicycle*); object noun phrase complement (e.g., *John knew that Mary was angry*).

Level 4: Gerundive complement (e.g., *I felt like turning it*); comparative (e.g., *John is older than Mary*).

Level 5: Subject noun phrase relative clause (e.g., *The man who cleans the rooms left early today*); subject noun phrase complement (e.g., *For John to have left Mary was surprising*); nominalization (e.g., *John's refusal of the drink angered Mary*).

Level 6: Two sentences conjoined with a subordinating conjunction such as *if, because, before, so* (e.g., *They will play today, if it does not rain*).

Level 7: More than one use of sentence combining in a given sentence (e.g., *John decided to leave Mary when he heard that she was seeing Mark*).

Sentence complexity was calculated by obtaining the weighted average of the sentences depending on the complexity level. To simplify, each sentence was multiplied by the number that was assigned to it based on its complexity level and divided by the total number of sentences produced by the subject. For example if the subject produced two sentences at level 1, one sentence at level 3 and one at level 4, his/her sentence complexity would be $(2x1+3x1+4x1)/4 = 2.25$.

Word Level

At the word level**,** three variables were examined (1) number of different words (NDW), (2) percentage of spelling errors, and (3) writing conventions. *NDW* is a widely used measure of lexical diversity (e.g., Berman & Verhoeven, 2002; Houck & Billingsley, 1989; Moran, 1981; Nelson & Van Meter, 2002; Nelson et al., 2004; Scott & Windsor, 2000). Number of spelling errors, extensively used in studies examining writing (Mackie & Dockrell, 2004; Moran, 1981; Nelson et al., 2004; Nelson & Van Meter, 2002; Poplin, Gray, Larsen, Banikowski, & Mehring, 1980), was the number of words spelled incorrectly. A word was counted as a spelling error only once if the child used the same (incorrect) spelling. If however, a word was spelled incorrectly but differently, each incorrect spelling was counted as an error. The *percentage of spelling errors* was calculated by dividing the number of spelling errors by the total number of words produced by the subject. With a few exceptions, punctuation is a matter of choice (Simone, 1996). Most children resort to the very basic punctuation such as periods at the end of a sentence or use of capital letters to begin a sentence (Scott, 1998). For *writing conventions*, use of end periods and initial capital letters was examined.

Transcription, Coding, and Reliability

All written samples were transcribed into SALT by a research assistant. Every transcript was checked by the author to ensure that all writing samples were correctly transcribed. After practice and establishing coding guidelines, the author and a trained research assistant coded 20% of the written samples independently to obtain reliability. Interrater reliability ranged from 80% to 100% for coded items across transcripts. Scoring differences between the author and the research assistant were settled by consensus following discussion.

In summary, thirteen written language variables were examined and organized into four levels. The levels and the variables examined are shown in the table below:

Table 1. Written language variables by level.

Language Level	**Dependent Measures**
DISCOURSE	Total Words
	Total Ideas
T-UNIT	No. of T-units
	Mean Length of T-unit
	Clause Density
	No. of Clauses
	Errors per T-unit
SENTENCE	No. of Sentences
	% Grammatical Sentences
	Sentence Complexity
WORD	Number of different words
	% Spelling Errors
	Writing Conventions

CHAPTER 3
RESULTS

This primary purpose of this study was to examine changes in expository writing of children from grades 3 through 6 using a text retell paradigm. Thirteen written language variables were analyzed at the discourse, T-unit, sentence, and word level. The second aim of this study was to determine if the writing variables analyzed could be categorized into factors to reflect the dimensions of writing. Finally, this study investigated how WM and STM are related to writing.

Question 1: How does writing develop between grades 3 and 6 at the discourse, T-unit, sentence, and word level?

Data for the dependent writing measures were analyzed using a multivariate analysis of variance (MANOVA) at each level of language with grade as the between-subjects factor. Table 2 contains the means and standard deviations for all writing variables across grades. Pairwise comparisons, adjusted for multiple comparisons, were used to compare the performance of the 4 grades, corrected for Type I error using a Bonferroni correction. Measures of effect size have been reported using partial eta squared (η^2). Effect sizes measure the degree of association between the effect and the dependent variable and have values ranging from 0 to 1.0. Effect sizes less than .10 are considered small, effect sizes between .10 and .25 are considered moderate and effect sizes greater than .25 are considered large.

Discourse Level Measures

Two variables were analyzed across the groups at the discourse level, *total words*, and *total ideas*. The MANOVA for the dependent variable of total words showed a significant main effect for grade $\underline{F}(3,116) = 17.33$, $p < .0001$, partial $\eta^2 = .31$. There was a clear increase in overall productivity reflected in the total number of words used at every grade. Pairwise comparisons showed that children in grade 3 differed significantly from children in grades 4, 5, and 6 ($p < .001$, for all three grades) and children in grade 4 differed significantly from children in grade 6 ($p < .05$). The mean total words for children in each grade level was higher than the mean at the preceding grade levels showing an increase in overall productivity in the total number of words used from 3rd to 6th grade.

Similarly, for total ideas, a significant main effect for grade was found, $\underline{F}(3,116) = 13.7$, $p < .0001$, partial $\eta^2 = .26$ indicating that the number of propositions children are able to recall is sensitive to grade. 3rd graders produced significantly fewer ideas than 4th ($p < .05$), 5th ($p < .001$), and 6th graders ($p < .001$) and 4th graders produced significantly fewer ideas than 6th graders ($p < .03$). Again, the mean number of ideas at each grade was higher than mean at the preceding grade showing an increase in the total number of ideas from 3rd to 6th grades.

T-unit Level Measures

Five variables were analyzed across the groups at the T-unit level, *number of T-units*, *mean length of T-unit*, *number of clauses, clause density, and errors/ T-unit*. The analysis of the number of T-units produced showed a significant main effect for grade, $\underline{F}(3,116) = 15.25$, $p < .0001$, partial $\eta^2 = .28$. Performance of 3rd graders differed

significantly from 4th graders ($p < .002$), 5th($p < .0001$) and 6th graders ($p < .0001$) and 4th graders produced significantly fewer T-units than 6th graders ($p < .007$). Similar to discourse level variables, the number of T-units produced from 3rd to 6th grade showed a steady increase with grade.

For the variable, mean length of T-units, no statistically significant difference between grades was noted, $F(3,116) = 1.51$, $p = .22$. Similarly, there were no statistically significant differences between grades for clause density, $F(3,116) = 0.14$, $p = .94$.

A significant main effect for grade was observed for the number of clauses, $F(3,116) = 14.5$, $p < .0001$, partial $\eta^2 = .27$. Children in grade 3 produced significantly fewer clauses than children in grades 4 ($p < .02$), and children in grades 5 and 6 ($p < .0001$ for both). Performance of children in grade 4 differed significantly from children in grade 6 ($p < .001$). Once again a steady increase was noted from grade 3 to 6 in the number of clauses produced. Finally, for the number of errors/T-unit, no significant effect was obtained for grade, $F(3,116) = .88$, $p= .46$.

Sentence Level Measures

At the sentence level, *number of sentences*, *percentage of grammatically correct sentences, and sentence complexity* were examined. Number of sentences showed a main effect for grade $F(3,116) = 13.6$, $p < .0001$, partial $\eta^2 = .26$. 3rd graders were significantly different from 4th ($p < .004$), 5th ($p < .0001$), and 6th graders ($p < .0001$). 4th graders were significantly different from 6th graders ($p < .001$) and 5th graders were significantly different from 6th graders ($p < .02$). Similar to the trend noted on several other variables, the number of sentences produced by the participants also increased with grade. This was the only measure on which the difference between grade 5 and 6 was significant.

There was no significant main effect for grade for percentage of grammatically correct sentences, $\underline{F}(3,116) = 1.43$, $p = .24$. However, a significant main effect for grade, $\underline{F}(3,116) = 4.34$, $p < .006$, partial $\eta^2 = .10$ was noted for sentence complexity. Significant differences were found between 3rd and 4th graders ($p < .05$), 3rd and 5th graders ($p < .05$), and 3rd and 6th graders ($p < .001$). The means for the 4th and 5th graders was nearly identical.

Word Level Measures

At the word level, three variables were examined, (1) *NDW*, (2) *percentage of spelling errors*, and (3) *writing conventions*. For the dependent variable NDW, a significant main effect was found for grade, $\underline{F}(3,116) = 18.87$, $p < .0001$, partial $\eta^2 = .33$. Not only does overall productivity in writing increase with grade level, but lexical diversity also increases with grade. 3rd graders produced significantly fewer different words than 4th graders ($p < .04$), 5th graders ($p < .0001$), and 6th graders ($p < .0001$) and 4th graders produced significantly fewer different words than both 5th ($p < .05$) and 6th graders ($p < .0001$). Mean scores showed steady increase in lexical diversity from 3rd to 6th grade.

Percentage of spelling errors also showed a main effect for grade, $\underline{F}(3,116) = 6.11$, $p < .001$ partial $\eta^2 = .14$. 3rd graders made significantly more spelling errors than 5th ($p < .02$) and 6th graders ($p < .0001$) and 4th graders made significantly more spelling errors than 6th graders ($p < .01$). 3rd and 4th graders and 5th and 6th graders showed the same percentage of spelling errors. Finally, no differences were observed between grades for writing conventions, $\underline{F}(3,116) = .80$, $p = .49$. All four grades showed between 82% and 90% accuracy for punctuation.

Table 2. Means and standard deviations for writing measures at the discourse, T-unit, sentence, and word level.

Grades	3		4		5		6		
	M	SD	M	SD	M	SD	M	SD	*F*-Ratio
Discourse Level Measures									
Total Words	61.0[a]	20.8	89.2[a,b]	30.1	97.7[a]	24.0	109.8[a,b]	32.7	17.34***
Total Ideas	6.8[a]	3.3	9.4[a,b]	3.5	10.6[a]	3.3	12.9[a,b]	4.9	13.7***
T-unit Level Measures									
No. of T-units	6.5[a]	2.0	8.5[a,b]	2.4	9.5[a]	2.7	10.6[a,b]	2.8	15.25***
MLT-unit	9.6	2.3	10.5	1.8	10.5	1.7	10.3	1.7	1.51
Clause Density	1.78	0.5	1.77	0.4	1.83	0.4	1.82	0.4	0.14
No. of Clauses	11.2[a]	3.6	15.0[a,b]	5.1	17.1[a]	5.0	19.2[a,b]	5.7	14.45***
Errors/T-unit	0.30	0.27	0.21	0.21	0.28	0.24	0.27	0.20	0.87
Sentence Level Measures									
No. of Sentences	5.9[a]	2.1	7.9[a,b]	2.4	8.4[a,c]	2.4	10.0[a,b,c]	3.0	13.59***
% Grammatical Sentences	0.73	0.24	0.81	0.2	0.73	0.2	0.73	0.2	1.43
Sentence Complexity	8.8[a]	6.3	14.7[a]	9.4	14.4[a]	11.3	17.1[a]	9.4	4.34**
Word Level Measures									
NDW	33.8[a]	9.7	41.7[a,b]	12.2	49.3[a,b]	9.9	53.7[a,b]	12.0	18.87***
% Spelling Errors	0.072[a]	0.06	0.055[b]	0.03	0.047[a]	0.04	0.027[a,b]	0.03	6.12**
Writing Conventions	88.6	16.4	90.1	16.1	86.3	24.2	82.3	24.1	0.80

Note: * $p < 0.5$; ** $p < .01$; *** $p < .0001$. Values sharing the same superscript significantly different from each other at $p < .05$

Question 2. Do the thirteen language variables cluster into factors that categorize the dimensions of written language?

To measure the dimensionality of the thirteen written language variables analyzed in this study, an exploratory factor analysis (EFA) was done in SPSS with a principal component analysis factor extraction method, component correlation matrix estimates, and Promax rotation (power = 4). The EFA produced four clear factors with eigenvalues greater than average in the correlation matrix with estimated communalities on the diagonal and a scree plot according to the Kaiser-Guttman rule (eigenvalues of correlation matrix > 1). The four factors accounted for 86% of the variance in the microstructure of expository written language, with correlations between factors ranging from .04 to .29. Eigenvalues and standardized loadings for the writing variables and the four factors are presented in Tables 3 and 4 respectively. The first factor, *Productivity*, resulted in loadings of total number of words, ideas, T-units, sentences, clauses, and number of different words. The second factor, *Complexity*, resulted in loadings on MLT-unit, clause density, and sentence complexity; the third factor, *Accuracy*, resulted in loadings on errors/T-unit and % of grammatically correct sentences; and the fourth factor, *Mechanics*, resulted in loadings on spelling errors and punctuation. Clearly, these factor loadings did not completely match the predicted factors. It was predicted that number of clauses would load on the factor, Complexity instead it loaded on Productivity. Accuracy was not predicted to be a separate factor; instead errors/t-unit and percentage of grammatically correct sentences were hypothesized to load on the Complexity rather the Accuracy factor. The EFA indicates that when assessing written language, four aspects are crucial to examine- overall productivity in writing, complexity of writing, accuracy in writing and the mechanics of writing.

Table 3. Four-factor solution of expository written microstructure.

Factor	Initial Eigenvalue	% of Variance	Rotations Sums of Squared Loadings
1	5.37	41.35	5.25
2	2.57	19.77	2.86
3	2.11	16.25	2.24
4	1.11	8.50	1.63
5	.60	4.64	
6	.43	3.34	
7	.26	1.99	
8	.23	1.76	
9	.11	.86	
10	.10	.79	
11	.07	.54	
12	.02	.15	
13	.00	.03	

Table 4. Standardized regression coefficient factor loadings for the four-factor solution.

	Factor			
Writing Variables	Productivity	Complexity	Accuracy	Mechanics
1. Total words	.93	.17	.03	.003
2. Total ideas	.88	.03	.03	.003
3. No. of T-units	.97	-.23	.01	.06
4. MLT-unit	.08	.86	.06	-.06
5. Clause Density	-.02	.94	-.04	-.05
6. No. of clauses	.88	.28	-.03	.01
7. Errors/T-unit	-.02	.01	-.97	-.01
8. No. of sentences	.93	-.34	-.00	-.07
9. % Grammatical Sentences	-.02	.02	.98	-.00
10. Sentence Complexity	-.07	.87	-.01	.11
11. NDW	.92	.12	-.05	.00
12. % Spelling Errors	.02	-.03	.03	.86
13. Writing conventions	.01	-.03	.03	-.83

Question 3. Do STM and WM correlate with writing measures at the discourse, T-unit, sentence and word level?

Table 5 contains the means and standard deviations for the independent measures. As expected, PPVT-3 vocabulary scores showed a significant main effect for grade, $F(3,116) = 12.75$, $p < .0001$. 3rd graders had significantly lower vocabulary scores than both 5th ($p < .0001$) and 6th graders ($p < .0001$) and 4th graders had significantly lower scores than 5th graders and 6th graders ($p < .004$) On the CLPT WM subtest, 3rd graders did not differ from 5th graders, however, 3rd graders performed significantly more poorly than 5th graders on the WM subtest of Digit Ordering, $\underline{F}(1,58) = 8.61$, $p < .005$. Finally, no significant effects were found between 3rd and 5th graders on the STM-Memory for Digits subtest ($p = .76$).

Correlations between vocabulary, memory measures and writing variables are shown in Table 6. Significant correlations were found between vocabulary and working memory tasks and several writing variables. At the discourse level, total words was significantly correlated to WM tasks and vocabulary. Similarly, total ideas was significantly correlated to WM measures and vocabulary ($p < .01$) in addition to STM ($p < .05$).

At the T-unit level, significant correlations were found for number of T-units, number of clauses, WM and vocabulary ($p < .01$). No significant correlations were noted between MLT-unit, clause density, and errors per T-unit and STM, WM measures or vocabulary.

At the sentence level, significant correlations were found only between number of sentences and vocabulary ($p < .01$). Finally, at the word level, NDW was significantly correlated to WM and vocabulary ($p < .01$) while conversely, spelling was significantly

correlated only to STM measure but not to WM or vocabulary. Finally punctuations did not show any correlation to either memory measure or vocabulary.

Table 5. Means and standard deviations for independent measures.

Grades	3		4		5		6	
	M	SD	M	SD	M	SD	M	SD
Vocabulary								
PPVT-3 Modified	18.1	3.2	18.9	5.5	22.4	3.4	23.2	2.7
Short-term Memory								
Memory for Digits	10.2	2.6			10.4	2.4		
Working Memory								
CLPT Memory	27	4.3			28.9	3.6		
Digit Ordering	13.7	2.5			15.4	2.1		

Note: For vocabulary, n = 120; for STM and WM, n = 60.

Table 6. Correlations between memory, vocabulary measures and writing variables.

	STM Memory for Digits	WM CLPT Memory	WM Digit Ordering	Vocabulary PPVT-3 Modified
Discourse Level				
1. Total Words	.23	.38**	.32*	.47**
2. Total Ideas	.27*	.39**	.37**	.45**
T-unit Level				
3. No. of T-units	.20	.29*	.26*	.46**
4. MLT-unit	-.004	.16	.04	.05
5. No. of Clauses	.24	.28*	.29*	.43**
6. Clause Density	0.5	-.02	-.007	-.02
7. Errors/T-unit	-.09	-.14	.008	-.08
Sentence Level				
8. No. of Sentences	.16	.20	.25	.44**
9. % Grammatical Sentences	.05	.12	-.02	.09
10. Sentence Complexity	.02	.06	.04	-.07
Word Level				
11. NDW	.18	.35**	.30*	.46**
12. % Spelling Errors	-.31*	-.18	-.13	-.15
13. Writing Conventions	.20	.04	.16	-.02

Note. p* < .05; p** < .01

Question 4. Do STM and WM contribute unique variance to writing after controlling for age and vocabulary?

To explore the relationship between memory and writing measures, the correlations were examined more closely using a stepwise regression analyses. To simplify the analyses, only correlations that were found to be significant were examined. Of particular interest was the relationship between writing variables and memory measures while controlling for age and vocabulary. Therefore variables were entered into the regression equation with age first followed by WM and STM measures and vocabulary. A composite WM score was calculated by averaging scores from the CLPT-memory and Digit Ordering tests. Table 7 shows the results of the stepwise regression analyses.

As shown in Table 7, when the effects of age were partialed out, WM accounted for 5% of the unique variance in total number of words and 9% of the unique variance in number of ideas. No other variable entered significantly into the equation. As also shown, STM contributed 9% of the variance in spelling. No other variable entered significantly into the equation. After controlling for the effects of age, WM, STM, and vocabulary did not enter significantly into the regression equation for other writing variables examined, namely, number of T-units, number of clauses, number of sentences and number of different words.

Table 7. Forward stepwise regression with memory and vocabulary scores as predictor variables

	Proportion of Variance	Increment in R^2	*F* ratio
Number of Total Words			
1. Age	.44	-	46.58**
2. WM (composite)	.49	.05	27.64**
Number of ideas			
1. Age	.28	-	23.05**
2. WM (composite)	.37	.09	17.05**
Number of T-units	.		
1. Age	.56	-	26.32**
Number of clauses			
1. Age	.34	-	29.51*
Number of sentences			
1. Age	.26	-	20.19**
NDW			
1. Age	.42	-	42.36**
Spelling			
1. STM	.09	-	6.3*

Note. p* < .01, p** < .001

Summary of Results

Written language samples collected from one hundred and twenty children using a text-retell paradigm were analyzed at the discourse, T-unit, sentence, and word level. Four experimental questions were addressed: 1) How does writing develop between grades 3 and 6 at the discourse, T-unit, sentence, and word level?; 2) Do the thirteen language variables cluster into factors that categorize the dimensions of written language?; 3) Do STM and WM correlate with writing measures at the discourse, T-unit, sentence and word level?; and 4) Do STM and WM contribute unique variance to writing after controlling for age and vocabulary?

Measures of productivity and lexical diversity, which include total number of words and produced, number of T-units, clauses, and sentences, and number of different words were sensitive to grade. On most of these measures, results were statistically

significant between grade 3 and grades 4, 5, and 6, and between grade 4 and grade 6. The means for grade 6 were higher than grade 5 but the differences were not significant, except for the number of sentences. The difference between grades was not statistically significant for mean length of T-unit, clause density, errors per T-units, percentage of grammatically correct sentences, and punctuation. Finally for spelling, 3rd graders showed poorer performance compared to 5th and 6th graders and 4th graders showed poorer performance compared to 6th graders.

When the dimensionality of writing was examined, the exploratory factor analysis produced four factors namely, 1) Productivity, 2) Complexity, 3) Accuracy, and 4) Mechanics. Correlation between memory measures and writing variables showed that WM was more highly correlated with text-generation process such as total number of words and ideas, number of T-units and clauses and number of different words whereas STM was more highly correlated with spelling which is a transcription process. In the stepwise regression analyses, when age and vocabulary were controlled, WM added unique variance to total number of words and number of ideas while STM added unique variance to spelling.

CHAPTER 4
DISCUSSION

The aims of this study were threefold: (1) to examine changes in expository writing of children from grades 3 through 6, (2) to determine if writing variables analyzed could be categorized into factors to reflect the dimensions of writing, and (3) to investigate the contribution of WM and STM to writing. Written language samples were collected from thirty children each from grades 3 through 6 using a text-retell paradigm. Thirteen variables were analyzed to examine the microstructure of expository writing at the discourse, T-unit, sentence, and word levels.

Changes in Writing across Grades and Factors underlying Dimensions of Writing

The first aim of this study was to examine how students' writing skills change across grades. It was hypothesized that the differences between two adjacent grade levels would not be significant (i.e., grades 3 and 4 or 4 and 5) while significant differences between lower and higher grades would be found (i.e., grades 3 and 5 or 4 and 6). Predictions made were partly validated. Differences between higher and lower grades were significantly different. However, significant differences were also found between some adjacent grades. The performance of 3rd graders was lower than 4th graders and 4th graders showed lower performance than 5th graders on total number of words, T-units, clauses, sentences, and different words, total ideas, mean length of T-unit, and sentence complexity. The general trend was for performance to improve steadily with grade. Specifically, performance of grade 3 students was significantly lower than that of students in grades 4, 5, and 6 and performance of grade 4 students was significantly

lower than that of students in grades 5 and 6 on most variables Although the means for most variables for grade 5 were lower than the means for grade 6, differences were generally not statistically significant.

The second aim of this study was to explore the dimensionality of written language similar to dimensions identified for oral narratives (Justice et al., 2006). An exploratory factor analysis confirmed that writing is a complex activity comprising multidimensional constructs – *productivity* (total number of words, ideas, sentences, T-units, clauses, and NDW), *complexity* (MLT-unit, clause density, sentence complexity), *accuracy* (errors/T-unit, % of grammatical sentences), and *mechanics* (% spelling errors, writing conventions) of writing. The factor analysis provides an empirical basis for organizing the microstructure of writing into validated categories. In the sections below, each of these dimensions of writing is discussed.

Measures of Productivity

Measures of productivity at the various levels of language, (1) total number of words and number of ideas at the discourse level, (2) number of T-units and clauses at the T-unit level, (3) number of sentences at the sentence level, and (4) number of different words at the word level increased steadily with grade. Children in grades 5 and 6 used more words and different words and recalled more ideas than children in grades 3 and 4. These results are consistent with findings from previous studies of written language showing that measures of productivity are sensitive to changes in age and grade (Berman & Verhoeven; Nelson & Van Meter, 2003).

Measures of Complexity

The steady trend of improvement with grade was not as consistent for measures of complexity as it was for measures of productivity. No significant improvement or change

was noted for mean length of T-unit or clause density, however, sentence complexity was sensitive to grade. The results of this study are consistent with results of previous studies using T-units to examine competence in syntactic complexity showing a steady but very slow increase in the mean length of T-units as a function of age (Hunt, 1965, 1970; Klecan-Aker & Hedrick, 1985; Loban, 1976; Morris & Crump, 1982; O'Donnell, Griffin, & Norris, 1967; Scott, 1988). This rate of growth is often so slow that statistically significant differences between adjacent grades are not typically found (Scott, 1988). Clause-density has shown little change with age as well, with several periods of short plateaus (Loban, 1976) before it asymptotes at grade 8 (Hunt, 1970; Nippold, Ward-Lonergan, & Fanning, 2005). Consistent with the results of previous research, in this study, 4th and 5th graders showed a marginal improvement in clause density over 3rd and 4th graders.

In contrast, sentence complexity showed a steady increase with grade, showing as expected, that children's ability to formulate complex sentences increases throughout elementary school. For example to convey two ideas, a 3rd grader produced one simple and one lower level complex sentence 'Most people who live in the country are farmers.' and 'They grow their crops to sell or to feed the animals on the farm.' while a 6th grader combined the two ideas by producing a higher level complex sentence 'The people who live in the country are farmers who grow crops to sell and feed the animals'. Level of schooling seems to be crucial in affecting changes in measures of productivity including over-all text length and lexical diversity and syntactic development and complexity (Berman & Verhoeven, 2002).

Accuracy Measures

Unlike productivity measures, accuracy measures, which included errors/T-unit and % grammatically correct sentences, did not show a steady increase with grade. Large variability was noted for errors/T-unit, which may explain the lack of significant findings. Almost no increase was noted for % grammatically correct sentences. One likely explanation is that children in higher grades were attempting to produce more complex sentences (as seen from significant differences noted in sentence complexity), which resulted in them producing more errors than might be expected. This aspect will need to be examined more closely in future studies.

Mechanics of Writing

The performance of students were in line with the predictions of this study, with 3rd graders making more spelling errors than 5th and 6th graders and 4th graders making significantly more spelling errors than 6th graders. This expected pattern of improved performance with age and grade has been noted in other studies (Berman & Verhoeven, 2000; Moran, 1981; Nelson & Van Meter, 2003). Considerable variability was observed in spelling performance as noted from the large standard deviations obtained. This variability could be an artifact of the language sampling procedure used. Written samples were obtained using a text-retelling paradigm in which children might have felt compelled to use the words they had heard. It is highly likely that the students attempted to spell words they had heard in the stimulus paragraph though they may not have known how to spell those words. The most common spelling errors were for the words ‘country’ (e.g., cuntry, contry) and ‘suburbs’ (e.g., soberbs, suberbs).

Students at different grade level did not differ significantly on writing conventions. The punctuations measures used in this study were very basic and included only initial

capital letters and end periods. It is plausible that simple writing conventions may not be a very sensitive indicator of punctuation measures in typically developing children beyond 3rd grade. There is little research on the developmental changes in punctuation. Researchers have suggested that children at this age are generally poor at punctuation and also confine use to the most basic writing conventions (Ferreiro & Kucchermaglio, 1996; Simone, 1996) which may very well explain why no differences were observed across grades.

Summary of Changes in Writing across Grades and Dimensionality of Writing

Several variables examined in this study showed sensitivity to grade while some variables did not. This suggests that there is a set of variables which includes total number of words, ideas, T-units, clauses, sentences produced, number of different words, and spelling errors that better differentiates performance across grades and should be used to develop standardized norm referenced measures for evaluating writing.

The performance of grade 3 students was consistently lower than students in grades 4, 5, and 6 and performance of grade 4 students was lower than students in grades 5 and 6 on several variables. A marked shift in literacy skills occurs at grade 3 with children having mastered the basic reading skills and starting to read for meaning as opposed to learning to read prior to grade 3 (Chall, 1983). In addition, vocabulary shows a steep growth with children learning about 9,000 new words from grades 1 to 3 but 20,000 from grades 3 to 5 (Anglin, 1993). This shift is reflected in the writing of children as well.

Data from this cross-sectional study suggest that children's writing skills plateau at grade 5 similar to plateaus reported for oral narrative productions (Justice et al., 2006). With the exception of the number of sentences produced, there were no statistically significant differences between grades 5 and 6 on the other variables examined. It is also

plausible, however, that the absence of significant changes between grades does not reflect a plateau but rather is a result of methodological constraints and limitations. The same paragraph was used for students in 3rd through 6th grade and might, at least at the higher grades, reflect a ceiling effect. While using different levels of paragraphs for grade 6 might help tease this issue apart, it would be difficult to control variables using a retell procedure.

This scheme of examining writing along dimensions and at various levels of language could be very relevant for teachers and clinicians when evaluating and planning intervention programs that take into account an individual students' strengths and weaknesses because research has shown that children can struggle with different levels of language (Berninger, Mizokawa, Bragg, Cartwright, & Yates, 1994). A long-term goal of this research is to design a clinical instrument for SLPs and teachers to use for evaluating multiple dimensions of children writing skills. To that end, the data gathered for this study will allow clinician's and educators who wish to use a story retell paradigm for assessing the performance of 3rd through 6th grade children who are struggling with written language.

Relationship between Memory and Writing

The third aim of this study was to examine the relationships between memory and writing. The results of this study add to the current body of evidence indicating that WM and STM are differentially related to writing (Berninger et al., 1992, 1994; Swanson & Berninger, 1996). As predicted, text generation processes showed a higher correlation with WM than STM. Text-generation processes draw on WM since they require translating the writer's thoughts into linguistic representations in the form of sentences, phrases and words. The text generation variables in this study that were correlated with

WM were number of total words, T-units, and clauses, total ideas and number of different words. Further, WM was found to contribute unique variance to writing variables such as total number of words and ideas when entered into a regression equation, after controlling for age. It must be noted that when the contributions of age were partialed out, the contributions of WM and STM to writing diminish, implying that age contributes significantly to writing. As mentioned earlier, the changes in mean length of T-unit and clause density are minimal across grades, which might explain why significant correlations weren't obtained between WM and these variables. The elementary and early middle school children studied sometimes omitted periods at the end of a sentence, leaving the examiner to determine what constituted a sentence. It is possible the examiner's judgment contributed to the lack of correlation between the number of sentences and WM.

Spelling, a transcription process, showed a higher correlation with STM, once again consistent with results obtained by other studies (Berninger, et al., 1992, 1994; Swanson & Berninger, 1996). Transcription relies directly on orthographic and phonological processes in STM. In this study, spelling, only one of the two measures of transcription examined was correlated to STM. It was expected that punctuation would also show a high correlation to STM based on previous investigations because it is considered a transcription process However, perhaps because punctuation is still a developing skill and because the punctuation measured (end periods and initial capital letters) do not cover the whole range of writing conventions, it could have contributed to the lack of correlation observed. An alternate explanation could be that punctuation is a convention that does not require memory as much as it requires linguistic knowledge of

syntactic rules or conventions. Rather unexpectedly, number of ideas showed a significant correlation to STM. Unlike spontaneously generated writing, a retelling task probably shows a higher reliance on both WM and STM memory, which is echoed in the correlation between WM, STM and number of ideas generated.

The results of this study add to the existing evidence regarding the differential role of WM and STM in writing. Most of the work examining writing and the role of memory has involved spontaneously generated narratives. These findings support the unique contributions of memory in writing obtained using a text-retelling format. Children may have difficulty with writing obtained via retellings due to memory and linguistic knowledge. Furthermore, it is likely that memory and linguistic knowledge interact to affect writing performance. The contribution of memory and linguistic knowledge will need to be teased apart in future studies probably by comparing performance between written language samples obtained through retellings and spontaneous generation to help determine the contribution of these two skills on writing.

Clinical Implications

This study is the first step in attempting to build a normative database for evaluating expository written text in school age children. To date we have few systematic methods for these that are evidence based. Writing is a language-based activity and given the training and knowledge that SLPs posses in the area of oral language, they can make valuable contributions to improving the writing of children. Since writing is a challenging activity for most children, even those not in special education classrooms, it is very likely that a large number of children struggling with writing in regular classrooms would benefit from intervention by SLPs. In addition to addressing writing during one-on-one

therapy, SLPs can collaborate with classroom teachers to improve writing of grade school children.

The retelling format is an efficient and standardized method of evaluating writing that should serve the SLP well in beginning to identify writing impairments. Evaluating expository writing using this method in conjunction with story grammar for narratives should give us an adequate database for (1) determining skill level, and (2) formulating intervention goals. The variables analyzed in this study are quick and simple to calculate using SALT. Given that SLPs are always strapped for time and generally overburdened with large caseloads, this aspect if favorable. Since the variables are analyzed at various levels of the text, clinicians can use this paradigm to identify relative strengths and weaknesses in children's writing, which in turn will assist in setting clinical goals.

Further, finding a relationship between memory and writing supports the importance of taking into account STM and WM skills when evaluating children with written language difficulties and underscores the need to provide adequate support to students with memory difficulties. Finally, the findings of this study strongly support the need to consider lower-order processes of transcription and higher-order text generation processes in the evaluation and remediation of writing difficulties (Berninger, 1999).

Limitations and Future Directions

Method of written language sampling: The elicitation procedure used in this study is only one method of collecting a written language sample, other methods such as watching an educational video or spontaneous writing can also be used. It is difficult to predict if similar findings would result from writing samples collected in other contexts such as report writing. It is very likely that performance might change on other types of expository tasks. Given the scarcity of data on writing, it is clear that more work is

needed in this area to build a comprehensive database that will enable SLPs to assess and evaluate written language in school-age children in a more comprehensive manner. This study is an attempt in the right direction.

Data collection: Although participants for this study were chosen from schools ranging in their socioeconomic status they were all recruited from one school district. Building a normative database that would allow for the development of a reliable or valid screening instrument would require stratified sampling, a larger number of subjects, as well as subjects from different states to be fully representative. Also, data were collected for only four grades. Normative data on writing for students in all grades should be extended at least through high school. More research will also be needed to determine if writing difficulties can be reliably identified using this protocol. Some comparison groups might include children with language impairments and bilingual children at risk for reading failure.

The PPVT-3 was modified for group administration with one modification administered to grades 3 and 4 and another for grades 5 and 6. This made comparison of vocabulary across grades difficult. While an attempt was made to correct this error by recalculating scores on items common to all four grades, it is an issue to be mindful of in future investigations.

Components of writing examined: The variables examined in this study were confined to examining the microstructure of writing. More detailed analyses including types of complex sentences, and examination of types of spelling errors would continue to improve our understanding of grades level development in children. Studies in the

future examining the process and hence the macro-structural aspects (e.g., cohesion and structural organization, revision and editing process) of writing are also needed.

Evaluation of memory: Examination of the role of memory to expository text was preliminary and exploratory. Memory data were only collected for two grades (3 and 5) and a limited number of tests were used. One goal for future research would be to include a larger range of STM and WM tasks and to examine the role of memory across more grades. The role of WM and STM to writing might be different for higher grades when lower order transcription processes are more automatized. SLPs frequently work with children with language impairments and reading deficits, both of whom have memory deficits. Studies exploring the use of various strategies to support these students and its effect on writing could be the subject of future research as well.

General Conclusions

In summary, this study examined changes in the expository writing of children from grades 3 through 6. Analysis of writing included several variables at the discourse, T-unit, sentence, and word levels. Results showed that variables measuring productivity and complexity of written language are sensitive to grade. These results allow us to identify changes in writing among children from grades 3 through 6 and will lead to procedures for assessing and treating children with written language disabilities. In addition, this study demonstrated the important role of memory to writing. Once again, these findings provide preliminary but standardized data for developing a system to evaluate the performance of students who are struggling with writing.

APPENDIX A
STUDIES EXAMINING WRITING

Genre/ Modality	Studies	Task	Participants/ Summary of Results
Narrative Written	Mackie & Dockrell (2004)	PLST was used to assess writing. Children were asked to look at a picture, which was visible throughout the task and then write a story about it. Children were allowed 30 minutes.	11 children with SLI (mean age 11 yrs.), 11 CA matched, and 11 LA matched (mean age 7.3 years). Measures: total number of words, words per minute, content, proportion of syntax errors, and spelling errors. SLI children wrote shorter stories and used fewer words than CA group and produced more syntax errors than both CA and LA matched group.
	Fey, Catts, Proctor-Williams, Tomblin, & Zhang (2004)	Children were allowed to a choose set of pictures, asked to tell story with examiner prompts and then allowed to choose another set of pictures and asked to write a story.	538 children, 262 with typical language, 111- SLI, 75-NLI, and 90-LNIQ children in 2nd and 4th grades. Stories of normally developing children had more different words, more grammatical complexity, fewer errors and better overall quality than other 3 groups. Oral stories were better than written stories but greater improvements were seen for written stories from grades 2 through 4.
	Nelson & Van Meter (2003)	Children were asked to write a story about a problem and what happens- Data collected at 3 points in the school year	83 ND; 76 special needs; 6 ELL Grades 1 through 5. MLT-unit did not differ from 1st-2nd or 4th-5th grade nor differentiate special needs students till mid 5th grade. NDW and % of words spelled correctly was sensitive to grade level and special needs differences.
	Berman & Verhoeven (2002)	Participants were shown a video depicting scenes of conflict (moral, social, physical) between people. They were asked to tell a story about an incident or situation in which they experienced similar problems with someone.	20 each- 4th, 7th, 11th grade and university graduate ND students. Study was conducted in seven languages. Measures: total number of words, number of words per clause, lexical diversity, and textual coherence. Effect of age for text length was significant. Significant effect for genre- narratives longer than expository text. Lexical diversity greater in expository text than narratives. Younger subjects made more spelling errors.

	Scott & Windsor (2000)	Children were shown a 19-minute video about *Yanis and his dream* and asked to write a story. The children were allowed 5 minutes to write.	60 students total- 20 with LLD, mean age 11.5 yrs. 20 matched for CA. 20 matched for LA, mean age 8.11 years. Productivity measures included total T-units, total words, total time, T-units/minute, words/minute, % of T-units with mazes. For lexical diversity, NDW was examined. Grammatical complexity measures included words/T-unit, and clauses/T-unit. Grammatical errors included errors/T-unit. Effect of genre and modality were consistent across groups. Productivity measures were higher for narratives than expository text. LLD children's performance significantly lower than CA peers on all measures. The only measure that distinguished LLD children from both CA and LA matched peers was extent of grammatical error.
	Gillam & Johnston (1992)	Children were shown 3 pictures. Choose 1 of 3 to write a story.	10 LI, 10 each RA and CA matched. LI children produced higher % of grammatically unacceptable T-units compared to matched peers. No differences were found for other measures. Grammatically unacceptable T-units were more dramatic for written samples. Written samples more complex than oral samples for all groups. LI & RA children had different speaking-writing relationships from CA & LA groups (i.e., percentage of complex T-units were higher in spoken than written sample for LI & RA).
	Graves, Montague, & Wong (1990)	Compared stories under 3 conditions- Provided story grammar & characterization cues.	30 LD, grades 5 and 6. No differences in fluency were noted. Differences were noted in story elements, coherence and organization.
	Issacson & Mattoon (1990)	Compared stories under two planning conditions (goal & purpose)	42 LD children; grades 5 and 6. No difference in the holistic aspects of writing.
	Vallecorsa & Garriss (1990)	Children were shown 3 pictures and asked to compose a story.	23 LD, 23 NLD; grades 6 and 7. Written compositions evaluated for quality, fluency, and cohesion. LD children less coherent and fluent and wrote fewer internal responses.

	Laughton & Morris (1989)	Compared stories under 3 conditions. Story prompts, production of fables with hidden morals.	96 LD, 96 NLD; grades 3,4,5, & 6. LD children included fewer components in their stories.
	Houck & Billingsley (1989)	Subjects were asked to write about a trip and given a few directions. Allowed 20 mns.	48 LD, 48 NLD (16 LD & 16 NLD in each grade 4, 8, and 11). Compared to NLD, LD children wrote fewer words and sentences, wrote more words per sentence, produced fewer words with 7 letters or more, higher capitalization and spelling errors. No difference for number of T-units & number of morphemes per T-unit.
	Montague, Maddux, & Dereshiwsky (1988)	Compared retold and written stories for quality, fluency, and coherence for grades.	36 LD, 36 NLD children; grades 4-5, 7-8 and 10. LD children less fluent and less coherent. No task or developmental effect.
	MacArthur & Graham (1987)	Compared dictated, handwritten and word processed compositions.	11 LD children, grades 5 and 6. Dictated compositions were longer and of better quality.
	Newcomer, Barenbaum, & Nodine (1988)	Subjects shown a picture of a girl on a bike for oral retell; pig in the kitchen for written composition.	LD group- 16 third, 16 fifth graders and 15 seventh graders. Low achieving group- 15 third, 17 fifth, and 14 seventh graders. NA group- 19 third, 19 fifth, and 17 seventh graders. Modality (oral vs. written) did not affect story production. Overall LD children wrote fewer stories and were less fluent at all three grade levels. No differences in coherence and no task effect.
	Barenbaum, Newcomer, & Nodine (1987)	Compared stories under two conditions. Draw a picture; write a story	LD group- 16 third and fifth graders and 15 seventh graders. Low achieving group- 15 third, 17 fifth, and 14 seventh graders. NA group- 19 third, 19 fifth, and 17 seventh graders. LD children wrote fewer stories and were less fluent; task effect and developmental effect were evident. Picture drawing was not beneficial to students.
	Nodine, Barenbaum, & Newcomer (1985)	Children were shown pictures and asked to produce a story.	27 LD, 31 RD, 31 NLD; Grades 5 and 6. LD children wrote fewer stories and were less fluent. No differences in cohesion were noted.

	Poplin, Gray, Larsen, Banikowski, & Mehring (1980)	Measured writing performance on Test of Written Language (TOWL).	99 LD, 99 NLD; Grades 3-4, 5-6, 7-8. LD made more errors in spelling, style, word usage and vocabulary (for grades 7 and 8).
	Poteet (1979)	Story composition	85 LD, 124 NLD; Grades 2, 4, 6. LD children made more mechanical errors; no difference in syntax.
Expository Written	Berman & Verhoeven, (2002)	Participants were shown a video depicting scenes of conflict (moral, social, physical) between people. They were asked to write a composition on the topic of problems between people.	20 each- 4th, 7th, 11th grade and university graduate ND students. Study was conducted in seven languages. Measures: total number of words, number of words per clause, lexical diversity, and textual coherence. Effect of age for text length was significant. Significant effect for genre- narratives longer than expository text. Lexical diversity greater in expository text than narratives. Younger subjects made more spelling errors.
	Scott & Windsor (2000)	Children were shown a 15-minute video about *The Desert* and asked to write a composition. The children were allowed 5 minutes to write.	20 LLD, 20 CA (mean age 11.5), 20 LA (mean age 8.11). Written summaries for expository (and narratives) were shorter than oral compositions. Measures of expository writing lower than measures of narrative writing.
	Englert, Raphael, Anderson, Gregg& Anthony (1989)	Measure metacognitive processes and use of various text structures.	46 LD, 46 NLD, 46 HA; grades 4 and 5. LD children less able to produce text structures; insensitive to planning processes.
	Blair & Crump (1984)	Compare syntactic complexity of stories and essays.	54 LD; grades 6,7, and 8. Essays had greater syntactic density and longer T-units across grades.
	Morris & Crump (1982)	Compared vocabulary and syntactic maturity in essays.	72 LD, 72 NLD; ages 9-15. LD children used less variety of vocabulary words; no significant difference in T-units across age levels.

	Moran (1981)	Children were allowed to pick a topic and instructed to write a paragraph about it.	26 LD, 26 NLD; grades 7-10. Measures: Syntactic maturity (mean morphemes per T-unit, total number of words and morphemes), writing conventions correct (grammatical errors), and percentage of words spelled correctly. Only spelling performance was significantly different between two groups.

CA= Chronological age matched; ELL= English Language Learners; HA= High Achieving; LA= Language age matched; LI= Language Impaired; LLD= Language Learning Disabled; LNIQ= Low nonverbal IQ; ND/NL/ NLD = Normally developing; NLI= Nonspecific Language Impairment; RA = Reading age matched; SLI= Specific Language Impairment.

APPENDIX B
IRB CONSENT FORMS

1. TITLE OF PROTOCOL: Expository oral and written language samples: Tracking developmental changes from grades 2 through 6.

2. PRINCIPAL INVESTIGATOR(s): Cynthia Puranik, MA, CCC-SLP, Clinical Supervisor and Doctoral Candidate. University of Florida, Department of Communication Sciences and Disorders, 354 Dauer Hall, PO Box 117420, Gainesville, FL 32611-7420, Tel: (352) 392-2113 x 286. Fax: (352) 846-0243. E-mail: cpuranik@csd.ufl.edu

3. SUPERVISOR (IF PI IS STUDENT): Linda J. Lombardino, Professor- Department of Communication Sciences and Disorders, 347, Dauer Hall, PO Box 117420, Gainesville, FL 32611-7420, Tel: (352) 392-2113 x 285. E-mail: llombard@csd.ufl.edu

4. DATES OF PROPOSED PROTOCOL: January 2005 to December 2005.

5. SOURCE OF FUNDING FOR THE PROTOCOL: None

6. SCIENTIFIC PURPOSE OF THE INVESTIGATION:

The analysis of spontaneously produced oral and written language samples has played an important role in the study of children with language impairments and learning disabilities. However there are gaps in our knowledge and limitations of current studies. For example 1) the majority of studies have been conducted a long time ago; 2) Most studies have focused only on a small number of variables; 3) Studies for expository text are scant; most studies have looked at language samples using narratives; 4) No study has examined production of narratives or expository language using the procedures intended for this study. Both genre and modality affect production of language samples; 5) Developmental progression has not been studied at the discourse, sentence, and word level; 6) The role of memory in production of oral and written expository language samples has not be examined.

In this study, we will analyze several variables at the discourse, sentence, and word level crucial to the oral language and writing process. The primary objective of this proposal is to produce a comprehensive understanding of the developmental progression of children's oral and written language skills. Since this study will document the performance of children developing normally, this knowledge will be used by teachers and speech-language pathologists involved in working with children with written language disabilities for assessment and intervention purposes. Specifically it will help in 1) understanding and estimating the written language capabilities of learning-disabled

children; and 2) understanding the potential pathways to provide intervention for children at risk for written language disabilities. Secondly, this study will examine the correlations between short-term working memory and the ability to produce oral and language samples.

7. DESCRIBE THE RESEARCH METHODOLOGY IN NON-TECHNICAL LANGUAGE.

This research is divided into two parts. In Part I, 150 participants each from grades 2 through 6 will be chosen. Children will be read a paragraph. Following the reading, children will be required to reproduce the paragraph in writing. Graded paragraphs will be used for language sample collection. The written samples and vocabulary test will be group administered and collected in the classroom. In Part II, 30 participants from each grade will then be randomly selected from the larger group to provide an oral language sample, complete 2 short-term (digit span, nonword repetition) and 2 working memory tasks (listening span, digit ordering). As in the collection of the written sample, graded paragraphs will be read to the children. Following the reading, children will reproduce the paragraph orally. This will be audio taped by the researcher for transcription at a later stage. After the oral sample has been collected children will be administered the memory tasks. Oral samples and memory tasks will be collected individually in a quiet room at school.

8. POTENTIAL BENEFITS AND ANTICIPATED RISK.

No benefits or risks are anticipated for the participants. Most children appear to enjoy the activities. Children will be given candy or stickers for their participation.

9. DESCRIBE HOW PARTICIPANT(S) WILL BE RECRUITED, THE NUMBER AND AGE OF THE PARTICIPANTS, AND PROPOSED COMPENSATION (if any):

1) Following the protocol set in different counties, the appropriate administrator will be contacted first. We will be contacting counties around Alachua.
2) After obtaining permission from the county, different schools in the county will be contacted. If the principal of the school agrees, parental consent forms will be sent to the parents of the children.
3) The letters will be handed to the classroom teacher who will then be requested to send out the parental consent forms to children in his/her classroom.
4) Parental consent will be obtained for 150 children in each grade.

No monetary compensation for participation will be provided.

10. DESCRIBE THE INFORMED CONSENT PROCESS. INCLUDE A COPY OF THE INFORMED CONSENT DOCUMENT (if applicable).

Parents of each potential participant will receive an informed consent document describing the purpose of the study and the requirements of the participant. Classroom teachers will first distribute the consent form to parents of these students. This identification and consent process will take place before the investigators are made aware of the potential participants. The document will contain information regarding the confidentiality of those involved and statements citing that this is a completely voluntary role with the right to withdraw without penalty. Students whose parents have agreed to participate by signing and returning the informed consent document (attached) will then be made known to the investigators. A participant will be part of the study pending the signing and return of the informed consent document.

A child assent script will be used prior to each assessment and intervention session to assure that the child is participating voluntarily (attached).

_____
Principal Investigator's Signature

_____
Supervisor's Signature

I approve this protocol for submission to the UFIRB:

_____ _____
Dept. Chair/Center Director Date

Informed Consent Letter for Parents and Guardians

January, 2005

Dear Parent/Guardian,

I am a doctoral student in Communication Sciences and Disorders at the University of Florida, conducting research under the supervision of Dr. Linda Lombardino, a professor of communication processes and disorders. **We are interested in tracking developmental changes in oral and written language from grades 2 through 6. This information will be used by teachers and educators to help children learning to read and write.**

This study is divided into two parts. In Part I, written language samples will be collected. Your child will first be read a paragraph and then asked to write what he/she remembers. This assignment is expected to take approximately 5-10 minutes and will be conducted in the classroom. Only **some** children will be randomly selected for Part II. If your child is selected for Part II, he/she will be read a paragraph and will have to reproduce the paragraph orally and will also be given four short memory tests and a vocabulary test. This should take between 15-20 minutes. The entire protocol will be accomplished in one session. We also ask that you allow us to audiotape your child's oral language sample for transcription at a later stage. Tapes and written records will be available only to an undergraduate clinical assistant, my supervisor, and me. These will be numerically coded and will not be marked with your child's name. All individual records will be destroyed once the study has ended. Your child's identity will be kept confidential to the extent provided by law. No real names, initials, or other identifying information will be used during spoken or written presentation of study results. Participation or non-participation in this study will not affect your child's grades or placement in programs. We also ask that you give us permission to obtain your child's FCAT scores from school files.

Your participation is voluntary. You and your child have the right to withdraw consent for your child's participation at any time without consequence. There are no known risks in participating. Your child will be given stickers or candy for participating. There are no direct benefits to you for participating in this study. If you have any questions about this research protocol, please contact me at (352) 392-2113, ext 250 or Dr. Lombardino at (352) 392-2113, ext 285. Questions or concerns about your child's rights as a research participant may be directed to the UFIRB Office, University of Florida, Box 112250 Gainesville, FL 32611, (352) 392-0433.

Sincerely,

---	---
Cynthia Puranik, M.A. CCC/SLP	Linda J. Lombardino, Ph. D.
Doctoral Candidate	Professor, Speech Language Pathology

Parent Consent Form

(Please fill out both sides of this form)

I have read the procedure described above and I have received a copy of this form.

I voluntarily agree to allow my child _____, to participate in this study titled- Expository oral and written language samples: Tracking developmental changes from grades 2 through 6.

Parent-Guardian/Date

_____

Principal Investigator/Date

_____

Supervisor/Investigator/Date

_____

cc: Parent/Guardian
File

Parent Consent Form

Child's Name: _____ _____ _____ [ ] Male [ ] Female

Child's Birthdate: _____ **Child's Grade level:** _____

With which parent does your child live? (*Check one or both*)
[ ] Mother or Female Guardian [ ] Father or Male Guardian

Child's Race/Ethnicity
[ ] White [ ] African American [ ] Hispanic [ ] Native American
[ ] Asian [ ] Other _____

Please indicate highest level of education	**Mother or Female Guardian**	**Father or Male Guardian**
No high school diploma or equivalent Please specify grade level completed	_____	_____
High school diploma or equivalent	[ ] Yes [ ] No	[ ] Yes [ ] No
Attended college but no degree. Please specify years completed.	_____	_____
Associate's degree or technical school	[ ] Yes [ ] No	[ ] Yes [ ] No
Bachelor's degree	[ ] Yes [ ] No	[ ] Yes [ ] No
Attended graduate school but no degree. Please specify years completed.	_____	_____
Completed graduate school. Please specify highest degree.	_____	_____

The primary language spoken in your home is:
[ ] English [ ] Spanish [ ] Other_____

Is your child taking medications prescribed by a medical doctor? [ ] Yes [ ] No
If yes, list medications _____

Is your child receiving services from any of the following?

	Currently receiving	*Received in the past*
Speech and Language Therapy	[ ]	[ ]
Resource Services for Reading	[ ]	[ ]
Gifted/Advance Placement	[ ]	[ ]
Occupational Therapy	[ ]	[ ]
Physical Therapy	[ ]	[ ]
Counseling	[ ]	[ ]
LEP/ESL Bilingual Education Services	[ ]	[ ]

Child Assent Script

The following is a script that will be used prior to each session to ensure that the child knows of his/her involvement and that he/she may choose not to participate if he/she does not want to.

Part I

Investigator: **I am going to read you a short paragraph two times. After I finish reading, I would like you to write what you remember on a sheet of paper.**

Do you want to listen to me and then write out the stories?

If the child indicates **yes**, the investigator will begin the session.

If the child indicates **no**, the investigator will not obtain a written language sample from the child.

Part II

Investigator: **I am going to read you a short paragraph two times. After I finish reading, I would like you to tell me what you remember in your own words. I will also tape your story so I can type what you said when I return to work. Also I will give you four short tests that are called memory tasks.**

Do you want to listen to me and retell the story in your own words? Do you want to do the memory tasks?

If the child indicates **yes to both tasks**, the investigator will begin the session.

If the child indicates **no for any one task**, the investigator will terminate the session.

APPENDIX C
TESTING PROTOCOL

PPVT- Grades 3 & 4

I want to find out if you know the names of some pictures. Show Practice Item 1. See, there are four pictures on this page. Each of them is numbered. Indicate by pointing to and saying the numbers in turn: 1, 2, 3, and 4. Then say: I will say a word; then I want you to bubble the number on your page that best tells the meaning of the word. Let's try one. What number best tells the meaning of hook? Good!

Practice Items: Let's try another one. What number is group? That was a good answer. When we begin the test, you will bubble #3 on your answer sheet (point to bubble sheet) ***Now let's practice one last one. What number is dripping? Good! Point to the bubble sheet and say, 'Remember to bubble the right number'). Is everybody ready?***

Test Items: 1. (point to item # on stimulus sheet) What number is _____?

1)	61. vehicle	(4)	26)	97. pedal	(2)
2)	63. luggage	(2)	27)	90. interviewing	(1)
3)	101. inhaling	(4)	28)	133. blazing	(3)
4)	65. hydrant	(4)	29)	67. calculator	(2)
5)	75. vase	(3)	30)	103. tubular	(3)
6)	147. ladle	(2)	31)	105. tusk	(1)
7)	71. vegetable	(3)	32)	107. fern	(1)
8)	111. inflated	(3)	33)	143. pedestrian	(2)
9)	73. gigantic	(2)	34)	109. solo	(4)
10)	141. cornea	(2)	35)	69. squash	(4)
11)	137. hoisting	(1)	36)	155. cultivating	(1)
12)	77. towing	(1)	37)	113. timer	(1)
13)	79. trunk	(2)	38)	115. links	(4)
14)	149. abrasive	(1)	39)	151. cascade	(4)
15)	81. island	(2)	40)	117. microscope	(1)
16)	83. heart	(3)	41)	119. garment	(4)
17)	139. consuming	(4)	42)	142. constrained	(3)
18)	85. flamingo	(2)	43)	121. carpenter	(2)
19)	87. palm	(1)	44)	123. hazardous	(3)
20)	135. reprimanding	(1)	45)	145. syringe	(4)
21)	89. canoe	(3)	46)	125. valve	(3)
22)	91. clarinet	(4)	47)	127. feline	(2)
23)	93. pitcher	(3)	48)	129. coast	(4)
24)	95. polluting	(3)	49)	131. foundation	(4)
25)	153. detonation	(2)	50)	99. bouquet	(4)

PPVT- Grades 5 & 6

I want to find out if you know the names of some pictures. Show Practice Item 1. See, there are four pictures on this page. Each of them is numbered. Indicate by pointing to and saying the numbers in turn: 1, 2, 3, and 4. Then say: I will say a word; then I want you to bubble the number on your page that best tells the meaning of the word. Let's try one. What number best tells the meaning of globe? Good!

Practice Items: Let's try another one. What number is vegetable? That was a good answer. When we begin the test, you will bubble #3 on your answer sheet (point to bubble sheet). Now let's practice one last one. What number is frame? Good! Point to the bubble sheet and say, 'Remember to bubble the right number'). Is everybody ready?

Test Items: 1. (point to item # on stimulus sheet) What number is _____?

1)	85. flamingo	(2)	26)	117. microscope	(1)
2)	87. palm	(1)	27)	155. cultivating	(1)
3)	111. inflated	(3)	28)	131. foundation	(4)
4)	89. canoe	(3)	29)	147. ladle	(2)
5)	119. garment	(4)	30)	113. timer	(1)
6)	91. clarinet	(4)	31)	151. cascade	(4)
7)	93. pitcher	(3)	32)	121. carpenter	(2)
8)	159. disappointed	(4)	33)	153. detonation	(2)
9)	95. polluting	(3)	34)	170. pilfering	(2)
10)	115. links	(4)	35)	165. primate	(4)
11)	141. cornea	(2)	36)	145. syringe	(4)
12)	109. solo	(4)	37)	156. aquatic	(4)
13)	97. pedal	(2)	38)	139. consuming	(4)
14)	99. bouquet	(4)	39)	143. pedestrian	(2)
15)	163. periodical	(2)	40)	167. talon	(3)
16)	101. inhaling	(4)	41)	123. hazardous	(3)
17)	171. trajectory	(1)	42)	179. nautical	(4)
18)	103. tubular	(3)	43)	125. valve	(3)
19)	157. indigent	(2)	44)	135. reprimanding	(1)
20)	105. tusk	(1)	45)	127. feline	(2)
21)	133. blazing	(3)	46)	161. poultry	(4)
22)	107. fern	(1)	47)	173. derrick	(4)
23)	177. gaff	(1)	48)	175. monetary	(3)
24)	129. coast	(4)	49)	149. abrasive	(1)
25)	168.octagon	(3)	50)	137. hoisting	(1)

CLPT-Sentence Span Task

Instructions: We will now wear earphones and listen to a tape. The person on the tape will tell you what to do, but I'll tell you a little bit first. You'll hear groups of sentences. After each sentence, tell me YES if it is true or NO if it is false. The person on the tape will ask you to tell me the last word in each sentence in the group. As we go, it gets harder because there are more and more sentences in the groups, but just do your best. We'll do some practice ones so you'll get an idea of what the sentences are like. Are you ready to begin?

Level		Correct Response	Child's Response		T/F Score	Word recall	Score
Practice Items							
1.	Children can play	Y	Y	N			
1.	Apples are black	N	Y	N			
2.	Ice is hot	N	Y	N			
	Mice eat cheese	Y	Y	N			
Test Items							
1.	Trees have leaves	Y	Y	N			
1.	Trains can fly	N	Y	N			
2.	Pumpkins are purple	N	Y	N			
	Buses have wheels	Y	Y	N			
2.	Boys can eat	Y	Y	N			
	Bananas are blue	N	Y	N			
3.	Carrots can dance	N	Y	N			
	Water is dry	N	Y	N			
	Sugar is sweet	Y	Y	N			
3.	Buckets tell jokes	N	Y	N			
	Horses have tails	Y	Y	N			
	Milk is white	Y	Y	N			
4.	Feathers can tickle	Y	Y	N			
	Babies drive trucks	N	Y	N			
	Birds can fly	Y	Y	N			
	Cars build bridges	N	Y	N			
4.	Snails have shells	Y	Y	N			
	Chairs eat cake	N	Y	N			
	Giants are small	N	Y	N			
	Balloons can float	Y	Y	N			

Level		Correct Response	Child's Response		T/F Score	Word recall	Score
5.	Shoes have ears	N	Y	N			
	Fire burns paper	Y	Y	N			
	Robins eat worms	Y	Y	N			
	Cars can race	Y	Y	N			
	Hotdogs can bark	N	Y	N			
5.	Horses have feet	Y	Y	N			
	Dishes can whistle	N	Y	N			
	Fish pull wagons	N	Y	N			
	Roses have thorns	Y	Y	N			
	Cats can talk	N	Y	N			
6.	Apples are square	N	Y	N			
	Rabbits read books	N	Y	N			
	Houses can jump	N	Y	N			
	Pencils eat candy	N	Y	N			
	Airplanes can fly	Y	Y	N			
	Balls are round	Y	Y	N			
6.	Fish can swim	N	Y	N			
	Clouds wear slippers	N	Y	N			
	Sheep eat lions	N	Y	N			
	People have eyes	Y	Y	N			
	Dogs can run	Y	Y	N			
	Lemons are yellow	Y	Y	N			
				=	/42		/42
	Score (%)	=					

Scoring guide: (1) One point each given for every True/False correct response for a maximum possible of 42. (2) One point given for every word recalled for a maximum possible of 42. Note: Sequence of word recall need not match order of presentation.

Digit Ordering

Read the number series clearly and slowly to the subject (about 1 word per second). Their task is to repeat them back to you in numerical order from lowest to highest. Put a check in the Score box when they get that sequence right. **Discontinue** when all items have been given at a level and subject made two or more errors at that level.

"You are going to hear lists of numbers from 1 to 10 that are out of order. You need to say the list back to me in the correct numerical order, which means from the smallest to the biggest number. For example, if you hear 7-4, you say 4-7. It starts out easy so you can get used to the task. Let's try some practice items first"

Practice Items: (1) 6 – 3 # of trials: _____ (2) 1 – 10 # of trials: _____

Subject Name:_____ Subject #:_____ Grade:_____

Item#	Test sequence	Response	Score
1	5 – 2	2 – 5	
2	3 – 8	3 – 8	
3	9 – 4	4 – 9	
4	8 – 1	1 – 8	
5	5 – 2 – 3	2 – 3 – 5	
6	7 – 4 – 10	4 – 7 – 10	
7	6 – 2 – 9	2 – 6 – 9	
8	3 – 8 – 5	3 – 5 – 8	
9	5 – 4 – 1 – 7	1 – 4 – 5 – 7	
10	8 – 3 – 9 – 6	3 – 6 – 8 – 9	
11	6 – 2 – 10 – 4	2 – 4 – 6 – 10	
12	8 – 6 – 3 – 5	3 – 5 – 6 – 8	
13	6 – 10 – 7 – 4 – 1	1 – 4 – 6 – 7 – 10	
14	2 – 8 – 3 – 7 – 6	2 – 3 – 6 – 7 – 8	
15	9 – 1 – 5 – 3 – 10	1 – 3 – 5 – 9 – 10	
16	3 – 6 – 5 – 2 – 9	2 – 3 – 5 – 6 – 9	
17	10 – 1 – 8 – 2 – 4 – 7	1 – 2 – 4 – 7 – 8 – 10	
18	6 – 3 – 5 – 10 – 8 – 2	2 – 3 – 5 – 6 – 8 – 10	
19	4 – 6 – 9 – 2 – 10 – 7	2 – 4 – 6 – 7 – 9 – 10	
20	3 – 6 – 2 – 8 – 5 – 1	1 – 2 – 3 – 5 – 6 – 8	

21	4 – 10 – 3 – 7 – 2 – 5 – 1	1 – 2 – 3 – 4 – 5 – 7 – 10	
22	6 – 1 – 4 – 8 – 10 – 3 – 5	1 – 3 – 4 – 5- 6 – 8 – 10	
23	3 – 9 – 4 – 2 – 5 – 10 – 7	2 – 3 – 4 – 5 – 7 – 9 – 10	
24	8 – 1 – 7 – 5 – 3 – 4 – 9	1 – 3 – 4 – 5 – 7 – 8 - 9	

Total Items correct _____

Written Language Stimulus Paragraph

Instruct students to write their names, grades, and date on top of the page.

I am going to read a paragraph called 'Where do people live?' When I am finished, I would like you to write down what you remember. *Read the text*. Just in case you missed some parts of the paragraph, I am going to read it to you one last time. Pay good attention, because I won't be able to repeat it. *Read text*. Okay now begin writing.

People live in different places. Some people live in a city while others live in the country. Still other people live in the areas between the city and the country, which are called suburbs.

People live in the city to be near their jobs. Cities have lots of factories, schools, and offices. If people don't want to drive a long way to their jobs, they live in the city. There are many things to do in the city such as visit museums and zoos. They also have many movie theaters.

People live in the country to be close to their jobs, too. Many people who live in the country are farmers. They plant crops on their land. They may sell their crops or may use them to feed the animals that live on the farm. Farmers raise cows, pigs, and chickens. Although life in the country is quiet, there are other things to do. You can find a river to fish in or take walks in the woods.

Many people live in the suburbs. Some people think that people who live in the suburbs have the best of both worlds. It doesn't take as long to get to either the city or the country. The suburbs are more crowded than the country but less crowded than the city. Where people live depends upon what they like most.

(Total # of words: 227)

APPENDIX D
PROTOCOL FOR LINGUISTIC ANALYSIS

Discourse Level	T-unit/Sentence Level	Word Level
Fluency Total # of words: _____ Total # of ideas: _____ _____	# of Sentences: _____ # Simple correct: _____ _____ # Simple incorrect: _____ _____ # Complex correct: _____ _____ # Complex incorrect: _____ _____	Total # of different words: _____ Spelling Accuracy: # incorrect: _____
	Grammatical Complexity Total # of T-units: _____ MLT-unit: _____ Total # of Clauses: _____ Level 1: ____ C ____ IC Level 2: ____ C ____ IC Level 3: ____ C ____ IC Level 4: ____ C ____ IC Level 5: ____ C ____ IC Level 6: ____ C ____ IC Level 7: ____ C ____ IC	**Writing conventions** % Capitalization: _____ % End periods: _____
	Grammatical Errors: _____ • Verb or pronoun tense/ agreement/case. • Omitted or incorrect inflection/ Omitted or substitution of grammatical elements • Violation of word order	**Lexical Errors** _____ • Use of nonwords/ neologisms or coining. • Revisions • Nonspecific vocabulary/ Lack of referent or word substitutions.

Rules for coding in SALT

1) Enter utterances as T-units
   - A t-unit is one main clause plus any subordinate (dependent) clause or nonclausal structure (e.g., prepositional/ verbal phrases etc.) that is embedded in it. All coordinated clauses are separated out into T-units, unless they contain a co-referential subject deletion in the second clause.
   - Examples:
     i. If people live in the city they don't have to drive (1 t-unit)
     ii. There are people that live in the city and people that live in the country (2 t-units)
   - The words 'and', 'then', 'but', 'or', and 'so' are often used to start a new T-unit.

2) Must have a period (.) at the end of the T-unit.

3) Each line must have a code for
   - # of clauses (e.g., [1cl], [2cl], [3cl])
   - correct or incorrect sentence
   - simple or complex sentence (e.g., [sc], [si], [cc],[ci])

   Line codes are always enclosed in square brackets [ ]

4) As needed each utterance will have a code for the following
   - Errors-grammatical and/or lexical ([GE] [LE])
   - Punctuation errors- missing capitalization, missing end period ([i-caperr] [.err])
   - Spelling errors ([spelerr])

5) Explanation for each code (as shown below) should appear at the top of **each** written language transcript.

+[1cl]: 1 clause
+[2cl]: 2 clauses
+[3cl]: 3 clauses
+[4cl]: 4 clauses
+[sc]: Simple correct
+[cc]: Complex correct
+[si]: Simple incorrect
+[ci]: Complex incorrect
+[GE]:Grammatical Error
+[LE]:Lexical Error
+[FE]:Fluency Error
+[spelerr]: Spelling error
+[i-caperr]: Initial word capitalization error
+[.err]: Missing end period

6) Print ‘Standard Measures’ and ‘Code Summary’ for data.

Rules for classifying Simple and Complex Sentences

Simple Sentence- Sentence with one main clause.

e.g., People live in different places.

Farmers raise cows, pigs, and chickens.

Complex Sentence- Sentence with one main and one or more subordinate/embedded clauses or two main clause or one main clause and verb phrase joined by a coordinating conjunction (clause→ must have a verb). **Note**: A clause is a group of related words containing a subject with a verb.

e.g., The suburbs are more crowded than the country but less crowded than the city.

If people don’t want to drive a long way to their jobs, they live in the city.

Rules for Errors

1. Grammatical Errors

Verb or pronoun tense/agreement/case, omitted or incorrect inflection/ omitted or substitution of grammatical elements, violation of word order.

e.g., - The city have a lot of people.
- People living in the country are also close to their jobs, which are usually farming.
- In the contary (country) there farmers.
- They grow crops and eigth (either) sell it of (off) feed it to their animals.

2. Lexical Errors

Use of nonwords/revisions/ nonspecific vocabulary/ lack of referent or word substitutions.

e.g., - People plant crops grow farms.
- People that live in the city useuly (usually) diniune peopl
- The suburiers (suburbs) has meidun (medium) of people.

Spelling Errors

- Don't count a spelling error more than once, unless it is spelled incorrectly and differently each time.
- Their/there, too/to, cities/city's was counted as a spelling error.

Number of ideas

No.	Idea from stimulus paragraph
1	People live in different places.
2	People live in the city.
3	People live in the country.
4	People live in the suburbs.
5	Suburbs- place between the city and country.
6	People live in cities to be near their jobs.
7	Cities have schools/factories/offices
8	People live in cities if they don't want to drive a long way.
9	Visit museums, and zoos
10	Go to the movie theatre.
11	People live in the country to be close to their jobs
12	People who live in the country are farmers
13	They plant crops
14	They sell crops
15	Or feed crops to their animals
16	Farmers raise cows, pigs, chickens
17	Life in the country is quiet
18	Could go fishing
19	Take a walk in the woods
20	People who live in the suburbs have best of both worlds.
21	It doesn't take long to get to either the city or the country
22	The suburbs are less crowded than the city
23	The suburbs are more crowded than the country
24	People live where they like it best
25	There are many things to do in the city

Sample of a written language analysis in SALT

$ CHILD
+ Name: 3036

CODES

+[1cl]: 1 clause
+[2cl]: 2 clauses
+[3cl]: 3 clauses
+[4cl]: 4 clauses
+[sc]: Simple correct
+[cc]: Complex correct
+[si]: Simple incorrect
+[ci]: Complex incorrect
+[GE]:Grammatical Error
+[LE]:Lexical Error
+[spelerr]: Spelling error
+[i-caperr]: Initial word capitalization error
+[.err]: Missing end period

LANGUAGE SAMPLE

c Suburb/s are between the country and city [1cl] [sc].
c there[i-caperr] are (alot) a lot (farnerms) farmer/s[spelerr] in[GE] suburb/s[.err] [1cl] [si].
c people[i-caperr] live in the city for[LE] they can be close to their job [2cl] [ci] [L5-I].
c Farmer/s in the suburb/s train[LE] pig/s, chicken/s and cow/s [1cl] [si].
c (their) there[i-caperr][spelerr] is[GE] (alot) a lot of school/s, office/s and factories in the (cities) city/s [1cl] [si].
c (their) there[i-caperr] are not many farmer/s in the city [1cl] [sc].
c the[i-caperr] farmer/s grow crop/s and give them to their animal/s [2cl] [cc] [L2].

STANDARD MEASURES

UTTERANCES
Total Utterances (number of T-units) 7

SYNTAX/MORPHOLOGY
MLU in Words (MLT-unit) 9.43

SEMANTICS
No. Different Word Roots (NDW) 38
Total Main Body Words (TNW) 66

CODE SUMMARY

	Word Codes					Utterance Codes			
	MAIN BODY		MAZES			MAIN BODY		MAZES	
	Anal Set	Total Utts	Anal Set	Total Utts		Anal Set	Total Utts	Anal Set	Total Utts
[.ERR]	1	1	0	0	[1CL]	5	5	0	0
[GE]	2	2	0	0	[2CL]	2	2	0	0
[I-CAPERR]	5	5	0	0	[CC]	1	1	0	0
[LE]	2	2	0	0	[CI]	1	1	0	0
[SPELERR]	2	2	0	0	[SC]	2	2	0	0
					[SI]	3	3	0	0

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BIOGRAPHICAL SKETCH

Cynthia Puranik was born and raised in Mumbai, India, where she completed most of her former schooling. She began her professional career at University of Florida, Gainesville, where she earned a Master of Arts degree in 1996. Following her master's, Cynthia has been working as a Speech-Language Pathologist in Tampa, Florida, in various clinical settings including rehabilitation centers, private practice and the public schools. She returned to the University of Florida in 2002 to pursue her doctoral degree. She hopes to pursue a career in research and teaching at the University level.

Cynthia's teaching and clinical experiences are in the areas of language development and disorders, with a focus on literacy and reading disabilities. Her specific areas of research interest include examining the relationship between written language and aspects of cognitive functioning, exploring similarities and differences between language impairment and dyslexia, and investigating the effect of grammatical deficits on literacy.