Input Manipulations, Working Memory, and Word Learning Abilities of Children.

Janice Elisabeth Horohov
Louisiana State University and Agricultural & Mechanical College

Follow this and additional works at: https://digitalcommons.lsu.edu/gradschool_disstheses

Recommended Citation
https://digitalcommons.lsu.edu/gradschool_disstheses/7090

This Dissertation is brought to you for free and open access by the Graduate School at LSU Digital Commons. It has been accepted for inclusion in LSU Historical Dissertations and Theses by an authorized administrator of LSU Digital Commons. For more information, please contact gradetd@lsu.edu.
INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

Bell & Howell Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600

UMI®
INPUT MANIPULATIONS, WORKING MEMORY, AND WORD LEARNING ABILITIES OF CHILDREN

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Communication Sciences and Disorders

by

Janice Elisabeth Horohov
B.S., The Pennsylvania State University, 1978
M.S., University of Tennessee, 1985
December 1999
ACKNOWLEDGMENTS

First and foremost, I must thank my husband, Dr. David W. Horohov, for his patience, understanding and support over the years it took me to accomplish my goal of obtaining my doctorate. Next, I wish to thank my children, Nikolai and Jessica, for their understanding when my studying and writing took time away from my role as their mother. They were as understanding and supportive as any children could be.

I would like to thank my major professor, Dr. Janna B. Oetting, for her guidance, encouragement and support in the many aspects of my research, and her invaluable assistance in obtaining my NIH Fellowship. I extend my thanks to the members of my committee, Dr. Janet McDonald, Dr. Janet Norris, Dr. Paul Hoffman, Dr. Prakash Dixit, and Dr. Richard Magill for their time and input regarding both my prospectus and dissertation. Special thanks to Dr. Janet McDonald for her assistance with my data analysis and her multiple readings of my Results section. Thanks also to Dr. Paul Hoffman for his aid in the correlational analysis and regression procedures used in this research.

In addition, I extend my thanks to Dr. Kelly Higgins and Ms. Lesley Eyles for agreeing to take the time and effort to perform the reliability on my data. Sincere appreciation to my dear friend, Rosemary J. Klei for her assistance with the typing and proofing of this document and related forms, and the last minute changes that were needed. Thanks to my daughter, Jessica, for assisting with the videotaping of the storybooks, and the proofreading of data sheets. Many thanks to the graduate research assistants who have worked and currently work for Dr. Janna Oetting. They performed
standardized testing on many of the participants in this study, and often provided me with transportation to and from the schools.

Finally, I would like to thank the National Institute of Health Division for Deafness and Communication Disorders for awarding me a three year fellowship, and the Department of Communication Sciences and Disorders at LSU for awarding me the graduate assistantship, which allowed me to pursue this degree.
# TABLE OF CONTENTS

Acknowledgments ............................................................................................................ ii

List of Tables .................................................................................................................. vi.

List of Figures ................................................................................................................ vii.

Abstract ......................................................................................................................... viii

Literature Review............................................................................................................ 1.
  Word Learning in Children with Specific Language Impairment ................................. 2
    Language Sample Analysis Studies ............................................................................... 2
    Experimental Studies of Word Learning ......................................................................... 4.
  Potential Explanations for the Word Learning Deficits of Children with SLI ............... 7
    Short-Term Phonological Working Memory Deficit Hypothesis .................................. 8
      Testing the Phonological Working Memory Hypothesis ........................................... 11
      Criticisms of the Hypothesis .................................................................................. 17
  General Capacity Limitations ....................................................................................... 19
    The Limited Capacity Hypothesis ............................................................................... 20
    Limited Processing Capacity Research ................................................................. 20.

Research Plan ................................................................................................................. 26
  Identifying a Naturalistic Word Learning Context .................................................... 26
  Investigating Two Working Memory Hypotheses ....................................................... 28
    Manipulation of Sentence Complexity ....................................................................... 28
    Manipulation of Presentation Rate ............................................................................ 29
    Manipulation of Word Type ..................................................................................... 30
  Testing the Relation Between Working Memory Capacity and Word Learning ............ 30

End Note ......................................................................................................................... 31

Methods ......................................................................................................................... 32
  Participants .................................................................................................................. 32
  Procedures .................................................................................................................. 39
  Materials ..................................................................................................................... 39
    Preparation of Storybook ......................................................................................... 39
    Preparation of Multiple Choice Test ........................................................................... 43
    Nonsense Word Stimuli ........................................................................................... 43
  Task Administration ..................................................................................................... 44
  Data Collection and Scoring ....................................................................................... 46
  Reliability .................................................................................................................... 47

End Notes ......................................................................................................................... 47

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
LIST OF TABLES

2.1 Participant Profile: SLI .................................................................35
2.2 Participant Profile: CA ...............................................................36
2.3 Participant Profile: LM .................................................................37
2.4 Participant Profile: Race and Gender Matching ..........................38
2.5 Original Storybook Nouns and Verbs .........................................40
2.6 Average Speech Presentation Rates in Syllables/second ...............42
2.7 Nonword Repetition Task Stimuli ...............................................44
3.1 Effect Size Values for Modality Differences ...............................50
3.2 Summary of Comprehension Scores ..........................................53
3.3 Summary of Production Scores ....................................................54
3.4 Percentage of Error Types by group ............................................58
3.5 Item Analysis of Nouns ...............................................................59
3.6 Item Analysis of Verbs ...............................................................60
3.7 Nonword Repetition Scores: Means and Standard Deviations ....61
3.8 Nonword Repetition Task: Real Word Productions ....................64
3.9 Group Pearson Correlation Coefficients ......................................65
3.10 Multiple Regression Analysis .....................................................67
3.11 Partial Correlations after Accounting for PPVT .........................67
# LIST OF FIGURES

3.1 Group by Race by Mode Interaction ................................................................. 52

3.2 Group by Rate Interaction .................................................................................. 55

3.3 Nonword Repetition Task .................................................................................. 63
ABSTRACT

A storybook task was used to examine the word learning abilities of children with and without specific language impairment (SLI). Speech rate, sentence complexity and word type were manipulated within the narrative. A nonword repetition task also was used to examine the relation between working memory and word learning. Fifty-four children participated; a third were classified as SLI and the others served as either age-matched or language-matched controls.

For comprehension, a significant main effect for word type was observed with verb scores higher than noun scores. Main effects for group, race, and rate also were observed and these were qualified by two significant two-way interactions (group by race and group by rate). Follow-up analyses revealed that group differences were observed for the European-American children only. Also, presentation rate affected the word learning abilities of the children with SLI but not those of the controls. Results obtained for the production probe were similar to those found for comprehension; however, regardless of race, children with SLI performed more poorly than the age-matched controls, and presentation rate was not found to influence word learning.

Group differences were present on nonword repetition, as were syllable length effects. Correlational analysis revealed that children’s performance on several standardized language tests and the nonword repetition task were correlated to both word learning tasks. Further analysis found that children’s receptive word knowledge as assessed by raw scores from the Peabody Picture Vocabulary Test (PPVT) had a role in their nonword repetition performance. In addition, regression analysis indicated that the

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
children's performance on the nonword repetition task did not contribute significantly to their word learning scores once variance related to the PPVT was removed.
LITERATURE REVIEW

Prior to learning how to read, a child acquires new vocabulary from the oral language to which he or she is exposed. This acquisition occurs relatively quickly and seemingly effortlessly in normal children. In contrast, children with language impairments exhibit difficulty learning words, often lagging behind their normally developing peers. Although several theories have been proposed to explain children's word learning deficits, two in particular have received considerable attention in recent years (Baddeley, 1986; Gathercole & Baddeley, 1990a,b, Just & Carpenter, 1992). Both of these propose a limited working memory system as the underlying cause of children's lexical difficulty. One hypothesis proposes a specific deficit in the processing of the phonological content of language (Baddeley, 1986; Gathercole & Baddeley, 1990a,b). The other characterizes the deficit as more general in nature (Just & Carpenter, 1992). The purpose of the current work was to learn more about the nature of the vocabulary deficit in children with specific language impairment (SLI) and to further explore hypotheses related to a general or specific limitation in these children's working memory systems.

In the first section of this chapter, studies of the word learning abilities of children with specific language impairment are presented. The next section reviews two hypotheses which suggest that limitations in working memory account for the word learning deficits of children with language impairments. This section of the literature review is fairly long and detailed given that both hypotheses are based on theoretical models of working memory. In order to fully evaluate the validity of the two working
memory hypotheses proposed for children with SLI, the theoretical framework of each hypothesis must be discussed. In addition, evidence for and against each model must be evaluated. The literature review ends with a discussion of the rationale for the current project. Included in this section is a discussion of the specific research questions that guided the work.

**Word Learning in Children With Specific Language Impairment**

By definition, children diagnosed as SLI demonstrate low oral language skills in the absence of clinically documented deficits in cognition. Also, these children are thought to have intact motor, sensory, and social ability (for a detailed discussion of SLI see Leonard, 1998; Watkins & Rice, 1994). One common characteristic of children with SLI is poor vocabulary skills. Often these children are reported to begin producing their first words later than normal, and their acquisition of additional words is thought to occur at a slower rate (Leonard, 1988). Documentation of these children's lexical limitations can be found in studies involving language sample analysis and those involving experimental manipulations. Results from these two types of studies are reviewed below.

**Language Sample Analysis Studies**

One of the first studies to examine the lexicons of children with SLI was completed by Leonard, Camarata, Rowan, and Chapman (1982a). In this study, the focus was on the nature of very young children's first fifty words. In this study, the children with SLI were between 2;8 and 3;4 years of age and the normally developing children were between 1;5 and 2;0 years of age. Language samples were collected.
through a play session involving an examiner and each child. For both groups, general nominals made up about half of their total lexicons. In addition, about 24% of the SLI and normal lexicons involved action words and words referring to properties of things. Personal-social, functional, and specific nominals made up the remaining 10% of the children's total lexical inventory. The authors concluded that the results supported the view that word acquisition abilities of children with SLI are delayed, but that patterns of lexical acquisition parallel those of normally developing children.

More recently, Watkins, Kelly, Harbers, and Hollis (1995) examined the lexicon of older preschool children with SLI. Data were obtained from language samples collected during a play session between individual children and an examiner. The participants were 25 children with SLI, and two groups of normally developing children, 25 who were language-matched and 25 who were age-matched. Two dependent measures, type-token ratio (the ratio of the number of different words to total words) (TTR) and the number of different words (NDW) produced in a language sample were examined. Results indicated that TTR did not differentiate the children with SLI from either the age or language-matched controls. However, the children with SLI were found to produce significantly fewer different words than the age-matched children.

Differences in the frequency of word usage between children with SLI and normally developing language-matched peers also have been reported by Conti-Ramsden and Jones (1997). Their subjects included three children with SLI who were 3;9, 5;3, and 5;8 years of age at the beginning of their study. They analyzed language samples collected from videotaped mother-child interactions, obtained approximately every six
weeks over a two-year period. These samples were compared to a corpus of language samples from normally developing children who were between the ages of 1;6 and 5;0. Conti-Ramsden and Jones stated that their results agreed with those of Watkins, et al. (1995). Specifically, differences in the frequency and types of words produced by the children were not reflected in the traditional TTR calculation. However, the children with SLI used fewer verbs and more nouns than the control children. In addition, use of verbs which are considered “general all purpose” verbs (e.g., put, make) were used frequently by the children with SLI.

The tendency for children with SLI to produce “general all purpose” (GAP) verbs over other word types also was documented by Rice and Bode (1993). Rice and Bode examined spontaneous language samples that were collected over a 3-month period. At the beginning of the study, the three children with SLI were 53, 44, and 44 months old. The samples from each child were collected once a week over the three month period. The authors of this study reported that the children frequently used a small number of GAP verbs in their utterances. Rice and Bode speculated that since GAP verbs refer to semantically and syntactically nonspecific actions, children with SLI may produce these words to compensate for a less diverse lexicon.

**Experimental Studies of Word Learning**

The lexical learning difficulties of children with SLI also have been documented in experimental studies of word learning. For example, Dollaghan (1987) investigated the nature and quality of information children with and without SLI store in memory after limited exposure to a novel word. In this study, children manipulated one object
while the examiner named it. Word learning was measured through comprehension and production tasks. Results indicated that the two groups of children performed equally well on the comprehension task. However, the children with SLI exhibited more difficulty producing the novel word as compared to the controls.

Similar results were found in a word learning study involving joint focus on novel objects during structured play sessions between preschoolers and adults (Kiernan & Gray, 1998). Participants were 30 preschool children with SLI and 30 age-matched peers. Individual play sessions involved several training procedures where an adult matched unfamiliar one-syllable words with manipulable toys. Training on the target items occurred when the child was attending to the object. As with the Dollaghan study, performance on the comprehension task did not differentiate the groups. However, the authors found that the children with SLI produced fewer object labels to criterion (75% correct on two consecutive days), than their age-matched peers. This occurred even though they had correctly identified them during the comprehension probe. Interestingly, although all of the control children and 73% of the children with SLI reached criterion on 2 to 3 target words, 23% of the children with SLI only reached criterion on one word. Moreover, one child with SLI failed to reached criterion on any of the target words.

Finally, in four separate studies, Rice and her colleagues examined children’s word learning by having them observe an animated video with novel words embedded in the narrative (Oetting, Rice, & Swank, 1995; Rice, Buhr, & Nemeth, 1990; Rice, Buhr, & Oetting, 1992; Rice, Oetting, Marquis, Bode, & Pae, 1994). After viewing, learning
was measured by having children point to pictures using a 4-choice picture format. In all of these studies, the total number of words comprehended by the children with SLI was less than that of the age-matched children. Each of these studies is briefly discussed below.

In the first study by Rice, Buhr, and Nemeth (1990), four word types (object, action, attribute and affective state) were used as targets. Results indicated that object and attribute words were easier for all children to acquire than the other word types. In addition, children with SLI exhibited greater difficulty acquiring new words (total = 6.4 out of 20) than either the age- (total = 10.7) or language-matched (total = 7.7) controls.

In a second study by Rice, Buhr, and Oetting (1992), a short pause was inserted prior to each target to highlight the words for the children. Novel object and attribute words were used as targets and these were placed in the sentence-final position. As before, children with SLI as well as age- and language-matched children were used as participants. No learning differences were found to be associated with insertion of a pause. However, group differences were found, with the age-matched children learning more novel words overall (total = 6.6) than either the SLI (total = 4.0) or language-matched (total = 5.8) group.

In a third study, Rice, Oetting, Marquis, Bode and Pae (1994) investigated the role of presentation frequency on novel word learning by preschool children with and without SLI. Again, age-matched and language-matched children were used as controls and a video viewing format was employed. Overall, increased frequency of input improved the children’s word learning ability, particularly when the novel words were
repeated 10 times in the story. As found in their earlier studies, from pretest to post-test, the age-matched group learned the most words (gain = 3.5 out of 8), while the SLI and language-matched controls exhibited a less robust gain (gains = 1.7 and .7 respectively). In addition, the children with SLI retained fewer verbs than the CA controls when vocabulary was tested one to three days later (difference score = -.8 and .1 respectively).

Finally, Oetting, Rice and Swank (1995) examined the word learning abilities of school-aged children who were between the ages of six and eight years. The normally developing group made significant gains learning object, attribute, action, and affective state words. Significantly fewer words were learned overall by the group with SLI as compared to the age-matched group. In addition, these children demonstrated greater difficulty acquiring the verbs (gain = -.11) than the age-matched controls (gain = 1.00). In the discussion, the authors highlighted the fact that the gain scores of these children with SLI were only slightly better than those obtained previously by three-year-olds (gain of SLI = 2.28, gain of 3-year-olds = 1.56, gain of age-matched controls = 4.67).

In summary, in all cases reviewed above, children with SLI exhibited a less robust vocabulary system than their normally developing peers. In a few of the studies, the lexical abilities of the children with SLI were found to be even lower than those of younger, language-matched controls (Rice, et al., 1990; Rice, et al., 1992).

Potential Explanations for the Word Learning Difficulties of Children with SLI

Why are children with SLI less efficient at word learning than their normally developing peers? To explain these children’s word learning problems, researchers have
looked for other deficits in these children that might be related to word learning. One variable that has received perhaps the greatest research attention is working memory. There are two reasons for this. First, in normally developing children, increases in working memory ability have been found to correlate with increases in vocabulary knowledge (Avons, Wragg, Cupples, & Lovegrove, 1998; Baddeley, Gathercole, & Papagno, 1998; Gathercole & Baddeley, 1990b, 1993). Second, children with SLI have been found to have less efficient working memory systems when compared to normally developing, age-matched peers (Ellis Weismer, 1985; Kamhi & Catts, 1986; Montgomery, 1995a; Stark & Tallal, 1988).

As mentioned earlier, two hypotheses concerning the nature of the underlying vocabulary deficits of children with SLI can be found in the literature. Although both focus on working memory as the factor underlying the lexical limitations of children with SLI, they differ in their characterization of the working memory deficit. In the next section of this chapter, each of these hypotheses and the theoretical models from which they are based, are reviewed in detail.

**Short-Term Phonological Working Memory Deficit Hypothesis**

Gathercole and Baddeley (1990a,b) argue that deficits specific to short-term phonological working memory adversely impact children's long-term learning of words. Their hypothesis is based on a model of working memory that was initially proposed by Baddeley and Hitch (1974) and further refined by Baddeley (1986). Two components, the central executive system and the subordinate phonological or articulatory loop system, of their working memory model are thought to be critical for vocabulary
learning. Because their hypothesis about SLI is based on their working memory model, a brief overview of their central executive system and their phonological or articulatory loop system is presented below.

The central executive system is responsible for regulation of information flow within working memory and transmission of information between parts of the cognitive system. This includes retrieval of information from other locations (e.g., long term memory), as well as information processing and storage. According to the model, the central executive permits higher level cognitive functions to be undertaken such as mental arithmetic, list recall, logical reasoning, random letter generation, semantic verification, and the retrieval of event information from long-term memory (Gathercole & Baddeley, 1993).

One assumption of the model is that processing resources of the central executive system are believed to have a finite capacity. Thus, the efficiency of working memory is tied directly to the demands placed upon this component of the system. Unfortunately, little research has been conducted related to the central executive as it has been defined by Baddeley. However, some empirical work has suggested that it plays a role in the planning of activities, and that, as tasks become more automatic, demand on the executive system decreases (Gathercole & Baddeley, 1993; Shallice & Burgess, 1991).

The phonological loop is composed of a phonological store (i.e., phonological working memory system) and an articulatory control process (i.e., subvocal rehearsal). The function of the phonological store is to maintain verbal input in a phonological code...
for one to two seconds. Subvocal or articulatory rehearsal is thought to allow a system to maintain or restore information that is being stored in the phonological store.

Evidence for the presence and function of the phonological loop has come from numerous sources. These include studies of articulatory suppression, word length, phonological similarity, and irrelevant speech effects (Conrad & Hull, 1964; Hitch, Halliday, & Litter, 1989; Hulme & Tordoff, 1989). Of these, word length and phonological similarity effects have been demonstrated in research related to this study.

The length effect is the finding that longer words are more difficult to recall than shorter words. The length effect is thought to occur because phonological representations become increasingly more difficult to remember and recall as they increase in syllable length. The similarity effect is the finding that words that are phonologically dissimilar are easier to remember than similar ones. This effect is thought to occur because the phonological representation of the item in memory is subject to partial loss from decay or interference from other phonological items. Word length and word similarity effects have been found in children as young as four years of age (Hulme & Tordoff, 1989).

Although the central executive system remains constant throughout one’s life, an individual’s auditory memory span does increase with age. According to Baddeley, this increase occurs because a child’s ability to rehearse and retrieve information improves with age. Indeed, empirical evidence has shown that older children and adults rehearse more quickly than younger children, and they are better able to maintain items in memory (Ellis & Henelly, 1980; Naveh-Benjamin & Ayres, 1986). It is important to
note, however, that the relation between overt articulation rate and memory span has not been proven (Gathercole & Baddeley, 1990a; Montgomery, 1995a). In fact, in an investigation of memory span maturation, Henry and Millar (1991) found that overt articulation rate had only a minor role in overall span length relative to age.

Testing the Phonological Working Memory Hypothesis

To investigate the proposed role of phonological short-term working memory in vocabulary acquisition, Gathercole and Baddeley (1989) undertook a longitudinal study of 104 children when they were four and five years of age. At initial testing and one year later, nonverbal intelligence, receptive vocabulary and single word reading skills were assessed. Short-term working memory was evaluated via a nonword repetition task where items varied in syllable number and complexity. Analysis of the data revealed a moderate correlation ($r = .57$) between phonological memory store and vocabulary. In addition, memory store was found to account for a significant amount (8%) of the variance after all other factors (e.g., vocabulary ability at age four) were remove through stepwise regression.

The next study they completed involved children with SLI (Gathercole & Baddeley, 1990a). The goal of this study was to examine whether (a) children with SLI would demonstrate reduced list recall, and (b) factors other than phonological short term working memory could be ruled out as an explanation for these children’s limitations in list recall. Participants were six children with SLI; six age-matched and six-language-matched normally developing children served as controls. List recall involved asking children to repeat lists of nonwords that varied in syllable length.
Children in the SLI group exhibited significant deficits in their nonword repetition skills when compared to the two control groups. Additionally, children with SLI exhibited greater difficulty with the repetition of three and four syllable stimuli than the controls. Since no significant production differences were found between the groups when repeating stimuli that contained consonant clusters, the authors ruled out difficulty with articulation as a performance factor. The children with SLI also were not found to be affected by list length or phonological similarity in ways that were different from the controls. From these findings, Gathercole and Baddeley eliminated problems with phonological encoding or sub-vocal rehearsal as causal factors. They also ruled out deficits in auditory perception and phonological representation because the groups did not differ on an auditory discrimination task.

Finally, Gathercole and Baddeley measured both articulation rate and articulation latency of all of the children. Stimuli were one and three syllable familiar words. Results indicated that children with SLI had slower articulation rates than the age-matched controls, but they were not significantly different from the language-matched controls. Also, group effects were not found with articulation latency. The authors concluded that although the rate of speech production might be linked to language ability, it is not the cause of phonological memory deficits in children with SLI. Instead, Gathercole and Baddeley argued that all of these findings, taken together, indicate that the vocabulary deficits of children with SLI are due to inadequate short-term memory of phonological content.
Other researchers have investigated the validity of the phonological short-term memory deficit hypothesis. For example, Montgomery (1995a) examined the articulation rate, perceptual processing, and phonological encoding skills of children with SLI, and compared them to those of normally developing language-matched children. As with the Gathercole and Baddeley report (1990a), Montgomery found strong word length and phonological similarity effects across both groups, and the groups had similar articulation rates. In addition, the children with SLI exhibited more difficulty with repetition of multisyllable stimuli than did the control group. Montgomery interpreted the results as supporting Gathercole and Baddeley’s hypothesis that children with SLI have a decreased phonological storage capacity.

Furthermore, Kamhi, Catts, Mauer, Apel, and Gentry (1988) employed a nonsense word repetition task in children with SLI. Again, children with SLI exhibited significantly more difficulty repeating multisyllabic words than controls. While they did not seek to investigate working memory per se, the results could nonetheless be taken as support for Gathercole and Baddeley’s hypothesis.

Up to this point, the assessment of vocabulary ability has been based primarily upon standardized test scores. The use of such structured tools provides limited information with regard to how children learn new words. The next set of research reviewed has used children’s comprehension of sentences as the dependent measure of interest. This set of studies is particularly useful for thinking about the relation between working memory ability and vocabulary acquisition because sentence comprehension is a necessary component of word learning.
In a study by Curtiss and Tallal (1991), several nonlinguistic factors such as memory were investigated longitudinally to determine their role in vocabulary deficits. The participants included three groups of children: SLI, normal age-matched, and normal language-matched controls. Receptive and expressive language skills were evaluated using a sentence-picture matching task and a sentence-completion task. The authors were interested in nonlinguistic sequencing abilities of language impaired children. Previously, Lowe and Campbell (1965) had shown that children with language impairments required longer time intervals between sequential auditory stimuli to make correct ordering judgements. Curtiss and Tallal questioned whether a linguistic sequencing deficit might exist in these children. Because of the crucial role sequencing plays in providing linguistic cues for meaning, two sets of sentences, those requiring word order (+seq) for correct semantic understanding and those which did not (-seq), were presented to all children. Example of the two types of stimuli sentences are below.

1. The girl is pushing the boy. (+ seq)
   The boy is pushing the girl. (+seq)
2. The ball is big. (- seq)
   The ball is little. (-seq)

Curtiss and Tallal found significant group differences between age-matched controls and children with SLI. A group by sentence type effect was found, where children with SLI, but not the controls, performed significantly poorer on sentences requiring word order than those which did not. Also for the children with SLI, the authors reported a significant correlation between performance on the linguistic task and
the nonlinguistic sequencing task. A significant correlation was not observed for the controls.

In a second experiment, Curtiss and Tallal manipulated the syntactic redundancy, or complexity, of the sentences. Increased syntactic redundancy is believed to assist adults in linguistic processing (Curtiss & Tallal, 1991). However, increased syntactic redundancy also increases sentence length, which in turn is thought to increase processing load. The authors constructed sentences which contained either double marking of number within noun phrases or an overt marking of a subject with a relative clause. The meaning of the paired sentences were similar. Examples of the redundant (R) and nonredundant (N) stimuli are below:

1. Point to the picture of three hats. (R)
   Point to the picture of the hats. (N)

2. The girl who is pushing the boy is smiling. (R)
   The girl pushing the boy is smiling. (N)

Children with SLI and age-matched controls were asked to complete a sentence comprehension task involving picture pointing. Again, results indicated a significant group effect, with normally developing children performing better than the SLI group on all sentences. An age effect also was observed which indicated that both groups improved over time. A sentence type by group interaction indicated that children with SLI performed consistently better on the nonredundant sentences. Normally developing children performed like adults; they preferred redundant sentences.

When the SLI group was compared to language-matched controls, both groups performed better on the nonredundant sentences. However, further analysis revealed
that by the last two years of the five years reported, the language-matched controls were
beginning to prefer redundant sentences while the SLI group exhibited no such change.
In other words, the language-matched children were exhibiting normal developmental
changes while the children with SLI were not.

Expanding the Curtiss and Tallal (1991) study, Montgomery (1995b)
investigated the role of phonological short-term memory on complex language. This
investigation involved the use of a nonsense word recall task and a sentence
comprehension task which included redundant and nonredundant sentences. The
children with SLI had significantly more difficulty repeating three and four syllables
items than the language-matched controls. The group difference remained even after
vocabulary differences between the groups were factored out. In addition, children with
SLI comprehended significantly fewer redundant sentences than nonredundant ones, and
group differences occurred only on the redundant stimuli. As in the Gathercole and
Baddeley study, Montgomery found a positive correlation ($r = .62$) between children's
performance on the recall task and their performance on the sentence comprehension
task. He concluded that the poorer performance by the children with SLI was not due
to difficulty with sentence-level processing of semantic or syntactic knowledge, but
rather to the increased demand made on phonological working memory. Again, in
support of Gathercole and Baddeley's hypothesis, Montgomery concluded that children
with SLI possess a limited phonological working memory capacity, and that this
limitation adversely impacts on their ability to comprehend sentences.
Criticisms of the Hypothesis

While the studies reviewed above claim to provide support for Gathercole and Baddeley's proposal, their hypothesis has not been accepted without dissent. Some criticize the particular methodology used by Gathercole and Baddeley, as well as their interpretations of the data (Howard & van der Lely, 1995; Snowling, Chat, & Hulme, 1991; van der Lely & Howard, 1993). Another line of criticism involves the exclusive nature of the phonological deficit underlying the word acquisition difficulties of these children (Ellis Weismer & Hesketh, 1996, 1998; Oetting, et al., 1995; Rice, et al., 1994). Details regarding these criticisms are reviewed below.

Although repetition of nonwords rather than real words has been claimed to be a more reliable indicator of phonological memory capacity because listeners must employ multiple phonological processes independent of word knowledge (Gathercole & Baddeley, 1990b; Henry & Miller, 1991; Montgomery, 1995a), Snowing, Chat, and Hulme, (1991) disagreed with Gathercole and Baddeley's interpretation of their nonword repetition data. According to these researchers, recall of digits should be used for evaluating phonological working memory. They argued that when unfamiliar labels are recalled, increased demand is placed on phonological segmentation and articulation. In addition, children may perform poorly because of perceptual difficulties with the nonsense stimuli. Furthermore, children with a good understanding of language, including morphology, phonology and prosody, may be better able to use this knowledge to aid in the repetition of nonwords than children with SLI. Thus, children with SLI could experience difficulty with nonword repetition tasks for reasons other
than those specifically related to phonological representation of the items. Indeed, normal children performing nonword repetition tasks have demonstrated that they are better at repeating items that are more wordlike compared to those that are not wordlike. In addition, production errors tend to create real words, suggesting that word knowledge continues to influence tasks involving nonwords (Dollaghan, Bilber & Campbell, 1995). In fact, Gathercole, Willis, Emslle, and Baddeley (1991) themselves found that children were better at repeating wordlike stimuli as compared to stimuli that does not include real word syllables.

Methodological concerns also were raised by van der Lely and Howard (1993). Specifically, they felt that the only appropriate control group in studies of SLI were those involving language-matched children, since language ability would directly affect performance on the tasks. Using a pointing task rather than a recall task, they had children with SLI and their language-matched controls recall lists of words which differed either in semantic, lexical (word or nonword), or phonological similarity. The authors found that the recall performance of the groups did not differ significantly on any of these linguistic factors. Therefore, the children with SLI were shown to resemble younger, normally developing children. This finding led van der Lely and Howard to conclude that the vocabulary deficits of children with SLI were related to delayed linguistic development, not a specific phonological deficit. A debate between van der Lely and Howard, and Gathercole and Baddeley continued in subsequent “Letters to the Editor” with no obvious resolution (see Gathercole & Baddeley, 1995; Howard & van der Lely, 1995).
Finally, Rice, et al. (1994) examined post hoc the validity of Gathercole and Baddeley’s claim regarding word learning deficits in children with SLI. They reasoned that, under the hypothesis, word class effects should not occur unless differences in sound sequences exist between the classes. Specifically, children with SLI should not exhibit any increased vulnerability in the learning of one word class over another relative to control children. However, in at least two studies discussed earlier, verb learning was found to be more difficult for children with SLI than for their peers (Oetting, et al., 1995; Rice, et al., 1990). Rice et al. postulated that phonological working memory may be one of the factors involved in word learning deficits, but it cannot explain these children’s particular vulnerability with verbs.

The above studies question the application of the deficient phonological working memory approach supported by Baddeley and his colleagues for various reasons. Also, it’s important to note that much of the data presented by Baddeley and his colleagues has been correlational. One must exhibit caution interpreting the data used to support the relation between phonological working memory and vocabulary acquisition, because a correlation does not necessarily indicate cause and effect.

General Capacity Limitations

As an alternative to the Gathercole and Baddeley hypothesis, a more general approach to explain the memory and vocabulary learning deficits in children with SLI has been suggested. Below, the limited capacity hypothesis is presented along with supportive research data.
The Limited Capacity Hypothesis

The limited capacity hypothesis is based on work by Just and Carpenter (1992). Rather than focusing on the phonological storage capacity of Gathercole and Baddeley's model, Just and Carpenter's model focuses on a more global collection of resources supporting language comprehension. Their model predicts that when demands placed on one's system exceed available cognitive capacity, performance breaks down. They proposed that within the working memory system, the functions of storage and processing are performed through a shared but limited resource referred to as activation, and under taxing situations, tradeoffs are necessary. For example, in a sentence comprehension task, if insufficient activation is available, previously utilized activation will be reallocated to finish the processing of the sentence. As a result, the beginning of the sentence which had been maintained using that activation would be lost from memory. According to Just and Carpenter, individual performance differences may be explained by variations in processing efficiency or in total amount of resources available to the system.

Although Just and Carpenter's work has focused on reading comprehension in normal adults, others have applied their model to the language learning problems of children with SLI. This application implies that children with SLI are more restricted in the availability of cognitive resources as compared to their normally developing peers.

Limited Processing Capacity Research

The relevant data come in different forms and together suggest a more general deficit in children with SLI. For example, research has indicated that in addition to
recall difficulties, children with SLI are slower to recognize words and pictures that correspond to sentences, and they are slower to name picture stimuli (Kamhi & Catts, 1986; Lahey & Edwards, 1996; Montgomery, Scudder, & Moore, 1990; Stark & Tallal, 1988). In addition, at least one study has reported that children with SLI have nonlinguistic deficits. Roth and Clark (1987) found early symbolic play deficits in children with SLI relative to age-matched peers, although their behaviors were advanced compared to language-matched controls.

In addition, the data from studies discussed below suggest a general processing deficit rather than a specific deficit involving phonological content. For example, sequential memory of school-aged children with and without SLI was examined by Gillam, Cowan, and Day (1995). They employed the “list-final stimulus suffix” procedure to evaluate the children’s working memory abilities. The study revealed a group difference in recall accuracy for lists of digits only when strict sequential ordering was required. Under this rigid scoring condition, the children with SLI were found to have a stronger suffix effect than the control children. A stronger suffix effect indicates that children with SLI were more vulnerable to extraneous information.

A recent study of serial recall in children with SLI manipulated the rate at which pictures of objects were shown. Fazio (1998) predicted that if memory deficits were specific to phonological processing as Gathercole and Baddeley have claimed, serial recall of familiar objects should be affected more than unfamiliar ones. According to Fazio, pictures of familiar object should be quickly transformed into phonological code, but pictures of unfamiliar faces and patterns would not. No differences were found
between the two types of stimuli. However, the author found that the children with SLI performed more poorly than age-matched controls when pictures were presented at the fast rate. Fazio (1998) concluded that these results support a general processing deficit in the working memories of children with SLI.

Unlike the above studies which investigated serial processing deficits, another set of studies have looked at general capacity limitations by examining the influence of input factors on word learning. For example, Ellis Weismer and Hesketh (1993, 1996) conducted two studies which manipulated different input variables. As found in other studies, the children with SLI learned fewer words overall than the age-matched controls. In their first study, Ellis Weismer and Hesketh (1993) taught kindergarten children with and without SLI nine novel words. Presentation rate, emphatic stress, and visual cues were manipulated during the teaching phases of the study. For all three input conditions, a toy identified as a creature from outer space was used to train the children on novel words for objects or locations. A trial sequence of word training, followed by a production probe and then a comprehension probe was repeated five times for each child. Results indicated that the children with SLI learned fewer words overall than the controls. In general, speech rate alterations and use of visual cues affected the performance of all participants. The use of visual cues improved comprehension scores for all children, but did not affect production. There also was an improvement in word learning for children with SLI from the fast to slow rates of input. Stress patterns did not influence learning.
In a second study using the same methodology, Ellis Weismer and Hesketh (1996) again found that word learning by children with SLI and normal language controls was affected by altering the speech rate of the incoming linguistic signal. Three different speech training rates were used: fast, normal and slow. Results showed that the SLI group performed like the vocabulary-matched children, except in the fast training rate condition, where the SLI group’s performance was worse. As found in their earlier study, the slower rate did not significantly improve performance over the normal rate, although individual children in the SLI group performed better. Furthermore, for both groups, the rate manipulation affected production more than comprehension.

Ellis Weismer and Hesketh concluded that their results supported a generalized capacity limitation theory rather than a specific deficit in phonological short-term memory for two reasons. First, other nonphonological manipulations affected performance. Second, as part of the test battery, children were provided with not only the target label, but also phonologically related and unrelated labels. Results indicated that the phonologically related and unrelated foils were easy for all participants to eliminate. Ellis Weismer and Hesketh argued that within an inefficient system, components of linguistic processing such as the phonological representation might be adversely affected, but this could not be the only locus of the children’s word learning deficits.

In a more recent study of word learning in children with SLI, Ellis Weismer and Hesketh (1998) sought to reduce stress on the children’s systems by highlighting the
four target words. This study involved 20 children with SLI and 20 normally developing children between seven and eight years of age. As in their other studies, a novel target word was consistently paired with an unfamiliar object. In this study, emphatic stress was placed on the target word to highlight it. The addition of stress did not significantly affect comprehension or recognition, but it did improve production scores for all children. Again, children with SLI learned fewer words overall than the control children. Syllable structure was not found to affect performance, as would have been expected if a specific phonological deficit was present. The authors concluded that the greater demand placed on children’s systems by the production task was augmented by the addition of stress, thereby decreasing overall load.

In summary of the literature reviewed above, one can make the following observations about the two working memory hypotheses. Regarding Baddeley’s phonological working memory account, this hypothesis has been supported by correlational data only. By design, these data are limited in their ability to address a cause and effect relationship between phonological working memory and word learning ability. Studies supporting the phonological deficit account also have been limited because they have involved only standardized tests of vocabulary development and experimental probes involving sentence comprehension. Word learning has not been examined directly. Also observed in the literature are criticisms against this account. Criticisms related to methodological issues have focused on the tools used to test working memory ability and the lack of language-matched controls within studies. The phonological account has been criticized as too narrow in scope.
The second hypothesis, that of a general working memory deficit among children with SLI, is supported by findings from a number of studies in which a range of nonverbal cognitive skills have been shown to be limited in these children. In addition, findings from at least two experimental studies indicate that manipulations of presentation rate affect the word learning skills of children with SLI to a greater degree than those of normal controls. To the extent that children’s general working memory resources are exceeded by a fast presentation rate, the findings of these two studies implicate a relation between general working memory ability and word learning skill. It is important to note, however, that even in these two experimental studies, the word learning task administered to the children has been rather contrived. In both experiments, adults presented novel labels for unusual objects or their locations to the children. In both studies, only three nonce words were trained under each presentation condition. Moreover, simple carrier phrases were used to pair each target word to its referent.

Finally, it is interesting to note that criticisms against the general working memory account as it relates to children with SLI have yet to surface in the literature. Perhaps this is so because the account is relatively new. Indeed, the general working memory model from which this hypothesis is based was published only seven years ago. Another reason why researchers have been slow to criticize this account may be that the general nature of the proposal makes it difficult to determine, a priori, what type of factors will influence a child’s working memory system during tasks of word learning.
Research Plan

The purpose of the current work was two-fold. One aim was to further evaluate the lexical skills of children within the context of a naturalistic word learning context. The second aim was to collect data to further refine our understanding of the relation between children's working memory skills and their word learning abilities. The ways in which each of these goals were addressed are discussed below.

Identifying a Naturalistic Word Learning Context

As mentioned earlier, one of the difficulties in studying children's vocabulary development is identifying a methodology that captures word learning as it occurs in a controlled, yet naturalistic situation. The experimental studies presented earlier in the literature review employed two different word learning paradigms. Some involved fast mapping and modeling procedures. In these studies, only one to two novel words are generally included. Work by Rice and her colleagues was unique in that videotaped stories have been used to introduce a variety of novel words to children. A third format that can be found in the literature is storybook reading. Children's acquisition of words while listening to and reading storybooks has been demonstrated in several different studies (Jenkins, Stein, & Wysocki, 1984; Nagy, Anderson, & Herman, 1987; Nagy, Harman, & Anderson, 1985). These studies are reviewed below, because a story book reading format was used in the current work.

Eller, Papas, and Brown (1988) studied incidental learning in children listening to stories. The procedure involved repeated readings of the same story to non-reading kindergartners. Upon completion, each child was asked to "read" the story back to the
examiner. The authors found that children used both familiar and novel words from the modified story. In another study involving kindergarten children, Robbins and Ehri (1994) also demonstrated incidental word learning from storybooks. These children listened to a story twice and then completed a picture pointing comprehension task. Each of the eleven target words had appeared either once or twice in the experimental version. Gain scores were significantly better for experimental words present in the story than for control words. In addition, word learning was better for the words which had been heard four times than for those heard only twice. In two investigations conducted by Elley (1989), teachers read a storybook aloud three times to groups of seven year olds. The presence or absence of story relevant comments made by the teacher was one variable examined. Pre-testing to post-testing using a picture pointing test revealed positive gain scores on target word knowledge, especially when comments were provided.

Finally, a number of studies have investigated parents reading to their children (Arnold, Lonigan, Whitehurst, & Epstein, 1994; Snow & Goldfield, 1983, Senechal & Cornell, 1993). One investigation by Senechal and Cornell (1993) showed that after listening to a storybook only once, normally developing young children were able to comprehend, but not produce, novel words. Further investigations have revealed that repeated reading of the same book improved both comprehension and production skills. Repeated readings in conjunction with the asking of wh-labeling questions during each reading improved expressive more than receptive scores (Senechal, 1997). In another study, Senechal, Thomas, and Monker (1995) separated four-year-old children into low
and high vocabulary groups. The participants either listened passively, pointed to, or labeled target objects in the story. Results indicated that comprehension and production of novel words increased under the pointing and labeling conditions, especially for the high vocabulary group.

The use of a storybook reading format for the current work was appealing for several reasons. First, joint storybook reading has been described as a significant contributor to vocabulary learning in children (Durkin, 1974-1975; Wells, 1986). Second, storybooks have been employed in intervention settings with language impaired children with positive results (Norris & Hoffman, 1994). In addition, while children with SLI learn to read, they are considered by several investigators to be “at risk” for reading disabilities (Bishop & Adams, 1990; Catts, Hu, Larrivee, & Swank, 1994).

**Investigating Two Working Memory Hypotheses.**

The critical difference between the two working memory hypotheses reviewed above centers on the presence or absence of a specific phonological working memory deficit. One way to evaluate the validity of these two hypotheses, then, would be to design a word learning study that involves the manipulation of variables that do or do not involve the storage and retrieval of phonological content. Thus, in the current work, the following variables were chosen: sentence complexity, presentation rate, and word type. The rationale for choosing each of these variables is provided below.

**Manipulation of Sentence Complexity.**

Within the storybook task, the sentences containing the target novel words were designed to be either two separate sentences or one sentence with the second embedded
Manipulation of sentence complexity in the current study was adapted from the comprehension studies used by Montgomery (1995b). However, manipulation of sentence complexity differed from Montgomery in one important way. Specifically, in the Montgomery study, sentence length was not kept constant between the redundant and nonredundant sentences. To avoid this potential length by complexity confound in the current study, both types of sentences were written so that they had the same number of syllables. If sentence processing ability requires some degree of working memory capacity, children with SLI should perform more poorly on the complex sentences than the controls. In contrast, the normally developing children should perform equally well on both sentence types, since they should be able to handle both without difficulty. Therefore, there should be a group by sentence complexity interaction. This finding would provide support for a general working memory account of SLI.

**Manipulation of Presentation Rate.**

Manipulation of speech rate was accomplished by audio recording the target sentences as they were read at either a fast or slow rate. Alteration of the speech presentation rate was selected as a variable in the current study based upon the results obtained by Ellis Weismer and Hesketh (1993, 1996). Changes in the presentation rate was expected to affect word learning for the children with SLI more than the normally developing children. A group by rate interaction would support either working memory deficit account.
**Manipulation of Word Type.**

A third variable of word class was chosen for this study. Within individual target sentences, a nonce word was substituted for either a noun or a verb. This manipulation was chosen because, as mentioned earlier, Rice et al. (1994) postulated that if children with SLI demonstrate a specific phonological deficit, then their acquisition of words should not be influenced by word class (e.g., noun vs. verb). Alternatively, differences in children’s ability to learn words could be related to word type effects. In particular, some investigators claim that verbs are more difficult to acquire than nouns (Huttenlocher & Lu, 1979; Maratsos, 1990). In fact, Gentner (1978, 1982) speculated that nouns are easier to acquire than verbs because nouns are conceptually distinct, with the referents being conceptually more basic and more accessible than those of verbs. She described verbs and other predicates as expressing relational meaning and simple nouns as expressing referential meaning. In other words, whereas nouns refer to referents, verbs refer to relations between things. According to Gentner, the abstract nature of verbs and other predicates plays a role in their slower acquisition in early language development. So, if children with SLI are shown to be more vulnerable in their verb learning compared to noun learning, a specifically phonological working memory deficit would be in doubt. Therefore, a group by word interaction would support the general deficit account of SLI.

**Testing the Relation between Working Memory Capacity and Word Learning.**

A second way to evaluate the two hypotheses would be to examine the relation between children’s nonword repetition skills and their word learning abilities. Recall
that nonword repetition has been traditionally viewed as a phonological working memory task. One could also argue that nonword repetition requires general working memory skills. Thus, finding that nonword repetition does or does not correlate to word learning ability cannot be used to tease the two accounts apart. Nevertheless, examining the relation between nonword repetition and word learning is important for testing whether either one of the accounts is viable.

In summary, the goals of the current work were to examine word learning through a naturalistic word learning paradigm while also examining the validity of two working memory hypotheses. The following research questions guided the work:

1) Are there group differences between normal children and children with SLI's ability to learn words?
2) Does sentence complexity affect children's ability to learn words?
3) Does the speech rate of the incoming linguistic signal affect word learning?
4) Does word class affect children's ability to learn novel words?
5) Does performance on a nonword repetition task relate to children's word learning abilities?

End Note

1. The suffix effect occurs when a stimulus item is added to the end of a word list and it interferes with recall of the final words. This is thought to occur because the list final suffix item interferers with the normal ability to use acoustic and phonological information in working memory.
METHODS

In this chapter, the procedure to further investigate word learning deficits in children with SLI is presented. A causal-comparison design was chosen to address questions 1, 2, 3 and 4. The between subject factor was group (3 levels: SLI, CA, LM), while the within subject factors were rate (2 levels: fast, slow), complexity (2 levels: simple, complex), and word type (2 levels: noun, verb). A correlational design and regression analysis were used to examine question 5.

Participants

A total of fifty-four children participated in this study. Eighteen children participated in each of the three groups (18 children with SLI, 18 normally developing age-matched children, and 18 normally developing language-matched children). All children came from monolingual English-speaking homes, although nonmainstream dialect use was free to vary. Children in the first two groups were between the ages of five and seven (SLI mean age in months = 74.4, S.D. = 5.9; CA mean age in months = 71.7, S.D. = 4.6), and they all attended regular public kindergarten. For the SLI and age-matched children, chronological age (+/- 5 months) was used to match the groups. The language-matched children were between three and five years of age (mean age in months = 53.5, S.D. 6.2), and at least eighteen months younger than their SLI match. These children were matched to the SLI children using Peabody Picture Vocabulary Test (PPVT) raw scores. Although many previous studies of SLI have used mean length of utterance (MLU) scores obtained from language samples to match children on general language level, the validity of this procedure has been questioned in recent studies. For
example, in a study by Oetting, (in press), results indicated that about half of the children with SLI produced MLU's which overlapped with normal kindergarten age-matched controls. In addition, some of the language-matched children overlapped with the age-matched controls. This is not unexpected considering the wide range of variability in MLU for normally developing children between the ages of five and six. As reported by Leadholm and Miller (1993), normative expectations for a 3-year-old on MLU is 2.78 to 3.97. For a 4-year-old, the average is 3.20 to 5.3, for a 5-year-old the range is 4.81 to 6.62, and for a 6-year-old, the range is 4.52 to 6.46. As demonstrated by these ranges, MLU does increase with age; however, there is considerable overlap in scores between the ages of 3 and 6 years. Although less often used, raw PPVT or the equivalent British Picture Vocabulary Scale (BPVS) scores have been used by others and appear reliable (Gathercole & Baddeley, 1990; Ellis Weismer & Hesketh, 1996; Montgomery, 1995; van der Lely & Howard, 1993).

Criteria for the SLI group included: (a) diagnosis of language impairment by a certified speech-language pathologist; (b) normal nonverbal intelligence as evidenced by an age deviation score of 85 or above on the Columbia Mental Maturity Scale (Burgemeister, Blum, & Lorge, 1972); (c) normal hearing based on a hearing screening conducted within 6 months of the study; (d) normal oral motor structure and function as measured by Oral Speech Mechanism Screening Examination - Revised (St. Louis & Ruscello, 1987); (e) limited vocabulary and grammatical ability as evidenced by a score one standard deviation below the mean on both the Peabody Picture Vocabulary Test - Revised (Dunn & Dunn, 1981) and the syntactic quotient (combined scores of subtests...
III-V) of the Test of Language Development-Primary (Newcomer & Hammill, 1988). The Goldman-Fristoe Test of Articulation (Goldman & Fristoe, 1980) also was administered, although it was not used as a part of the selection criteria. Participant profiles are provided in Table 2.1.

Children were recruited for the normally developing group if their teachers felt they were functioning within the average range of their class. They also did not present a history of speech and language impairments. The normally developing groups (age-matched and language-matched) scored within or above one standard deviation of the mean on the CMMS and PPVT. Two children in each control group obtained standard scores on the syntactic quotient of the TOLD which were slightly more than one standard deviation below the mean. All other control children scored within the normal limits on this test for their age (see Tables 2.2 and 2.3).

For the normally developing age-matched (CA) and language-matched (LM) children, considerable effort was made to solicit children who were similar to the SLI group on socio-economic status, race, and gender. Children for the control groups were selected from the same schools (CA group), or preschools in the same area (LM group) as the participants with SLI. Of the children in preschool, half were drawn from Head Start programs and half from private preschools. For the SLI group there were 8 African-American (AA) and 10 European-American (EA) children, for the CA group there were 6 AA and 12 EA children, and for the LM group there were 9 children of each race. Gender ratios were as follows: SLI group, 9 males, 9 females; CA group, 10 males and 8 females; and for the LM group, 8 males and 10 females. Table 2.4 provides
Table 2.1  
Participant Profile: SLI

<table>
<thead>
<tr>
<th>ID</th>
<th>PPVT R</th>
<th>PPVT S</th>
<th>CMMS</th>
<th>TOLD III</th>
<th>TOLD IV</th>
<th>TOLD V</th>
<th>TOLD Q</th>
<th>GFTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>41</td>
<td>76</td>
<td>86</td>
<td>7</td>
<td>6</td>
<td>4</td>
<td>72</td>
<td>32</td>
</tr>
<tr>
<td>2</td>
<td>44</td>
<td>76</td>
<td>96</td>
<td>9</td>
<td>7</td>
<td>4</td>
<td>79</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>41</td>
<td>76</td>
<td>86</td>
<td>3</td>
<td>3</td>
<td>4</td>
<td>57</td>
<td>13</td>
</tr>
<tr>
<td>5</td>
<td>42</td>
<td>81</td>
<td>90</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>70</td>
<td>34</td>
</tr>
<tr>
<td>7</td>
<td>36</td>
<td>64</td>
<td>97</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>59</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>49</td>
<td>78</td>
<td>89</td>
<td>3</td>
<td>6</td>
<td>4</td>
<td>64</td>
<td>7</td>
</tr>
<tr>
<td>9</td>
<td>45</td>
<td>74</td>
<td>94</td>
<td>7</td>
<td>6</td>
<td>8</td>
<td>81</td>
<td>27</td>
</tr>
<tr>
<td>10</td>
<td>53</td>
<td>84</td>
<td>98</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>72</td>
<td>68</td>
</tr>
<tr>
<td>11</td>
<td>51</td>
<td>72</td>
<td>87</td>
<td>6</td>
<td>9</td>
<td>5</td>
<td>79</td>
<td>84</td>
</tr>
<tr>
<td>13</td>
<td>48</td>
<td>75</td>
<td>90</td>
<td>5</td>
<td>4</td>
<td>4</td>
<td>64</td>
<td>3</td>
</tr>
<tr>
<td>14</td>
<td>49</td>
<td>78</td>
<td>95</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>87</td>
<td>27</td>
</tr>
<tr>
<td>15</td>
<td>65</td>
<td>85</td>
<td>91</td>
<td>7</td>
<td>9</td>
<td>7</td>
<td>85</td>
<td>99</td>
</tr>
<tr>
<td>17</td>
<td>55</td>
<td>71</td>
<td>103</td>
<td>4</td>
<td>6</td>
<td>4</td>
<td>66</td>
<td>99</td>
</tr>
<tr>
<td>18</td>
<td>43</td>
<td>71</td>
<td>97</td>
<td>4</td>
<td>4</td>
<td>8</td>
<td>70</td>
<td>84</td>
</tr>
<tr>
<td>19</td>
<td>49</td>
<td>66</td>
<td>91</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>70</td>
<td>40</td>
</tr>
<tr>
<td>20</td>
<td>50</td>
<td>77</td>
<td>96</td>
<td>6</td>
<td>10</td>
<td>7</td>
<td>85</td>
<td>99</td>
</tr>
<tr>
<td>21</td>
<td>43</td>
<td>69</td>
<td>94</td>
<td>9</td>
<td>5</td>
<td>7</td>
<td>81</td>
<td>99</td>
</tr>
<tr>
<td>22</td>
<td>47</td>
<td>62</td>
<td>89</td>
<td>5</td>
<td>6</td>
<td>6</td>
<td>72</td>
<td>48</td>
</tr>
</tbody>
</table>

Mean: 47.3  74.2  92.7  5.6  6.1  5.6  72.9  48.7  
Mean: 6.5  6.3  4.7  1.9  1.9  1.7  9.0  36.9

PPVT R = raw score from Peabody Picture Vocabulary Test - Revised.  
PPVTS = standard score from Peabody Picture Vocabulary Test - Revised, mean = 100, SD = 15.  
CMMS = standard score from Columbia Mental Maturity Scale, mean = 100, SD = 15.  
TOLD = standard score of syntactic quotient (Q) from Test of Language Development-Primary, mean = 100, SD = 15, standard scores on subtests III, IV, and V, mean = 10. SD = 3.  
GFTA = percentile rank on the Goldman-Fristoe Test of Articulation.
Table 2.2
Participant Profile: CA

<table>
<thead>
<tr>
<th>ID</th>
<th>PPVT R</th>
<th>PPVT S</th>
<th>CMMS</th>
<th>TOLD III</th>
<th>TOLD IV</th>
<th>TOLD V</th>
<th>TOLD Q</th>
<th>GFTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>51</td>
<td>64</td>
<td>89</td>
<td>108</td>
<td>10</td>
<td>12</td>
<td>8</td>
<td>100</td>
<td>84</td>
</tr>
<tr>
<td>52</td>
<td>75</td>
<td>96</td>
<td>107</td>
<td>5</td>
<td>7</td>
<td>9</td>
<td>81</td>
<td>99</td>
</tr>
<tr>
<td>53</td>
<td>60</td>
<td>87</td>
<td>112</td>
<td>13</td>
<td>16</td>
<td>11</td>
<td>121</td>
<td>87</td>
</tr>
<tr>
<td>55</td>
<td>69</td>
<td>101</td>
<td>131</td>
<td>8</td>
<td>9</td>
<td>9</td>
<td>91</td>
<td>99</td>
</tr>
<tr>
<td>57</td>
<td>101</td>
<td>131</td>
<td>103</td>
<td>11</td>
<td>12</td>
<td>12</td>
<td>111</td>
<td>99</td>
</tr>
<tr>
<td>58</td>
<td>62</td>
<td>98</td>
<td>101</td>
<td>7</td>
<td>10</td>
<td>9</td>
<td>91</td>
<td>99</td>
</tr>
<tr>
<td>59</td>
<td>68</td>
<td>101</td>
<td>88</td>
<td>8</td>
<td>12</td>
<td>11</td>
<td>102</td>
<td>78</td>
</tr>
<tr>
<td>62</td>
<td>87</td>
<td>119</td>
<td>109</td>
<td>11</td>
<td>11</td>
<td>9</td>
<td>102</td>
<td>99</td>
</tr>
<tr>
<td>63</td>
<td>84</td>
<td>115</td>
<td>95</td>
<td>12</td>
<td>13</td>
<td>10</td>
<td>111</td>
<td>99</td>
</tr>
<tr>
<td>64</td>
<td>77</td>
<td>109</td>
<td>106</td>
<td>7</td>
<td>9</td>
<td>6</td>
<td>83</td>
<td>88</td>
</tr>
<tr>
<td>65</td>
<td>68</td>
<td>93</td>
<td>110</td>
<td>8</td>
<td>12</td>
<td>12</td>
<td>104</td>
<td>99</td>
</tr>
<tr>
<td>66</td>
<td>74</td>
<td>106</td>
<td>101</td>
<td>8</td>
<td>14</td>
<td>10</td>
<td>104</td>
<td>99</td>
</tr>
<tr>
<td>67</td>
<td>54</td>
<td>92</td>
<td>105</td>
<td>8</td>
<td>12</td>
<td>11</td>
<td>102</td>
<td>89</td>
</tr>
<tr>
<td>68</td>
<td>84</td>
<td>116</td>
<td>97</td>
<td>5</td>
<td>12</td>
<td>10</td>
<td>94</td>
<td>99</td>
</tr>
<tr>
<td>70</td>
<td>59</td>
<td>88</td>
<td>116</td>
<td>11</td>
<td>8</td>
<td>8</td>
<td>94</td>
<td>76</td>
</tr>
<tr>
<td>71</td>
<td>65</td>
<td>93</td>
<td>118</td>
<td>11</td>
<td>8</td>
<td>8</td>
<td>94</td>
<td>50</td>
</tr>
<tr>
<td>118</td>
<td>61</td>
<td>86</td>
<td>96</td>
<td>9</td>
<td>6</td>
<td>8</td>
<td>85</td>
<td>87</td>
</tr>
<tr>
<td>121</td>
<td>53</td>
<td>91</td>
<td>106</td>
<td>8</td>
<td>10</td>
<td>9</td>
<td>94</td>
<td>65</td>
</tr>
</tbody>
</table>

Mean 70.3 100.7 106.1 8.9 10.7 9.4 98.0 88.6
S.D. 12.6 13.1 9.8 2.3 2.6 1.6 10.4 14.0

PPVTR = raw score from Peabody Picture Vocabulary Test - Revised.
PPVTS = standard score from Peabody Picture Vocabulary Test - Revised, mean = 100, SD = 15.
CMMS = standard score from Columbia Mental Maturity Scale, mean = 100, SD = 15.
TOLD = standard score of syntactic quotient (Q) from Test of Language Development-Primary, mean = 100, SD = 15, standard scores on subtests III, IV, and V, mean = 10. SD = 3.
GFTA = percentile rank on the Goldman-Fristoe Test of Articulation.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
## Table 2.3
Participant Profile: LM

<table>
<thead>
<tr>
<th>ID</th>
<th>PPVT R</th>
<th>PPVT S</th>
<th>CMMS</th>
<th>TOLD III</th>
<th>TOLDI V</th>
<th>TOLD V</th>
<th>TOLD Q</th>
<th>GFTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>151</td>
<td>45</td>
<td>92</td>
<td>104</td>
<td>11</td>
<td>9</td>
<td>9</td>
<td>98</td>
<td>81</td>
</tr>
<tr>
<td>152</td>
<td>42</td>
<td>108</td>
<td>136</td>
<td>12</td>
<td>9</td>
<td>10</td>
<td>102</td>
<td>43</td>
</tr>
<tr>
<td>153</td>
<td>54</td>
<td>100</td>
<td>107</td>
<td>12</td>
<td>8</td>
<td>11</td>
<td>102</td>
<td>83</td>
</tr>
<tr>
<td>155</td>
<td>31</td>
<td>94</td>
<td>89</td>
<td>8</td>
<td>4</td>
<td>9</td>
<td>81</td>
<td>63</td>
</tr>
<tr>
<td>156</td>
<td>50</td>
<td>89</td>
<td>99</td>
<td>10</td>
<td>13</td>
<td>13</td>
<td>113</td>
<td>99</td>
</tr>
<tr>
<td>157</td>
<td>45</td>
<td>95</td>
<td>83</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>81</td>
<td>99</td>
</tr>
<tr>
<td>159</td>
<td>49</td>
<td>92</td>
<td>94</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>87</td>
<td>79</td>
</tr>
<tr>
<td>160</td>
<td>55</td>
<td>104</td>
<td>114</td>
<td>7</td>
<td>9</td>
<td>12</td>
<td>96</td>
<td>67</td>
</tr>
<tr>
<td>161</td>
<td>44</td>
<td>94</td>
<td>94</td>
<td>12</td>
<td>9</td>
<td>9</td>
<td>100</td>
<td>85</td>
</tr>
<tr>
<td>163</td>
<td>50</td>
<td>96</td>
<td>93</td>
<td>10</td>
<td>7</td>
<td>10</td>
<td>94</td>
<td>90</td>
</tr>
<tr>
<td>164</td>
<td>49</td>
<td>112</td>
<td>100</td>
<td>7</td>
<td>11</td>
<td>11</td>
<td>98</td>
<td>89</td>
</tr>
<tr>
<td>165</td>
<td>61</td>
<td>101</td>
<td>104</td>
<td>8</td>
<td>10</td>
<td>11</td>
<td>98</td>
<td>89</td>
</tr>
<tr>
<td>167</td>
<td>54</td>
<td>100</td>
<td>105</td>
<td>11</td>
<td>6</td>
<td>8</td>
<td>89</td>
<td>62</td>
</tr>
<tr>
<td>168</td>
<td>41</td>
<td>91</td>
<td>105</td>
<td>10</td>
<td>11</td>
<td>11</td>
<td>104</td>
<td>72</td>
</tr>
<tr>
<td>169</td>
<td>56</td>
<td>94</td>
<td>79</td>
<td>6</td>
<td>8</td>
<td>5</td>
<td>76</td>
<td>65</td>
</tr>
<tr>
<td>170</td>
<td>45</td>
<td>92</td>
<td>92</td>
<td>12</td>
<td>8</td>
<td>5</td>
<td>89</td>
<td>91</td>
</tr>
<tr>
<td>171</td>
<td>44</td>
<td>94</td>
<td>96</td>
<td>9</td>
<td>11</td>
<td>10</td>
<td>100</td>
<td>78</td>
</tr>
<tr>
<td>172</td>
<td>44</td>
<td>88</td>
<td>96</td>
<td>10</td>
<td>13</td>
<td>9</td>
<td>104</td>
<td>79</td>
</tr>
</tbody>
</table>

**Mean** 47.9 96.4 99.4 9.3 8.9 9.4 95.1 78.6 79

**S.D.** 7.1 6.5 12.6 2.1 2.3 2.1 9.6 14.4

PPVTR = raw score from Peabody Picture Vocabulary Test - Revised.
PPVTS = standard score from Peabody Picture Vocabulary Test - Revised, mean = 100, SD = 15.
CMMS = standard score from Columbia Mental Maturity Scale, mean = 100, SD = 15.
TOLD = standard score of syntactic quotient (Q) from Test of Language Development-Primary, mean = 100, SD = 15, standard scores on subtests III, IV, and V, mean = 10, SD = 3.
GFTA = percentile rank on the Goldman-Fristoe Test of Articulation.
Table 2.4
Participant Profile: Race and Gender Matching

<table>
<thead>
<tr>
<th>SLI ID</th>
<th>SLI Race</th>
<th>SLI Sex</th>
<th>CA ID</th>
<th>CA Race</th>
<th>CA Sex</th>
<th>LM ID</th>
<th>LM Race</th>
<th>LM Sex</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AA</td>
<td>M</td>
<td>51</td>
<td>AA</td>
<td>M</td>
<td>151</td>
<td>AA</td>
<td>M</td>
</tr>
<tr>
<td>2</td>
<td>EA</td>
<td>M</td>
<td>52</td>
<td>EA</td>
<td>M</td>
<td>152</td>
<td>EA</td>
<td>M</td>
</tr>
<tr>
<td>3</td>
<td>EA</td>
<td>M</td>
<td>53</td>
<td>EA</td>
<td>M</td>
<td>153</td>
<td>EA</td>
<td>M</td>
</tr>
<tr>
<td>5</td>
<td>EA</td>
<td>F</td>
<td>55</td>
<td>EA</td>
<td>F</td>
<td>155</td>
<td>EA</td>
<td>F</td>
</tr>
<tr>
<td>7</td>
<td>EA</td>
<td>F</td>
<td>57</td>
<td>EA</td>
<td>F</td>
<td>157</td>
<td>EA</td>
<td>F</td>
</tr>
<tr>
<td>8</td>
<td>EA</td>
<td>M</td>
<td>58</td>
<td>EA</td>
<td>M</td>
<td>156</td>
<td>EA</td>
<td>M</td>
</tr>
<tr>
<td>9</td>
<td>EA</td>
<td>M</td>
<td>59</td>
<td>EA</td>
<td>M</td>
<td>159</td>
<td>EA</td>
<td>F</td>
</tr>
<tr>
<td>10</td>
<td>AA</td>
<td>F</td>
<td>65</td>
<td>EA</td>
<td>F</td>
<td>160</td>
<td>EA</td>
<td>F</td>
</tr>
<tr>
<td>11</td>
<td>AA</td>
<td>F</td>
<td>66</td>
<td>EA</td>
<td>F</td>
<td>163</td>
<td>EA</td>
<td>F</td>
</tr>
<tr>
<td>13</td>
<td>EA</td>
<td>M</td>
<td>64</td>
<td>EA</td>
<td>M</td>
<td>161</td>
<td>AA</td>
<td>F</td>
</tr>
<tr>
<td>14</td>
<td>EA</td>
<td>M</td>
<td>62</td>
<td>EA</td>
<td>M</td>
<td>164</td>
<td>EA</td>
<td>M</td>
</tr>
<tr>
<td>16</td>
<td>EA</td>
<td>M</td>
<td>63</td>
<td>EA</td>
<td>M</td>
<td>165</td>
<td>AA</td>
<td>M</td>
</tr>
<tr>
<td>15</td>
<td>AA</td>
<td>F</td>
<td>67</td>
<td>AA</td>
<td>M</td>
<td>167</td>
<td>AA</td>
<td>M</td>
</tr>
<tr>
<td>18</td>
<td>AA</td>
<td>F</td>
<td>68</td>
<td>AA</td>
<td>F</td>
<td>168</td>
<td>AA</td>
<td>F</td>
</tr>
<tr>
<td>19</td>
<td>AA</td>
<td>F</td>
<td>71</td>
<td>AA</td>
<td>F</td>
<td>169</td>
<td>AA</td>
<td>F</td>
</tr>
<tr>
<td>20</td>
<td>EA</td>
<td>M</td>
<td>70</td>
<td>EA</td>
<td>M</td>
<td>170</td>
<td>AA</td>
<td>M</td>
</tr>
<tr>
<td>21</td>
<td>AA</td>
<td>F</td>
<td>118</td>
<td>AA</td>
<td>F</td>
<td>171</td>
<td>AA</td>
<td>F</td>
</tr>
<tr>
<td>22</td>
<td>AA</td>
<td>F</td>
<td>121</td>
<td>AA</td>
<td>F</td>
<td>172</td>
<td>AA</td>
<td>F</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
the race and gender information for all three groups of children. The number of between group matches were as follows. For SLI and CA, 16 of 18 children matched on race, and 13 of 18 matched on both race and gender; for SLI and LM, 15 children were matched on race and 10 were matched on both race and gender.

Procedures

This study consisted of two tasks: a storybook task and a nonword repetition task. During the storybook task, the participants listened to two stories where target sentences had been manipulated to alter sentence complexity and rate of speech. Nonce items were substituted for both nouns and verbs in these sentences. Immediately after each target sentence, the participants performed a picture pointing comprehension probe and then a production probe where they were asked to provide a “real” word for the nonce word. After viewing the story, children completed the nonword repetition task. This task required children to repeat nonce words varying in length from one to four syllables.

Materials

Preparation of Storybooks.

Selection of the books was based on the following criteria: (a) they consisted of a basic level 1 story as indicated on the book jacket; (b) they consisted of a simple, picture supported text which depicted a sequence of related events (rather than a collection of objects), and (c) they did not contained any commercially familiar characters. The two storybooks selected were Wake up Sun (Dubowski & Dubowski, 1995) and Snug Bug (Harrison, 1986). Target words were chosen based on the presence of picture support.
Experimental words were two syllable nonce words used in place of known nouns or verbs (see Table 2.5). Although the order of noun and verb presentation in the books was not counterbalanced due to constraints of the text, eight target nouns and eight target verbs were included in each book. In addition, four of each word class occurred in both halves of the book. Natural morphological markers of nouns and verbs were included within the narrative. Of the sixteen nouns, two had plural endings and fourteen were bare stems. Morphological markers on the verb targets were more varied. They included five with third person present tense, four with present progressive, five with regular past tense, and one with irregular past tense marking. The remaining verb was a bare stem.

Table 2.5
Original Storybook Nouns and Verbs

<table>
<thead>
<tr>
<th>Book 1</th>
<th>Verbs</th>
<th>Book 2</th>
<th>Verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nouns</td>
<td></td>
<td>Nouns</td>
<td>Verbs</td>
</tr>
<tr>
<td>house</td>
<td>look/bark</td>
<td>car</td>
<td>hide</td>
</tr>
<tr>
<td>bird/owl</td>
<td>sleep</td>
<td>tub</td>
<td>lift/pull</td>
</tr>
<tr>
<td>mouth</td>
<td>stretch</td>
<td>bubble</td>
<td>dry</td>
</tr>
<tr>
<td>wall</td>
<td>peek</td>
<td>clock</td>
<td>spit</td>
</tr>
<tr>
<td>wheelbarrow</td>
<td>flap</td>
<td>window</td>
<td>yawn</td>
</tr>
<tr>
<td>cradle</td>
<td>fire</td>
<td>mug/cup</td>
<td>kneel</td>
</tr>
<tr>
<td>barn</td>
<td>dance/jump</td>
<td>bear</td>
<td>yell/scream</td>
</tr>
<tr>
<td>ball</td>
<td>drink</td>
<td>bed</td>
<td>close</td>
</tr>
</tbody>
</table>

In both books, the text was rewritten so that the words were presented in equivalent sentences which differed only in their linguistic complexity. Simple and
complex sentences occurred alternating, one type after the other. This pattern was counterbalanced between the books. The same semantic information was provided in both sentence types, with the additional modifying adjectives and adverbs being present in both. For the simple structure, two separate sentences contained the same information as did the one combined sentence, where the information from the second sentence was inserted as an embedded clause prior to the target word. For example, the two sentences “Dog is brown and furry. One night Dog was sleeping in his lodep when a flea bit him on the ear.” were combined into one sentence for the complex syntax condition. “One night dog, who is brown and furry, was sleeping in his lodep when a flea bit him on the ear.” Syllable number was kept constant so that the two simple sentences had the same number of syllables as the one complex sentence. As demonstrated by the above example, some of the simple sentences contained embedded content (e.g., ...when a flea bit him on the ear). When embedding occurred, it also was present in the complex sentence condition and it always occurred after the nonce word (for story narratives see Appendix A).

One half of each book was presented to a child at the fast rate of speech, the other half at the slower rate. In order to control the speech rate, the individual pages were videotaped and presentation of the narrative was copied onto the audio track of the tape. The exact rate of speech was determined prior to final editing of the videotape. Specifically, each version of the books was analyzed for speech rate by feeding the audio output into a 16 bit sound card and then into the Cooledit freeware program. The signal was digitized at a rate of 11025 signals per second. The time wave form for each target
sentence was measured from onset to offset. Using the number of syllables in each sentence, the syllables per second speech rate was calculated. The average values were 5.79 syllables/second at the fast rate and 2.07 syllables/second at the slow rate (Table 2.6). These fast and slow rates are similar to those reported by Ellis Weismer and Hesketh (1996). Their target sentences were presented at approximately 5.9 syllables for the fast speech rate and 2.8 syllables for the slow rate. In order to make the videotaped story more interesting to the children, fading in and out occurred at the beginning and end of each picture, similar to what is done during the television program Reading Rainbow (Children’s Television Workshop).

Table 2.6
Average Speech Production Rates in Syllables/second

<table>
<thead>
<tr>
<th>Book</th>
<th>Condition</th>
<th>Fast</th>
<th>Slow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wake up Sun</td>
<td>A (1,2)</td>
<td>5.75</td>
<td>2.21</td>
</tr>
<tr>
<td></td>
<td>B (1,2)</td>
<td>5.93</td>
<td>2.32</td>
</tr>
<tr>
<td>Snug Bug</td>
<td>A (1,2)</td>
<td>5.66</td>
<td>1.89</td>
</tr>
<tr>
<td></td>
<td>B (1,2)</td>
<td>5.83</td>
<td>1.93</td>
</tr>
<tr>
<td>Combined</td>
<td>Mean</td>
<td>5.79</td>
<td>2.07</td>
</tr>
<tr>
<td></td>
<td>S.D.</td>
<td>(0.67)</td>
<td>(0.40)</td>
</tr>
</tbody>
</table>

Overall, rate and complexity were counterbalanced within and between the two books. Word type was spread evenly over the rate and complexity factors. As a result, four conditions existed to which the SLI children were assigned with the corresponding matched controls put in the appropriate condition. Then the normally developing children were assigned to the condition in which their SLI-matched child was assigned.
Preparation of Multiple Choice Test.

A four picture multiple choice test was administered after listening to each target sentence (no more than one target per page). It was constructed from color photocopied pictures from the storybook, each page consisted of four pictures cut to be about three inches square and placed in one of four quadrants. The correct answer occurred in each of the four positions in a random, equally occurring pattern. The target and two of the foils were selected from the same page in the book. One of the foils was of the same word type as the target and another was from the alternate word type. The third foil was a picture from a different page in the book.

Nonsense Word Stimuli.

Nonsense word stimuli were 20 of the 40 used by Montgomery (1995b). Five nonce words corresponded to each of four syllable lengths (1, 2, 3, or 4). The items began with single consonants and did not contain the phonemes /r/ or /z, s/ in the initial position (See Table 2.7). The nonce words selected for the task were randomized and read by an adult male familiar with phonetic transcription. The stimuli were read at a normal speech rate. Stress patterns were on the initial syllable for one, two, and three syllable words, whereas the four syllable words were produced with the second syllable stressed. This followed the procedure used by Montgomery (1995b), which was said to reflect common stress patterns thereby making the stimuli more "word-like". Studies have shown that children's performance is better when words are perceived to be more word-like (Dollaghan, et al., 1995; Gathercole, et al., 1991). Stimuli were recorded onto the audio track of an 8mm videotape. The tape was edited to show a five to seven
second blue screen with a flashing white bar indicating when the word would begin.

Between items, the screen remained blue.

Table 2.7
Nonword repetition task stimuli

<table>
<thead>
<tr>
<th>Syllables</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>One</td>
<td>Two</td>
<td>Three</td>
<td>Four</td>
</tr>
<tr>
<td>dep</td>
<td>pennish</td>
<td>kopefate</td>
<td>gommecitate</td>
</tr>
<tr>
<td>caid</td>
<td>maudin</td>
<td>bofudish</td>
<td>banifamine</td>
</tr>
<tr>
<td>gud</td>
<td>tennod</td>
<td>gimaning</td>
<td>dopaniful</td>
</tr>
<tr>
<td>tob</td>
<td>gobush</td>
<td>nitandum</td>
<td>puzaniun</td>
</tr>
<tr>
<td>noke</td>
<td>hanpent</td>
<td>sakiding</td>
<td>misonokich</td>
</tr>
</tbody>
</table>

Task Administration

The tasks were administered as part of a battery of probes looking at children’s acquisition of words (Oetting, 1998). All children participated individually in eight 15-20 minute sessions. Each session was completed in a quiet room at the child’s school or daycare. Days 1, 2, and 3 involved standardized testing. For most children, days 4, 5, and 6 involved videotaped probes that examined children’s use of syntax to learn words, and days 7 and 8 involved the tasks described here. For the experimental tasks examined here, both the child and examiner were seated in front of the video monitor during viewing. Children were told that they would watch a video story with some silly words and that they should help the examiner figure out what the words meant by pointing to some pictures while the story was being read. Prior to administration of the
actual comprehension probe, a practice page with quadrants paired to a practice sentence was used to train the children on the task. For both books, the picture on the title page was used with the practice sentence. The following sentences were used as the practice items.

Tape: “The dog is sleeping. He is dreaming.”
Examiner: “Show me dreaming”
Tape: “The Mama Bug is carrying her Snug Bug. She has four feet.”
Examiner: “Show me feet”

All children had to respond appropriately before experimentation began. During story viewing, the children watched and listened to the story. After each target sentence was heard, the examiner paused the tape and placed the corresponding picture probe page in front of the child. The examiner then told the child to “show me x”. The particular nonce word being specified was stated with the bound morpheme used in the narrative, if one had been present. For example, if the target was bonnazed, the examiner said “show me bonnazed”. Even though previous studies have tested children with the bare stem, it was decided that the morphological marker present in the narrative would be maintained in the task. It was felt that removal of the morphological markers would make the verbs more difficult than the nouns, since all but one of the verbs would be different than the target word in the narrative. The quadrant the child pointed to was recorded for later scoring. For the production probe, the children were asked to provide a “real” word that meant the same thing as the nonce word. The child’s response was recorded. The child was then returned to his/her room.
The nonsense word repetition task was conducted during one of the storybook sessions. The edited video was shown, and the child was asked to listen to each item and repeat it back immediately after hearing it. Responses were audio recorded and subsequently transcribed broadly. Children were allowed no more than two opportunities to produce each item.

**Data Collection and Scoring**

Response sheets from the storybook task were scored at a separate time from testing. The comprehension picture pointing probe was scored either correct or incorrect for each item. Production responses also were scored correct or incorrect. Correct responses were those where the production could be inserted in the sentence in place of the nonce word and be semantically and syntactically acceptable. Correct morphology was not required. After the session ended, audiotapes for the nonsense word repetition task were transcribed onto a sheet where the individual phonemes were scored correct or incorrect. Phoneme omissions or substitutions were counted as incorrect; minor distortions were counted as correct as long as the production of the phoneme matched that of the target. When an incorrect phoneme was produced, it was written above the correct one on the form. Results were calculated following Montgomery (1995b). A count was made of the number of nonce items correct for each syllable length. These were then converted into a percentage of correct syllables for each child.
Reliability

Twenty percent of the storybook production responses were given to another examiner for coding. There were 384 opportunities (32 words x 3 groups x 4 children) for coding agreement or disagreement. Intercoder reliability was 99% (380/384). In addition, twenty percent of the audiotapes from the nonword repetition task were independently transcribed by a second person. Reliability was calculated by dividing the total number of agreements by the total number of opportunities. At the word level, there were 220 opportunities (20 nonce items x 11 children) for agreement or disagreement. Reliability between coders was 95% (209/220). There were 1342 opportunities (122 phonemes per child x 11 children) to produce a phoneme in the sample. Intertranscriber reliability was 98% (1316/1342) for phonemes correct.

End Notes

1. Three of the age-matched children obtained PPVTS scores which fell more than one standard deviation above the mean. When an ANOVA was performed with these children removed, significant group differences remained.

2. For eight (78%) children in the two kindergarten groups, the order of the probes was reversed (sessions 7 and 8 occurred before sessions 4 and 5). An ANOVA was run with the eight children who were tested in a different order removed. No significant changes from the results reported here were found.
RESULTS

Two tasks were administered to examine the word learning and short term memory capacity of children with SLI, and two groups of normal controls. The first, a storybook task, examined children's word learning abilities using comprehension and production probes. The comprehension probe required children to point to pictures corresponding to the target nonce words. The production probe required them to provide a real word synonym for the nonce item. During the second task, children were asked to repeat nonce words which varied in syllable length. These tasks were analyzed using analysis of variance, correlational analysis, and regression procedures. Findings from the analyses are presented sequentially below.

Storybook Task

Preliminary Analysis

The maximum number correct on the comprehension and production tasks was 64 (32 per task). To examine whether the children's race and gender, and the different response modes (comprehension versus production) influenced the children's total scores, a four-way mixed model analysis of variance (ANOVA) was run. The between subjects variables were group (3 levels: SLI, CA, LM), race (two levels: Euro-American, Afro-American), and gender (2 levels: male, female). The within-subject variable was mode (2 levels: comprehension, production). Significant main effects were found for group, $F(2,42) = 31.95, p < .001$, race $F(1,42) = 13.10, p < .001$, and mode, $F(1,42) = 529.40, p < .001$. These main effects were qualified by two two-way interactions, group
x race, $F(2,42) = 11.08, p < .001$, and group x mode, $F(2,42) = 5.22, p < .01$, and one three way interaction, group x race x mode, $F(2,42) = 3.87, p < .05$).

The three way interaction is illustrated in Figure 3.1. As can be seen, all three groups scored better on comprehension than production regardless of race, with the age-matched EA children scoring the highest overall. To examine the three way interaction statistically, differences within each group-race subgroup separated by response modality were examined using two two-way ANOVAs. For comprehension, main effects were found for group, $F(2,48) = 22.73, p < .001$, and race $F(1,48) = 8.39, p < .01$, and a significant group by race interaction, $F(1,48) = 7.31, p < .01$ was observed. Follow-up Tukeys ($p < .05$) were performed with the data separated by race. For the EA subgroup, the SLI and LM groups were significantly different from the CA groups. For the scores of the AA children, the SLI and CA groups were significantly different from those of the LM group, but they were not different from each other. For production, the two-way ANOVA again found effects for group $F(2,48) = 24.79, p < .001$, and race, $F(1,48) = 13.10, p < .001$, and the interaction involving group and race, $F(2,48) = 8.39, p < .001$, was significant. Follow-up Tukey analysis yielded the same results for both races; the scores of the CA group were significantly higher than those of the SLI and LM groups. Differences between the two races were significant for CA children ($t(16) = 3.70, p < .01$). Race differences were not observed for the other two groups.

To further examine the three-way group by race by mode interaction, differences within each group-race subgroup based on response modality were examined using paired $t$ tests. All six subgroups were found to have significant modality differences,
SLI-EA, t(9) = 8.12, p < .001; SLI-AA, t(7) = 15.17, p < .001; CA-EA, t(10) = 6.64, p < .001; CA-AA, t(6) = 7.94, p < .001; LM-EA, t(8) = 13.06, p < .001; LM-AA t(8) = 12.39, p < .001. Using these values, effect sizes were calculated for each subgroup and the results are provided in Table 3.1. As can be seen, large and significant effect sizes were observed for each subgroup, but the magnitude of the modality difference was the greatest for the SLI-AA subgroup. Since mode was significant for all subgroups, further analyses were conducted with comprehension and production data separated. For all remaining analyses, race also was included as a variable but gender was dropped.

Table 3.1
Effect Size Values for Modality Differences

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLI-EA</td>
<td>2.36</td>
</tr>
<tr>
<td>SLI-AA</td>
<td>5.36</td>
</tr>
<tr>
<td>CA-EA</td>
<td>2.14</td>
</tr>
<tr>
<td>CA-AA</td>
<td>3.00</td>
</tr>
<tr>
<td>LM-EA</td>
<td>4.37</td>
</tr>
<tr>
<td>LM-AA</td>
<td>4.13</td>
</tr>
</tbody>
</table>

A final note regarding the standardized tests administered to the children. Even though children from both the three groups obtained scores within the normal range on the CMMS, the mean scores suggested group differences between the children with SLI and the controls (SLI mean score = 92; CA mean score = 106.1; LM mean score = 99.4). Analysis of these values using paired t tests revealed significant group differences between SLI and CA, t(34) = 5.23, p < .001; and between SLI and LM, t(34)
= 2.13, \( p < .05 \). However, as will be presented later in this chapter, CMMS scores were not found to be correlated with the dependent measures of interest.

**Primary Analysis**

For each modality, a five-way ANOVA was run to examine the effects of group, race, rate, complexity and word type. The means and standard deviations by group are provided in Table 3.2. For comprehension, a significant main effect for word type, \( F(1,48) = 78.81, \ p < .001 \), was found. Verb scores of all groups were consistently higher than those for nouns. Group, \( F(2,48) = 22.73, \ p < .001 \), race \( F(1,48) = 8.39, \ p < .01 \), and rate \( F(1,48) = 4.87, \ p < .05 \) also were significant main effects and these were qualified by two two-way interactions between group and rate, \( F(2,48) = 3.64, \ p < .05 \), and group and race, \( F(2,48) = 7.31, \ p < .01 \) (see Figure 3.2). Tukey follow-up procedures indicated that with both presentation rates, the CA group scores were significantly different from the SLI and LM groups. In addition, paired t tests revealed that scores of the SLI group were significantly lower for items presented at a fast rate as compared to slow, \( t(17) = 2.52, \ p < .05 \). Rate effects were not significant for the CA and LM groups. The group by race interaction was examined previously in the preliminary section; for the EA children, CA subgroup scores were higher than those for the SLI or LM subgroups, and for the AA children the CA and SLI subgroups were significantly different from the LM group.

For production, word type was found to be a significant main effect, \( F(1,48) = 12.54, \ p < .001 \). As with comprehension, verb scores of all groups were consistently higher than those for nouns. Additional main effects were found for group \( F(2,48) = \)
Figure 3.1
Group by Race by Mode Interaction
Table 3.2
Summary of Comprehension Scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Comprehension</th>
<th>slow - simple</th>
<th>slow - complex</th>
<th>fast - simple</th>
<th>fast - complex</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLI</td>
<td>Noun</td>
<td>2.06</td>
<td>1.83</td>
<td>1.39</td>
<td>1.28</td>
<td>6.56</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.87)</td>
<td>(0.71)</td>
<td>(1.20)</td>
<td>(1.08)</td>
<td>(2.09)</td>
</tr>
<tr>
<td></td>
<td>Verb</td>
<td>2.83</td>
<td>2.78</td>
<td>2.28</td>
<td>2.61</td>
<td>10.50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.79)</td>
<td>(0.81)</td>
<td>(0.83)</td>
<td>(1.04)</td>
<td>(2.01)</td>
</tr>
<tr>
<td>CA</td>
<td>Noun</td>
<td>2.61</td>
<td>2.33</td>
<td>2.44</td>
<td>2.39</td>
<td>9.78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.20)</td>
<td>(1.14)</td>
<td>(1.20)</td>
<td>(0.85)</td>
<td>(2.72)</td>
</tr>
<tr>
<td></td>
<td>Verb</td>
<td>3.06</td>
<td>3.17</td>
<td>3.06</td>
<td>3.00</td>
<td>12.28</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.87)</td>
<td>(0.86)</td>
<td>(1.06)</td>
<td>(1.08)</td>
<td>(2.91)</td>
</tr>
<tr>
<td>LM</td>
<td>Noun</td>
<td>1.17</td>
<td>1.50</td>
<td>1.22</td>
<td>1.56</td>
<td>5.44</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.99)</td>
<td>(1.15)</td>
<td>(1.00)</td>
<td>(0.92)</td>
<td>(1.72)</td>
</tr>
<tr>
<td></td>
<td>Verb</td>
<td>2.50</td>
<td>2.17</td>
<td>2.11</td>
<td>2.56</td>
<td>9.33</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.04)</td>
<td>(0.86)</td>
<td>(0.76)</td>
<td>(0.86)</td>
<td>(1.50)</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Table 3.3
Summary of Production Scores

<table>
<thead>
<tr>
<th>Group</th>
<th>Production</th>
<th>slow - simple</th>
<th>slow - complex</th>
<th>fast - simple</th>
<th>fast - complex</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SLI</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noun</td>
<td>0.83</td>
<td>0.61</td>
<td>0.61</td>
<td>0.67</td>
<td>2.72</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.86)</td>
<td>(0.78)</td>
<td>(0.61)</td>
<td>(0.77)</td>
<td>(1.78)</td>
<td></td>
</tr>
<tr>
<td>Verb</td>
<td>1.17</td>
<td>0.94</td>
<td>0.67</td>
<td>0.94</td>
<td>3.67</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.92)</td>
<td>(0.80)</td>
<td>(0.77)</td>
<td>(0.80)</td>
<td>(2.40)</td>
<td></td>
</tr>
<tr>
<td>CA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noun</td>
<td>1.72</td>
<td>1.61</td>
<td>1.56</td>
<td>1.78</td>
<td>6.67</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.27)</td>
<td>(1.42)</td>
<td>(0.98)</td>
<td>(0.88)</td>
<td>(3.57)</td>
<td></td>
</tr>
<tr>
<td>Verb</td>
<td>2.17</td>
<td>1.83</td>
<td>2.00</td>
<td>1.83</td>
<td>7.94</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.20)</td>
<td>(1.15)</td>
<td>(1.19)</td>
<td>(1.15)</td>
<td>(4.08)</td>
<td></td>
</tr>
<tr>
<td>LM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noun</td>
<td>0.39</td>
<td>0.39</td>
<td>0.44</td>
<td>0.61</td>
<td>1.83</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.27)</td>
<td>(0.61)</td>
<td>(0.51)</td>
<td>(0.78)</td>
<td>(1.30)</td>
<td></td>
</tr>
<tr>
<td>Verb</td>
<td>0.67</td>
<td>0.94</td>
<td>0.89</td>
<td>0.94</td>
<td>3.11</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.69)</td>
<td>(0.94)</td>
<td>(0.76)</td>
<td>(0.94)</td>
<td>(1.71)</td>
<td></td>
</tr>
</tbody>
</table>
Figure 3.2
Group by Rate Interaction
24.79, \( p < .001 \), and race, \( F(1,48) = 13.10, p < .001 \), and these were qualified by a two-way group by race interaction, \( F(2,48) = 8.39, p < .001 \). Again, the interaction was examined previously in the preliminary analysis section where follow-up procedures showed that for both races (AA and EA), production scores of the CA group were significantly different than those for the SLI or LM subgroups. The interaction occurred because race effects were present in the CA group only.

**Error Analysis of Production Data**

Five types of errors were possible on the production probe. Type 1 errors were related to the target but could not replace it correctly in the sentence. These errors were further divided into same word type and different word type response categories. The former errors were of the same word type as the target, whereas the latter errors were not. A representative related - same word type response was found with the target sentences “Mama Bug is moving quickly and firmly. She *koenips* her Snug Bug off with the towel”. For this example, *koenips* referred to the verb “dries”, but a child answered “wash and put in bed”. Clearly this child had a general semantic understanding of what the nonce word meant, but the response could not be substituted for *koenips* in the sentence.

An example of a related-different word type different response was when a child answered “toothbrush” when asked what the nonce word *poenigs* meant in the target sentence “Snug Bug, as he stands on the faucet, *poenigs* his toothpaste into the bathroom sink.” While a toothbrush was involved in the sequence, it was neither the right word type nor did it fit into the sentence. A Type 2 error involved the child saying
a part of the sentence from the story. The production could be either a verbatim repetition of a part of the target sentence or a paraphrase of part of the sentence. For example, after hearing the previous sentence another child responded “into the sink” when asked what poenigs meant. With a Type 3 error, the production was a repetition of the nonce word that was given in the target sentence. Type 4 responses involved a child either refusing to answer or saying “I don’t know”. Finally, a Type 5 error was a response that was either completely unrelated to anything on the page or went with one of the foils. For example, for the sentence “Dog, pig and cow, after running across the yard, balloped around the barn”, a reply of “chicken”, pictured on the page, would be a Type 5 unrelated response. After the responses were categorized, the percentage of each response type was calculated (see Tables 3.4, 3.5 and 3-).

As can be seen in Table 3.4, all children regardless of group, had similar error patterns. For all three groups, 20% of the errors involved Type 1 responses; approximately half of these errors were semantically related. The groups likewise produced a large number of responses which were repetitions of the target sentence (Type 2), the smallest percentage being from the LM group. Type 3 responses, which involved repetitions of the nonce word, were infrequent for all the groups. The LM group produced the most unrelated responses (Type 5), almost double those of the CA group. Overall, the SLI and CA groups had about equal amounts of related (Types 1 and 2) and unrelated (Types 3, 4 and 5) responses, whereas 35% of the LM group’s responses were related and 63% were unrelated productions.
In Tables 3.5 and 3.6, the groups were pooled and error types were calculated for each word. This was done to examine the relative difficulty of the individual words and the range of correct, related and unrelated responses produced for each word. It is apparent that the words ranged greatly in degree of difficulty for all children, with percentage correct ranging from 5.6% to 48.1% for nouns and 5.6% to 57.4% for verbs. For these tables, the related responses (Types 1 and 2) were pooled as were the unrelated responses (Types 3, 4 and 5). No obvious pattern arose in terms of percentage of related and unrelated error responses. For some words, the children were more likely to provide a related response and for others an unrelated one.

Table 3.4
Percentage of Error Types by Group

<table>
<thead>
<tr>
<th>Group</th>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
<th>Type 4</th>
<th>Type 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>same word type</td>
<td>different word type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SLI</td>
<td>9.7</td>
<td>8.9</td>
<td>30.0</td>
<td>2.8</td>
<td>18.6</td>
</tr>
<tr>
<td>CA</td>
<td>10.2</td>
<td>13.1</td>
<td>25.6</td>
<td>1.9</td>
<td>26.5</td>
</tr>
<tr>
<td>LM</td>
<td>8.2</td>
<td>11.1</td>
<td>15.8</td>
<td>1.8</td>
<td>22.6</td>
</tr>
</tbody>
</table>

Type 1 = Related but incorrect  
Type 2 = Part of sentence  
Type 3 = Nonce word  
Type 4 = I don't know  
Type 5 = Unrelated
Table 3.5
Item Analysis of Nouns *

<table>
<thead>
<tr>
<th>Word</th>
<th>Correct</th>
<th>Related</th>
<th>Unrelated</th>
</tr>
</thead>
<tbody>
<tr>
<td>mouth</td>
<td>5.6</td>
<td>25.9</td>
<td>68.5</td>
</tr>
<tr>
<td>bubble</td>
<td>7.4</td>
<td>64.8</td>
<td>27.8</td>
</tr>
<tr>
<td>barn</td>
<td>9.3</td>
<td>46.2</td>
<td>44.4</td>
</tr>
<tr>
<td>wall</td>
<td>11.1</td>
<td>29.7</td>
<td>59.2</td>
</tr>
<tr>
<td>wheelbarrow</td>
<td>13.0</td>
<td>35.2</td>
<td>51.9</td>
</tr>
<tr>
<td>ball</td>
<td>13.0</td>
<td>33.3</td>
<td>53.7</td>
</tr>
<tr>
<td>cradle</td>
<td>14.8</td>
<td>35.2</td>
<td>50.0</td>
</tr>
<tr>
<td>bed</td>
<td>24.1</td>
<td>38.9</td>
<td>37.0</td>
</tr>
<tr>
<td>cup</td>
<td>24.1</td>
<td>48.1</td>
<td>27.8</td>
</tr>
<tr>
<td>window</td>
<td>27.8</td>
<td>35.2</td>
<td>37.0</td>
</tr>
<tr>
<td>tub</td>
<td>31.5</td>
<td>38.9</td>
<td>29.6</td>
</tr>
<tr>
<td>car</td>
<td>35.2</td>
<td>22.2</td>
<td>42.6</td>
</tr>
<tr>
<td>house</td>
<td>37.0</td>
<td>18.6</td>
<td>44.4</td>
</tr>
<tr>
<td>bird</td>
<td>37.0</td>
<td>16.7</td>
<td>46.3</td>
</tr>
<tr>
<td>clock</td>
<td>38.9</td>
<td>35.2</td>
<td>25.9</td>
</tr>
<tr>
<td>bear</td>
<td>48.1</td>
<td>29.6</td>
<td>22.3</td>
</tr>
</tbody>
</table>

*values represent percentage of total responses
Table 3.6
Item Analysis of Verbs *

<table>
<thead>
<tr>
<th>Word</th>
<th>Correct</th>
<th>Related</th>
<th>Unrelated</th>
</tr>
</thead>
<tbody>
<tr>
<td>close</td>
<td>5.6</td>
<td>66.7</td>
<td>27.7</td>
</tr>
<tr>
<td>spit</td>
<td>11.1</td>
<td>59.3</td>
<td>29.6</td>
</tr>
<tr>
<td>pull</td>
<td>14.8</td>
<td>38.9</td>
<td>46.3</td>
</tr>
<tr>
<td>shout</td>
<td>16.7</td>
<td>38.9</td>
<td>44.4</td>
</tr>
<tr>
<td>kneel</td>
<td>18.5</td>
<td>27.8</td>
<td>53.7</td>
</tr>
<tr>
<td>yawn</td>
<td>22.2</td>
<td>35.2</td>
<td>42.6</td>
</tr>
<tr>
<td>flap</td>
<td>22.2</td>
<td>46.2</td>
<td>31.6</td>
</tr>
<tr>
<td>dance</td>
<td>24.1</td>
<td>44.4</td>
<td>31.5</td>
</tr>
<tr>
<td>stretch</td>
<td>31.4</td>
<td>18.6</td>
<td>50.0</td>
</tr>
<tr>
<td>peek</td>
<td>33.3</td>
<td>22.2</td>
<td>44.4</td>
</tr>
<tr>
<td>dry</td>
<td>35.2</td>
<td>7.4</td>
<td>57.4</td>
</tr>
<tr>
<td>bark</td>
<td>46.2</td>
<td>24.1</td>
<td>29.7</td>
</tr>
<tr>
<td>drink</td>
<td>46.2</td>
<td>20.5</td>
<td>33.3</td>
</tr>
<tr>
<td>hide</td>
<td>48.1</td>
<td>24.1</td>
<td>27.8</td>
</tr>
<tr>
<td>fire</td>
<td>55.3</td>
<td>13.0</td>
<td>31.7</td>
</tr>
<tr>
<td>sleep</td>
<td>57.4</td>
<td>16.7</td>
<td>25.9</td>
</tr>
</tbody>
</table>

*values represent percentage of total responses
Nonword Repetition Task

The nonword repetition task (NRT) was administered to assess children's working memory systems. Recall that this was the task employed in studies by both Gathercole and Baddeley (1990a,b), and Montgomery (1995a,b). In those studies, working memory ability, as assessed through the NRT, was said to be related to word learning abilities. In the version of the task used in the current study, children listened to and repeated 20 target words. Means and standard deviations for the nonword repetition task are provided in Table 3.7.

Table 3.7
Nonword Repetition Scores: Means and Standard Deviations

<table>
<thead>
<tr>
<th>Group</th>
<th>1 syllable</th>
<th>2 syllables</th>
<th>3 syllables</th>
<th>4 syllables</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLI</td>
<td>3.00</td>
<td>2.56</td>
<td>1.72</td>
<td>2.11</td>
<td>9.39</td>
</tr>
<tr>
<td></td>
<td>(1.19)</td>
<td>(1.20)</td>
<td>(1.32)</td>
<td>(1.64)</td>
<td>(3.27)</td>
</tr>
<tr>
<td>CA</td>
<td>4.33</td>
<td>3.67</td>
<td>3.72</td>
<td>4.00</td>
<td>15.72</td>
</tr>
<tr>
<td></td>
<td>(0.91)</td>
<td>(0.77)</td>
<td>(1.13)</td>
<td>(1.14)</td>
<td>(2.69)</td>
</tr>
<tr>
<td>LM</td>
<td>4.24</td>
<td>3.18</td>
<td>2.82</td>
<td>3.00</td>
<td>13.24</td>
</tr>
<tr>
<td></td>
<td>(0.90)</td>
<td>(1.01)</td>
<td>(0.95)</td>
<td>(1.00)</td>
<td>(2.41)</td>
</tr>
</tbody>
</table>

Group Analysis

A four-way mixed model analyses of variance was run for correct nonce word repetitions by syllable length. The between subject variables were group (three levels: SLI, CA, LM), race (two levels: EA, AA), and gender (two levels: male, female). The within subject factor was syllable number (four levels: one, two, three, four). Group $E(2,41) = 1022.70$, $p < .001$, and syllable number, $E(3,123) = 10.28$, $p < .001$, were
significant main effects. Using the Tukey procedures, significant differences (p < .05) were found between the SLI group and both control groups, as well as between the CA and LM groups. Paired t tests were employed to investigate the syllable length main effects. Significant differences were found between one and two syllables, t(52), p < .001, one and three syllables, t(52), p < .001, and one and four syllables, t(52), p < .001 (see Figure 3.3).

Examination of children’s nonce word production errors revealed that in addition to phoneme substitutions and omissions, their errors sometimes resulted in real words. Table 3.8 lists children’s productions which were real words rather than nonce targets. Although the children with SLI produced the greatest number of real words overall (SLI = 19 vs. CA = 13 vs. LM = 16), their use of real words involved the fewest number of different words (SLI = 6 out of 13; CA = 9 out of 13; LM = 7 out of 13).

Correlations Between Nonword Repetition, Language Ability and Word Learning

The relation between short term working memory and word learning was examined using a correlational procedure. Specifically, total scores from the nonword repetition task were analyzed along with the total comprehension and production scores from the storybook task. Also examined were language measures collected at the onset of the study. These included the raw scores on the PPVT, the syntactic quotients of the TOLD, percentile scores on the GFTA, and the standard scores from the CMMS. Table 3.8 presents the Pearson correlations between each of these variables and the dependant variables for all three groups. As can be seen, NRT, PPVT and the TOLD were significantly related to the dependant measures, with PPVT demonstrating the highest
Figure 3.3
Nonword Repetition Task
correlation. Neither the CMMS nor the GFTA was found to be significantly correlated with the dependent measure of word learning. Interestingly, however, when the groups were separated, only the correlations of the CA group remained significant. For comprehension, scores from the CA group were correlated with NRT, $r = .58, p < .01$, and PPVTR, $r = .60, p < .01$. For production, scores from the CA group correlated with NRT, $r = .66, p < .01$, and with PPVTR, $r = .62, p < .01$.

Table 3.8
Nonword Repetition Task: Real Word Productions

<table>
<thead>
<tr>
<th>Nonce</th>
<th>Word</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>SLI</td>
</tr>
<tr>
<td>caid</td>
<td>cage</td>
<td>0</td>
</tr>
<tr>
<td>caid</td>
<td>cane</td>
<td>0</td>
</tr>
<tr>
<td>caid</td>
<td>cave</td>
<td>1</td>
</tr>
<tr>
<td>dep</td>
<td>deaf</td>
<td>6</td>
</tr>
<tr>
<td>dep</td>
<td>deck</td>
<td>1</td>
</tr>
<tr>
<td>dep</td>
<td>death</td>
<td>0</td>
</tr>
<tr>
<td>gobush</td>
<td>garbage</td>
<td>0</td>
</tr>
<tr>
<td>gud</td>
<td>good</td>
<td>0</td>
</tr>
<tr>
<td>gud</td>
<td>gut</td>
<td>0</td>
</tr>
<tr>
<td>maudin</td>
<td>mountain</td>
<td>3</td>
</tr>
<tr>
<td>nitandum</td>
<td>nintendo</td>
<td>1</td>
</tr>
<tr>
<td>nok</td>
<td>note</td>
<td>7</td>
</tr>
<tr>
<td>tob</td>
<td>tub</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td>19</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Table 3.9
Group Pearson Correlation Coefficient

<table>
<thead>
<tr>
<th></th>
<th>TOTC</th>
<th>TOTP</th>
<th>NRT</th>
<th>CMMS</th>
<th>PPVTR</th>
<th>PPVTS</th>
<th>TOLD</th>
<th>GFTA</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTC</td>
<td>--</td>
<td>.89**</td>
<td>.55**</td>
<td>.19</td>
<td>.77**</td>
<td>.41*</td>
<td>.40*</td>
<td>.33</td>
</tr>
<tr>
<td>TOTP</td>
<td>.89**</td>
<td>--</td>
<td>.50**</td>
<td>.30</td>
<td>.72**</td>
<td>.47**</td>
<td>.41*</td>
<td>.30</td>
</tr>
<tr>
<td>NRT</td>
<td>.55**</td>
<td>.50*</td>
<td>--</td>
<td>.31</td>
<td>.61**</td>
<td>.63**</td>
<td>.71**</td>
<td>.64**</td>
</tr>
<tr>
<td>CMMS</td>
<td>.19</td>
<td>.30</td>
<td>.31</td>
<td>--</td>
<td>.30</td>
<td>.40*</td>
<td>.49*</td>
<td>.23</td>
</tr>
<tr>
<td>PPVTR</td>
<td>.77**</td>
<td>.72**</td>
<td>.61**</td>
<td>.30</td>
<td>--</td>
<td>.68**</td>
<td>.45**</td>
<td>.51**</td>
</tr>
<tr>
<td>PPVTS</td>
<td>.41*</td>
<td>.47**</td>
<td>.63**</td>
<td>.40*</td>
<td>.68**</td>
<td>--</td>
<td>.68**</td>
<td>.51**</td>
</tr>
<tr>
<td>TOLD</td>
<td>.40*</td>
<td>.41*</td>
<td>.71**</td>
<td>.49**</td>
<td>.68**</td>
<td>.68**</td>
<td>--</td>
<td>.59**</td>
</tr>
<tr>
<td>GFTA</td>
<td>.33</td>
<td>.30</td>
<td>.64**</td>
<td>.23</td>
<td>.51**</td>
<td>.51**</td>
<td>.59**</td>
<td>--</td>
</tr>
</tbody>
</table>

1-tailed significance * = .01, ** = .001.

TOTC = total comprehension scores from the storybook probe.
TOTP = total production scores from the storybook probe.
NRT = percent of nonce syllables correct.
PPVTR = raw score from Peabody Picture Vocabulary Test - Revised.
PPVTS = standard score from Peabody Picture Vocabulary Test - Revised.
CMMS = standard scores from the Columbia Mental Maturity Scale.
TOLD = standard score from the syntactic quotient of the Test of Language Development-Primary.
GFTA = percentile scores from the Goldman-Fristoe Test of Articulation.

At this point, it is unclear how one should interpret the significant correlations found between NRT, PPVT and TOLD, and the word learning tasks. Two ways of proceeding were undertaken in the current study. First, following the procedure employed by Montgomery (1995b), an ANOVA was run on NRT using PPVT standard scores as a covariant. PPVTS was not found to be a significant factor. However, when the PPVT raw score was used as the covariant, it was found to be significant, t(49) = 2.93, p < .01. This difference in results is important because the standard score has been calculated from the raw score based on the child’s age. Therefore, using this value instead of the raw score partially removes the role of accumulated word knowledge from
the analysis. This point can be demonstrated by examining the CA and LM children's standard scores from the current study. Both groups have mean standard scores within the normal limits (CA = 100.7 vs. LM = 96.4), but their raw scores are quite different (CA = 70.3 vs. LM = 47.9). The current finding suggests that in previous studies vocabulary was not found to play a role because standard scores were used.

Another approach to further examine correlational data is to use a multiple regression procedure. Through this procedure, the variables which were significantly correlated to the word learning probes were analyzed to determine the relative contribution of each to the variance of the children's word learning scores. In order to compensate for variations in score ranges, all scores were standardized as z scores prior to their entry into the regression procedure. The initial regression results are provided in Table 3.10. Next, the variables were entered sequentially into the regression equation. Regardless of the order in which the variables were added, PPVT scores were found to be the only significant predictor for the dependent measures. Specifically, PPVT was found to be significant for comprehension, $F(1,51) = 76.36, p < .001$, and for production, $F(1,51) = 56.06, p < .001$. The regression equation was calculated, resulting in a significant PPVT beta value for comprehension (.77) and production (.72). As demonstrated by Table 3.11, partial correlations involving the children's performance on the word learning tasks and both the NRT and the TOLD were no longer significant after accounting for PPVT. These results indicate that although the PPVT and NRT are moderately correlated to each other and thus share some common variance, PPVT has already accounted for any variance that the NRT could account for separately.
Table 3.10
Multiple Regression Analysis

<table>
<thead>
<tr>
<th></th>
<th>Beta Weights</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Comprehension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPVT</td>
<td>.70</td>
<td>6.20</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>NRT</td>
<td>.12</td>
<td>0.87</td>
<td>.39</td>
</tr>
<tr>
<td>TOLD</td>
<td>-.01</td>
<td>-0.08</td>
<td>.93</td>
</tr>
<tr>
<td>Total Production</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PPVT</td>
<td>.67</td>
<td>5.38</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>NRT</td>
<td>.02</td>
<td>0.15</td>
<td>.88</td>
</tr>
<tr>
<td>TOLD</td>
<td>.10</td>
<td>0.70</td>
<td>.49</td>
</tr>
</tbody>
</table>

NRT = percent of nonce syllables correct.
PPVT = raw score from Peabody Picture Vocabulary Test - Revised.
TOLD = standard score from syntactic quotient of the Test of Language Development-Primary.

Table 3.11
Partial Correlations After Accounting for PPVT

<table>
<thead>
<tr>
<th></th>
<th>Partial Correlation</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Comprehension</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRT</td>
<td>.15</td>
<td>1.04</td>
<td>.30</td>
</tr>
<tr>
<td>TOLD</td>
<td>.08</td>
<td>0.57</td>
<td>.57</td>
</tr>
<tr>
<td>Total Production</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NRT</td>
<td>.10</td>
<td>0.73</td>
<td>.47</td>
</tr>
<tr>
<td>TOLD</td>
<td>.14</td>
<td>1.09</td>
<td>.32</td>
</tr>
</tbody>
</table>

PPVT = raw score from Peabody Picture Vocabulary Test - Revised.
NRT = percent of nonce syllables correct.
TOLD = standard score from syntactic quotient of the Test of Language Development-Primary.
DISCUSSION

The goal of this study was to examine the word learning abilities of children with and without SLI. A major component of this goal was to learn more about the underlying deficit responsible for differences in children's word learning abilities. To that end, it was necessary to examine two working memory hypotheses, and to determine whether either one could explain the word learning behaviors of children. In order to test the validity of these two working memory accounts, several input factors were manipulated within a storybook word learning paradigm. Along with this task, a nonword repetition task was administered to assess working memory capacity. It was predicted that group differences would exist between the children with SLI and their normally developing peers on both tasks. Furthermore, input manipulations were expected to affect the children with SLI more than the controls. Finally, a positive correlation was predicted between children's word learning abilities and their working memory capacities.

In the sections below, the results of this study are discussed as they relate to the proposed research questions. Next, the results are compared to previously reported work. Finally, the research findings are considered in light of the two working memory hypotheses.

Research Findings

The first question in this study asked whether there were group differences in word learning between the children with SLI and their normal controls. Interestingly, findings for group differences varied depending on the task used to assess the children's
knowledge of the novel words. Recall that word learning was assessed through two tasks. One examined the children's word knowledge through a picture pointing task, and the other involved a naming task. For the comprehension task, group differences interacted with race. For the EA children, those with SLI, like the LM preschoolers, were less proficient word learners than the CA controls. However, for the AA children, those with SLI were not found to be significantly different from the age-matched children. In fact, their scores were higher than those obtained by the preschoolers. For the production task, however, both the EA and AA CA groups performed significantly better than the SLI and LM groups.

The next three research questions involved the potential effects of three input manipulations on word learning. These were sentence complexity, word type, and presentation rate. Across the comprehension and production tasks, sentence complexity was not found to influence word learning. Word type, however, was found to be a significant factor. For both comprehension and production, verbs scores outnumbered noun scores. This finding was observed for all three groups regardless of race. Findings for rate were mixed. When children's word knowledge was tested through the comprehension task, influences of rate were found to interact with the group variable. Specifically, children with SLI were found to learn fewer words under the fast rate than with the slow, but the word learning scores of the two control groups were not affected by rate. When word knowledge was assessed through production, however, rate was found to be a nonsignificant influence. At both the fast and slow rates, scores of the CA children were significantly higher than the scores of the SLI and LM groups.
Another interesting finding of this study that was related to the first four questions was the comparison between the two testing probes. Across all children, word learning scores were highest when tested with the comprehension probe as compared to the production probe. For each group and race, analysis of the effect size for the differences between the two tasks was consistently found to be high (> 2.1).

The final research question looked at the children's working memory abilities. Group differences were found for the nonword repetition task, and no race effects were evident. In contrast to the word learning task, the children with SLI did more poorly than both control groups. Moreover, the CA group significantly outperformed the younger controls. The length of the nonce items also was found to influence performance, with the one syllable items being easier for all children to repeat than the three and four syllable ones. Interestingly, a positive correlation was found between the scores from the nonword repetition task and the children's total comprehension and production scores. However, when the correlation was followed with a regression analysis, the children's nonword repetition scores were not found to predict word learning ability once receptive language skills (i.e., raw PPVT scores) were taken into consideration.

Comparisons to Previous Research

Group Differences

Based on previous word learning studies, children with SLI were expected to learn fewer words than the CA children. This was true when word learning was tested through the production probe. This pattern of results also occurred for the EA children.
when word learning was tested through the comprehension probe. However, it was not true for the AA children. For these children, group differences between the CA and SLI groups were not found.

One possible source for the race differences found in this study could be the use of a storybook reading format. It is possible that cultural differences related to the frequency and quality of storybook reading experienced by the children affected their performance. Several studies have reported that AA children from low socioeconomic homes demonstrate less familiarity with the language, structure and use of books when entering school (Heath, 1982; Hester, 1996). Parental literacy also could play a role. In a study examining the role of various maternal factors on children’s interest in reading, DeBaryshe (1995) found several positive influences. The study included 60 low-income and 56 working-class families, most of whom were African American. Results indicated that maternal literacy was positively associated with mother’s beliefs about reading aloud to their children. These beliefs were, in turn, positively related to children’s interest in reading.

A second possible explanation for the race effects could be task familiarity. Recall that the word learning probe involved two tasks. In the comprehension task children were asked to point to a picture corresponding to the target item. In the production task, children were required to provide a real word which was synonymous with the target item. Such responses are similar to a labeling task, and this may be a less familiar task for minority children to perform. Support for this possibility comes from a study by Pena and Quinn (1997). They evaluated the performance of African-American
and Latino-American children on tasks requiring either verbal descriptions or word labeling. Both groups of minority Head Start children exhibited significantly better performance on the descriptive task, which was reported to be more familiar to them. Moreover, the descriptive task was found to be a more reliable tool for discriminating normal children from those identified as language impaired.

Another potential explanation for the group by race interaction could be related to differences in the knowledge base between the groups. It has been shown that AA children without language impairments do not perform well on standardized tests of language knowledge (Mount-Weitz, 1996; Washington & Craig, 1992). For example, in a study by Campbell, Dollaghan, Needleman, and Janosky (1997), performance differences were found between normal minority and majority children on "knowledge-dependent", but not on "processing-dependent" language tests. The knowledge-dependent task used was the Oral Language Scale from the Woodcock Language Proficiency Battery-Revised (Woodcock, 1991). This standardized test evaluated abilities similar to those used in the current study, because children were required to demonstrate sight word knowledge. One of the processing dependent tasks was a nonword repetition task which was similar to the one used here. Interestingly, in the current work, race interacted with group only on the word learning tasks. For the nonword repetition task, the participant's race was not a contributing factor. This finding is in agreement with those of Campbell, et al. (1997), who stated that processing based tasks are not racially biased. Therefore, it seems reasonable to speculate that
cultural differences like those thought to underlie biases in standardized language tests contributed to the effect obtained for the comprehension probe used here.

**Input Manipulations**

Previous studies that have examined input manipulations have found positive results when they have examined children's comprehension of sentences. For example, Curtiss and Tallal (1991), and Montgomery (1995b) found that increased sentence complexity resulted in decreased performance among normal and impaired children. However, in the current work, sentence complexity was not found to affect word learning. Methodological differences between the studies could explain the discrepancies in the results. First, the sentences used by the other researchers have not been consistent in length. For example, the redundant sentences of Montgomery were often longer (e.g., "The boy who is kicking the girl is tall and skinny") than the nonredundant ones ("The boy kicking the girl is tall and skinny"). Thus in previous work, the variable of sentence complexity has been confounded by sentence length. This confound makes it difficult to know which factor, length or complexity, was really being evaluated. In the current work, the number of syllables was kept constant across the two complexity conditions. One possible interpretation of the lack of a significant complexity effect obtained here is that the findings reported by Curtiss and Tallal and Montgomery actually involved a length effect, not a complexity effect.

Another unpredicted finding involved the variable of word type. Contrary to predictions, a group by word type effect was not found, although word type was significant for all groups. In fact, for both comprehension and production, more verbs
were acquired than nouns. This pattern was interesting because in other research which has looked at noun and verb acquisition and usage, nouns have outnumbered verbs (Conti-Ramsden & Jones, 1997; Rice, et al., 1990; Watkins, et al., 1995). Even though the word learning pattern found in the current study is the reverse of what was expected, this finding is not without precedence. In an early word learning study, Leonard, Schwartz, Chapman, Rowan, Prelock, Terrell, Weiss, and Messick (1982b) compared the word learning abilities of 3-year-old children with SLI to those of normally developing language-matched controls. The children were trained to associate novel words with unfamiliar objects and actions over ten structured sessions. Interestingly, results indicated that both the normal and impaired groups acquired more action words than object words.

Also, an advantage was found for verb learning in the study by Rice, et al. (1994). In that study, children with SLI and their age-matched controls comprehended more verbs than nouns under the high input frequency condition. Possible explanations provided by the authors included the following. First, they speculated that the actions shown in the video might have been of particular interest to children. Second, they hypothesized that the narrative also highlighted the verb-action pairings. The videos and narrative were described as being “about actions”. For example, in one story the main character finds a rocket ship, flies in the air, crashes, and then lands on an island. At the end of the story, animals on the island help the protagonist rebuild the ship so he can get home.
In the current study, the books were chosen because they clearly depicted actions as well as objects. For example, in the story about farm animals looking for the sun, they make so much noise jumping around and hollering that the farmer and his wife wake up. Since the farmer thinks a fox is in the hen house, he runs to the window and, with his face bright red, fires his gun out the window. A bright orange burst accompanies the words “bang bang” in the target sentence. The nonce word nebbeled was used for the target action, fired, in the narrative. Also as part of this section of the narrative, the word famoz was used to indicate the object, cradle, in which the baby was still sleeping.

Interestingly, the target word for fired was produced correctly by most of the children in all three groups. In contrast, the nonce word for cradle was missed by most of the children. This finding suggests that the narrative and corresponding action of firing the gun was more salient to the children than the narrative and corresponding object cradle.

Another possible explanation for the high verb learning scores might have been tied to morphological cues present in the word learning probes. For example, the present progressive -ing, was included when children were tested on verbs. The inflection might have increased the likelihood of verb selection. Some researchers have demonstrated that young children are sensitive to the information present in the syntactic structure of a sentence when interpreting novel actions (Fisher, 1993; Gleitman, 1990; Maratsos, 1990; Maratsos & Chalkey, 1995; Naigles, 1990). For example, Naigles (1990) showed that toddlers who simultaneously viewed two monitors displaying enactments of different syntactic situations were able to differentiate between them based on the verb phrase structure heard. Children attended more to the monitor showing the scene that matched
the syntax they heard, indicating that the two-year-olds were capable of using syntactic information. Recent evidence suggests that children with SLI also make use of morphosyntactic cues when interpreting novel verbs as well (Oetting, in press).

The final manipulation examined in the current study was presentation rate. Recall that the children with SLI were more influenced by rate than the controls. This finding is consistent with trends observed by Ellis Weismer and Hesketh (1993) and Fazio (1998). Interestingly, in a later study by Ellis Weismer and Hesketh (1996), children with SLI were influenced by presentation rate to a greater degree than normally developing children, but only for production. No group differences were found for comprehension of novel words. In the current work, rate influences were observed for comprehension but not production. The difference across studies may be tied to ceiling and floor effects. In the Ellis Weismer and Hesketh study, high comprehension scores (70% to 83% correct) for all children might be responsible for the lack of a significant rate effect. Indeed, within their discussion, the authors commented that in their preliminary work they had found significant rate effects for comprehension, but that accuracy was lower in that study. Floor effects may have occurred in the current study. Here, children’s scores were fairly low on the production task i.e., 6.4 out of 32, or 20% correct for the children with SLI). Therefore in the current work, production scores may have been too low to reveal significant effects for rate.

**Working Memory Skills**

Three different findings for the nonword repetition task can be compared to previous studies. These include: group effects, syllable length effects, and error patterns.
As in other studies, children with SLI performed more poorly than age-matched 
(Edwards & Lahey, 1998; Gathercole & Baddeley, 1990a; Kamhi, et al., 1988), and 
younger, normally developing controls (Montgomery, 1995a,b). Further analysis of the 
nonword repetition data from the current study did not reveal any significant race, or 
group by race effects. This is in accordance with the Campbell, et al. (1998) claim that 
processing-dependent tasks such as nonword repetition are unbiased towards minority 
children.

In the current study, nonword repetition accuracy decreased with increasing 
syllable length for all groups. However, only the performance differences between one 
syllable items and the two, three and four syllable items were statistically significant. 
Performance differences due to syllable length have been reported by other researchers. 
For instance, in a longitudinal study of normally developing children, Gathercole, et al., 
(1991) reported an accuracy decline with increasing syllable length. In a study 
employing children with SLI and normally developing controls, Montgomery (1995a,b) 
also found that children’s repetitions decreased in accuracy as syllable length increased. 
However, children with SLI repeated fewer three and four syllable items when compared 
to the control children. These results were similar to those of Gathercole and Baddeley 
(1990a). They also found that children with SLI repeated the three and four syllable 
words with less accuracy than the shorter items. The group by syllable length interaction 
found in these other studies was not found in the current investigation, however. Here all 
children demonstrated a similar pattern of accuracy. One explanation for the 
performance differences might be sample size. Although the 20 nonce items used in the
current study were drawn from the list published by Montgomery (1995a,b), the original set he used contained 48 words. It is possible that the nonce items used in the current study were not the most challenging ones for the children. Alternatively, the greater number of items used by Montgomery could have made the task more difficult in general, and therefore the children with SLI were less prepared to deal with the longer items.

In the current work, a number of the nonword repetition errors resulted in the production of real words. This also is in agreement with Dollaghan, et al., (1995), who stated that the influence of children’s previous word knowledge is evident from their repetition performance. Specifically, they found that production errors frequently resulted in the conversion of nonwords into real words.

Just as with the studies by Montgomery (1995b) and Gathercole and Baddeley (1989), it was found that total scores from the nonword repetition task were moderately correlated with measures of word learning. However, unlike the conclusions drawn by these other investigators, a direct cause and effect was not assigned to this correlation. Instead, regression analysis revealed that the majority of the variance in the children’s word learning performance was attributable to the children’s raw PPVT scores. Moreover, when the procedure used by Montgomery was followed and PPVT standard scores were used as a covariant in the analysis of NRT scores, Montgomery’s results were replicated. But it was subsequently demonstrated that the use of standard scores biased the results. When raw PPVT scores were used instead, the covariant was found to be significant. This finding, along with the moderate correlation found between the NRT and the PPVT scores indicates that the two variables share something in common, but it
is unclear what that shared variance is. Further work is necessary to illuminate the nature of the relationship between these two variables.

Testing the Two Working Memory Hypotheses

When this study was designed, various manipulations of input factors were made to evaluate children's word learning and to test the validity of two working memory hypotheses. Both hypotheses proposed that children with SLI had a more restricted working memory capacity than normally developing children. The major difference between the two hypotheses was the specificity of the proposed working memory deficit. Baddeley's phonological working memory deficit hypothesis proposes that novel items are maintained in the phonological store of the phonological working memory system prior to formation of long-term phonological representation. Therefore, if the store has a limited capacity, as suggested to be the case in children with SLI, long term learning of new words would be adversely impacted. In contrast, the limited capacity hypothesis proposes a global, nonspecific capacity restriction in these children. According to this approach, when task demands exceed the available resources, storage and computational functions break down. Within this proposal any type of manipulation has the potential for exceeding resources. Thus the deficit could be anywhere within the working memory system. This includes, but is not limited to, the phonological content of language.

Both hypotheses would predict that the children with SLI would perform more poorly on the word learning task than the CA children, regardless of race. In the current investigation, this performance difference was found for the children with SLI on the production task, but only for the EA children with SLI on the comprehension task. The
finding that the AA children with SLI were not significantly different from AA-CA
controls can not be explained by either working memory hypothesis.

Although input manipulations provided interesting information about word
learning, they were not particularly informative in terms of separating the two
hypotheses. Sentence complexity did not significantly alter performance for any group.
Word learning differences based on target word type also did not reveal a group by word
type interaction. Whatever caused the children to learn more verbs than nouns had the
same effect on all children, regardless of group membership. Therefore, the performance
differences cannot be attributed to, or evaluated in terms of the two working memory
accounts. The decreased word learning found at the fast presentation rate on the
comprehension task can fit with the predictions of either working memory deficit account
of SLI, since both might predict a processing problem associated with the timing of the
input.

The children with SLI did performed more poorly on the nonword repetition task
than both groups of controls. The moderate correlations obtained between the word
learning scores and the nonword repetition scores could be taken as support for the
proposal that they have a less efficient working memory system, since the task is meant to
evaluate phonological working memory capacity. However, it is important to note that
the same results would be anticipated under a general limited capacity hypothesis.

Moreover, regression analysis revealed that nonword repetition was not a
significant predictor of word learning once receptive language skills (raw PPVT scores)
were taken into account. Although this finding does not differentiate the two hypotheses,
it suggests that a child’s prior word knowledge plays a substantial role in novel word acquisition, and that working memory may play a less important role. At the same time, it is important to note that the strong influence of prior lexical knowledge could be obscuring contributions of working memory. The fact that the children with SLI and the younger, normally developing children were matched on PPVT raw scores must be considered as a confound. A link to vocabulary ability was established through this matching procedure. As a result, the role of prior vocabulary knowledge might be overinflated relative to that of the working memory system.

Contributions of the Current Study

One important finding from this study was the possible link between the characteristics of the participants and the methodology. The use of a storybook reading paradigm, although a more naturalistic task than those used by others, may be racially biased. As a result, if this procedure were to be used in the future, it would be prudent to consider race as a significant performance factor. However, even with the race effects, the findings from this work add to our knowledge of word learning in children. When considering the impact of this study on our knowledge of group differences, for production, children with SLI again have been shown to learn fewer words than normally developing peers. For comprehension, EA children with SLI also were found to acquire fewer new words than their corresponding CA-EA peers.

More importantly, these results add to our knowledge of word learning in AA children. In the current study, the comprehension task was found to be racially biased. This finding supports the claim that some types of procedures are more culturally biased.
than others. As stated by Mount-Weitz, (1996), little research has been conducted which examines word learning in African-American children. What little work has been performed has mainly compared their performance on standardized tests to that of majority children.

Results from the input manipulations have increased our knowledge base. First, the sentence complexity manipulation raised doubts with regard to the interpretation of previous work. Specifically, the effect reported by Curtiss and Tallal, and Montgomery could have been due to sentence length rather than sentence complexity. Next, the fact that all groups learned more verbs than nouns suggests that when the narrative and visual context of action labels are particularly salient, verb learning can be enhanced for all children.

Finally, the presentation rate effect found for the comprehension probe indicates that, in addition to the effects found by Ellis Weismer and Hesketh for their production probe, under different conditions rate also can affect comprehension. Moreover, the findings show that rate effects on word learning can be found in tasks that attempt to simulate a naturalistic word learning context. These findings also can be used to inform therapists providing intervention. Specifically, it seems advisable to use a slower speaking rate when interacting with children who demonstrate language learning difficulties. The slower rate may allow children more time to process information and language learning may be enhanced.


**Future Research**

From the current work, it is clear that there remains a need to study learning related to different cultural groups. The use of normal measures of cultural bias in the study were as standard reading procedures and the use of the BDI-II for measuring the situations with in the procedures continue to address the current reading paradigm to the other measures of word learning have employed different procedures and have not reported

Further, there is a need to extend the reading paradigm in the context of cultural diversity.

The measures used to measure cultural diversity among groups must be more refined to capture the nuances of cultural influence on reading performance. Additional measures of cultural bias could be developed to address the needs of learners in non-standardized ways. Differences in cultural reading procedures could be studied in comparison to traditional testing environments which are more similar to those used in more than one culture. The measures processingsound tests could be improved further than a non-standard based tests.

Turning to the design variations, some of the major manipulations undertaken in this study could be extended to future research. For example, there are several other ways in which the target sentences could have been modified. In the test used some sets of target sentences were of a basic subject-verb-object construction, while other sets were

It might have been better if the two sample sentences were
consistently short and did not contain any clauses. The complex sentences could likewise be shortened to be consistent with the two simple ones. Differences between word types might be examined more closely by eliminating all bound morphemes on the verbs. Alternatively, the use of bound morphemes at test could be compared to the use of a bare stem at test to examine whether the elicitation procedures used in the current work biased results. Also a book could have been chosen with some obvious action verbs and some which were not obvious, to examine the effect of referent saliency. Finally, further work could include input manipulations that are nonphonological in nature. For instance, the target item could be highlighted with nonverbal cues, as in the study by Ellis Weismer and Hesketh (1998).

A different working memory task also could be employed in future work. For example, Avons, et al (1998) examined a wider array of abilities including vocabulary scores (PPVT), and working memory using word span (i.e., spoken serial recall of 1-3 syllable real words), articulatory rate, nonword repetition, rhyme detection (using consonant-vowel-consonant words), and visual short-term memory (using patterns). A group of preschoolers were tested around age five and again 13 months later. Results from the first test revealed that memory span, rhyme detection and nonword repetition were the best predictors of vocabulary ability. However, at the second test time, only memory span and rhyme detection were significant predictors. Avons, et al. concluded that their results supported the role of the phonological store in vocabulary acquisition. The insignificant role for the nonword repetition task at the second test time was attributed to an increased influence of word knowledge on the task as children became
Findings by Avons, et al. suggest that tasks other than the nonword repetition task should be used to evaluate working memory ability.

Another potential working memory task was used by Ellis Weismer and Hesketh (under review). They had school-aged children with and without SLI perform a task with two parts. To assess working memory, children completed the Competing Language Processing Task (CLPT) developed by Gaulin and Campbell (1994). During this procedure, sets of 1-6 short, simple statements are presented to participants. Participants are required to first listen to each sentence, then respond yes or no with respect to the truth of each sentence. At the end of each set of sentences, the children are then asked to recall the last word from each sentence. Findings revealed that children with SLI were not different from the CA controls on the yes/no task, but they performed significantly more poorly on the recall task. Not only are these other working memory tasks interesting as alternatives to the nonword repetition task, the task employed by Ellis Weismer et al. could possibly be employed in conjunction with a storybook task since it involves sentences. The rationale for using a different type of task centers around the need to tease apart processing-related skills and content-related skills. Ideally, one would like to identify a working memory or processing task that does not correlate with accumulated word knowledge, but relates to, or predicts, children's ability to acquire words incidentally and rapidly in the process of everyday learning situations.

Summary and Conclusions

The purpose of the current work was to further examine the word learning abilities of children with and without SLI. Storybook reading was chosen to introduce
novel words to children in order to examine word learning in a quasi-naturalistic task. Within the storybook reading task, sentence complexity, word type, and presentation rate were manipulated to examine their influence on the children's word learning skills. Two probes were administered to determine word learning, one a comprehension task and the other a production task. Also as part of the study, a nonword repetition task was administered to the children as a measure of their working memory capacity.

On the storybook task, the children with SLI consistently performed more poorly than their age-matched and language-matched peers when word learning was tested through a production probe. When word learning was tested with a comprehension probe, group differences between the SLI and age-matched controls were significant for the European-American children only. When performance was broken down by presentation rate, the children with SLI were more influenced by rate than the controls. Performance of the children with SLI on the nonword repetition task was poorer than both control groups. The total scores from the nonword repetition task were moderately correlated with total comprehension and production scores for the storybook tasks. However, nonword repetition also was found to be moderately correlated to raw score on the PPVT. When regression analyses were completed, only PPVT raw score was found to be a significant predictor of the children's performance on the word learning task.

The above findings replicate and extend previous work in word learning. First, the group effects for production and the rate by group interaction replicate previous studies and further confirm that vocabulary learning is difficult for children with SLI.
Second, the findings from the comprehension probe provide useful information about the effects race and/or culture may play in experimental studies of word learning. Finally, the findings related to the nonword repetition task suggest that much more work needs to be done before the relation between working memory and vocabulary learning is understood.
REFERENCES


88


deficient in children with language impairments: A comment on van der Lely & Howard

influence of number of syllables and wordlikeness on children’s repetition of nonwords.  

memory in normal school-aged children: Some preliminary data. Perceptual and Motor
Skills, 79, 55-64.

Child Development, 49, 988-998.

Gentner, D. (1982). Why nouns are learned before verbs: Linguistic relativity

without language impairment. Journal of Speech and Hearing Research, 38, 393-402.

Acquisition, 1, 3-55.

Circle Pines, MN: American Guidance Services, Inc.


Heath, S. B. (1982). What no bedtime story means: Narrative skills at home and
school. Language in Society, 11, 49-76.


Kamhi, K. E. Pollick, & J. L. Harris (Eds.), Communication Development and Disorders

referral rate as predictors memory span in children. The Quarterly Journal of
Experimental Psychology, 41A, 321-337.


Oetting, J. B. (In press). Do children with SLI make use of argument structure cues to learn verbs? *Journal of Speech, Language and Hearing Research*


APPENDIX A

STORYBOOK NARRATIVE

The following text consists of both modified and original (italics) narrative from the books. Modified sentences with an “S” before them are the re-written simple sentences, and those with a “C” are the complex sentences.

Book 1: WAKE UP SUN. Version A

[Training sentence]
THE DOG IS SLEEPING. HE IS DREAMING.

PAGE 1
S  DOG IS BROWN AND FURRY. ONE NIGHT DOG WAS SLEEPING IN HIS LODGEWHEN A FLEA BIT HIM ON THE EAR.

PAGE 2
DOG WOKE UP.

PAGE 3
S  DOG THOUGHT IT WAS MORNING. HE DASUCKED AT THE SKY. "WOOF! WOOF!" SAID DOG. "IT MUST BE TIME TO GET UP."

PAGE 4
C  PIG, WHO WAS REALLY VERY TIRED, WAS MAVING ON THE STRAW. PIG WOKE UP. "OINK! OINK!" SAID PIG. "BE QUIET!"

PAGE 5
S  DOG’S LEGS WERE STIFF FROM SLEEPING. HE BONNAZED HIS BODY. "IT IS TIME TO GET UP," SAID DOG. "NO, IT IS NOT," SAID PIG. "THE SUN IS NOT UP." "WHERE CAN THE SUN BE?" ASKED DOG.

PAGE 6
C  DOG AND PIG, STANDING AT THE BARN DOOR, WERE BRING WATCHED BY THREE BROWN SEPALS AND A MOUSE. "MAYBE IT FELL INTO THE WELL," SAID PIG.

INSERT
DOG AND PIG RAN TO THE WELL.
PAGE 7
S PIG WAS WORRIED AND WIDE AWAKE. HE OPENED HIS ZADIR AND CALLED.
“SUN! SUN!” "ARE YOU DOWN THERE?” ASKED PIG.

PAGE 8
COW WOKE UP. "MOO! MOO!” SAID COW. "WHAT ARE YOU DOING?”
INSERT
THEY TURNED TO COW.

PAGE 9
C PIG, WHILE POINTING TO THE COW, WAS HOLDING ONTO THE SHUPICK TO STAND UP.
"WE ARE LOOKING FOR THE SUN,” HE SAID.”

PAGE 10
"MAYBE THE SUN IS HIDING BEHIND THE BARN,” SAID COW.

PAGE 11
DOG, PIG AND COW, AFTER RUNNING ACROSS THE YARD, BALLOPED AROUND THE BARN.
"COME OUT, SUN!” SHOUTED COW.

PAGE 12
"CLICK! CLUCK!” SAID CHICKEN. "WHAT IS WRONG?’

PAGE 13
"WE CAN NOT FIND THE SUN,” SAID COW.
CHICKEN, WHO WAS VERY SMART, STOOD ON THE CONTAMP LOOKING AT THE OTHER ANIMALS.
CHICKEN SAID, "MAYBE THE SUN IS SLEEPING LATE.”

PAGE 14
"THEN WE MUST WAKE UP THE SUN,” SAID DOG.
ALL OF THE ANIMALS BEGAN TO YELL.
CLUCK! CLUCK! MOO! MOO! OINK! OINK! WOOF! WOOF!
CHICKEN, BECAUSE SHE WAS SO EXCITED, KOOTTLED HER WINGS IN THE AIR.

PAGE 15
FARMER AND HIS WIFE WOKE UP.
BABY WAS FAST ASLEEP. SHE WAS LAYING IN HER FAMMOZ AND
DID NOT WAKE UP.

PAGE 16
"THERE MUST BE A FOX IN THE HEN HOUSE," FARMER SAID.

PAGE 17
THEN FARMER RAN TO THE OPEN WINDOW. HE NEBBLED HIS GUN, BANG BANG.

PAGE 18
THE ANIMALS STOPPED. THEY HAD HEARD THE FARMER'S GUN. IT WAS QUIET, BUT NOT FOR LONG.

PAGE 19
"WHAA! WHAA! WHAA!" FARMER'S BABY WOKE UP.

PAGE 20
FARMER'S BABY, WHO HAD WOKEN UP BECAUSE OF THE NOISE, CRIED JUST AS THE SUN ROSE OVER THE DILLER THAT MORNING. "LOOK!" SAID DOG. "FARMER'S BABY WOKE UP THE SUN!"

PAGE 21
THAT WAS A SPECIAL DAY. AFTER THAT DOG ALWAYS PLAYED ZUPUD WITH FARMER'S BABY.

PAGE 22
THE PIG, WHO LET BABY CHASE HIM AND PULL HIS TAIL EVERY DAY, WOULD GISTOV AND LAUGH.

PAGE 23
COW GAVE THE BABY LOTS OF GOOD TASTING MILK. SHE MOGPALED IT FROM HER CUP.

PAGE 24
AND CHICKEN LAID EGGS FOR HER, ONE EVERY DAY.

PAGE 25
THE ANIMALS WERE VERY NICE TO FARMER'S BABY. AFTER ALL, THEY KNEW SHE WAS THE ONLY ONE WHO COULD WAKE UP THE SUN!
Book 1: WAKE UP SUN. Version B

(Training sentence)
THE DOG IS SLEEPING. HE IS DREAMING.

PAGE 1
C ONE NIGHT DOG, WHO IS BROWN AND FURRY, WAS SLEEPING IN HIS LODGE WHEN A FLEA BIT HIM ON THE EAR.

PAGE 2
DOG WOKE UP.

PAGE 3
C DOG, THINKING IT WAS MORNING, DASHUCKED AT THE SKY. "WOOF! WOOF!" SAID DOG. "IT MUST BE TIME TO GET UP."

PAGE 4
S PIG WAS REALLY VERY TIRED. HE WAS MOVING ON THE STRAW. PIG WOKE UP. "OINK! OINK!" SAID PIG. "BE QUIET!"

PAGE 5
C DOG, WHOSE LEGS WERE STIFF FROM SLEEPING, BONNAZED HIS BODY. "IT IS TIME TO GET UP," SAID DOG. "NO, IT IS NOT." SAID PIG. "THE SUN IS NOT UP." "WHERE CAN THE SUN BE?" ASKED DOG.

PAGE 6
S DOG AND PIG WERE STANDING AT THE BARN DOOR. THEY WERE BEING WATCHED BY THREE BROWN SEPALS AND A MOUSE. "MAYBE IT FELL INTO THE WELL," SAID PIG. INSERT DOG AND PIG RAN TO THE WELL.

PAGE 7
C PIG, LOOKING WORRIED AND WIDE AWAKE, OPENED HIS ZADIR AND CALLED. "SUN! SUN!". "ARE YOU DOWN THERE?" ASKED PIG.

PAGE 8
COW WOKE UP. "MOO! MOO!" SAID COW. "WHAT ARE YOU DOING?" INSERT
THEY TURNED TO COW.

PAGE 9
S PIG WAS POINTING TO COW. HE WAS HOLDING ONTO THE SHUPICK TO STAND UP.
"WE ARE LOOKING FOR THE SUN," PIG SAID.

PAGE 10
"MAYBE THE SUN IS HIDING BEHIND THE BARN," SAID COW.

PAGE 11
S DOG, PIG AND COW RAN ACROSS THE YARD. THEN THEY BALLOPED AROUND THE BARN.
"COME OUT, SUN!" SHOUTED COW.

PAGE 12
"CLICK! CLUCK!" SAID CHICKEN. "WHAT IS WRONG?"

Page 13
"WE CAN NOT FIND THE SUN," SAID COW.
S CHICKEN WAS VERY SMART. SHE STOOD ON THE CONTAMP LOOKING AT THE OTHER ANIMALS.
CHICKEN SAID, "MAYBE THE SUN IS SLEEPING LATE."

PAGE 14
"THEN WE MUST WAKE UP THE SUN," SAID DOG.
ALL OF THE ANIMALS BEGAN TO YELL.
CLUCK! CLUCK! MOO! MOO! OINK! OINK! WOOF! WOOF!
S THE CHICKEN WAS VERY EXCITED. SHE KOOTTLED BER WINGS IN THE AIR.

PAGE 15
FARMER AND HIS WIFE WOKE UP.
C BABY, WHO WAS FAST ASLEEP, WAS LAYING IN HER FAMMOZ AND DID NOT WAKE UP

PAGE 16
"THERE MUST BE A FOX IN THE HEN HOUSE," FARMER SAID.

PAGE 17
C THEN THE FARMER, WHO RAN TO THE OPEN WINDOW, NEBBELED HIS GUN, BANG! BANG!

PAGE 18
THE ANIMALS STOPPED. THEY HAD HEARD THE FARMER'S GUN. IT WAS QUIET, BUT NOT FOR LONG.

PAGE 19
"WHAA! WHAA! WHAA!" FARMER'S BABY WOKE UP.

PAGE 20
FARMER'S BABY CRIED BECAUSE THE LOUD NOISE HAD WOKEN HER UP. JUST THEN THE SUN ROSE OVER THE DILLER THAT MORNING. "LOOK!" SAID DOG. "FARMER'S BABY WOKE UP THE SUN!"

PAGE 21
THE DOG, AFTER THAT VERY SPECIAL DAY, ALWAYS PLAYED ZUPUD WITH THE FARMER'S BABY.

PAGE 22
PIG LET BABY CHASE HIM AND PULL HIS TAIL EVERY DAY. HE WOULD GISTOV AND LAUGH.

PAGE 23
COW GAVE BABY LOTS OF MILK, WHICH TASTES GOOD, AND SHE MOGGaled IT FROM HER CUP.

PAGE 24
AND CHICKEN LAID EGGS FOR HER, ONE EVERY DAY.

PAGE 25
THE ANIMALS WERE VERY NICE TO FARMER'S BABY. AFTER ALL, THEY KNEW SHE WAS THE ONLY ONE WHO COULD WAKE UP THE SUN!
Book 2: SNUG BUG. Version A

[Training sentence]
MAMA BUG IS CARRYING SNUG BUG.
SHE HAS FOUR FEET.

PAGE 1
"IT IS TIME FOR BED. PUT YOU TOYS AWAY" SAYS MOMMA BUG.
S LITTLE SNUG BUG IS LOOKING AT HIS MAMA. HE IS SITTING IN HIS
HAM PET AND SAYS, "I WANT TO PLAY."

PAGE 2
"WHERE HAVE YOU GONE?" ASKS MAMA BUG.

PAGE 3
S SNUG BUD DOESN'T WANT TO BE FOUND. HE IS SATTING UNDER THE
RUG.

PAGE 4
MAMA BUG WANTS TO FIND SNUG BUG.
C SMART MAMA BUG, WHO KNOWS WHERE HER BOY IS, DESHONDS
THE RUG.
"THERE YOU ARE, MY LITTLE SNUG BUG! COME WITH ME".

PAGE 5
C MAMA BUG, KNOWING IT IS TIME TO WASH, SAYS "INTO THE PIMEL
YOU GO."

PAGE 6
MAMA BUG LIKES SNUG BUG TO BE CLEAN. SHE WASHES HIM ALL
OVER.WITH THE SOAP. IT MAKES HIM LAUGH.

PAGE 7
WHEE! LOOK AT ME!
MAMA BUG SAYS, "YOU ARE DONE."
S PLAYFUL SNUG BUG WANTS TO STAY IN THE WATER. HE SAYS, "THE
SOAPY HADLICKS ARE FUN, LET ME PLAY."

PAGE 8
GLUB, GLUB, GLUB.
SCRUB, SCRUB, SCRUB.
S MAMA BUG IS MOVING QUICKLY AND FIRMLY. SHE KONNIPS HER
SNUG BUG OFF WITH THE TOWEL.
SNUG BUG BRUSHES HIS TEETH,
SNUG BUG, AS HE STANDS ON THE FAUCET, POENIGS HIS TOOTHPASTE INTO THE BATHROOM SINK.

MAMA BUG, WHO IS FLYING THROUGH THE AIR, JUST PAST THE MUBIR...IT IS ALMOST EIGHT.

NOW IT'S TIME FOR A GO-TO-BED STORY.
MAMA READS “LITTLE MISS MUFFET SAT ON A TUFFET.”
SNUG BUG KNOWS THE BOOK BY HEART. THE SPIDER IS HIS FAVORITE PART.

SNUG BUG AND MOMMA BUG, WHO ARE HOLDING HANDS, LOOK OUT OF THE PAMMIT AND SEE THE MOON.
IT'S TIME FOR BED. IS SNUG BUG READY? NO!

LITTLE SNUG BUG, WHO IS TRYING TO FIND HIS TEDDY BUG, LOOKS BEHIND THE BESOP AND SAYS, “THERE YOU ARE”.
"MAMA BUG SAYS “NOW INTO BED.”

SLEEPY SNUG BUG NEEDS TO GO TO BED. HE GADROYS WITH HIS MOUTH OPEN.

MAMA BUG, BEING CAREFUL NOT TO SHAKE HER SNUG BUG, IS ZORTING ON HER KNEES NEXT TO HIM.
“SWEET DREAMS, SNUG BUG,” SAYS MAMA BUG. SHE GIVES SNUG BUG A BIG BUGGY HUG.

SNUG BUG SITS UP QUICKLY.
"MAMA! COME BACK! HELP HELP! HURRY!” THE VERY SCARED SNUG BUG MISEEDS OUT LOUD.
THERE'S SOMETHING HERE..
...IT'S BIG AND FURRY!”
MAMA COMES BACK. SHE HEARS HIS CRIES.
S   IT’S ONLY A SWEET LITTLE BOY. HE IS SLEEPING WITH HIS GTEFLES
     NEXT TO YOU.
JUJT SHUT YOUR EYES.”
SNUG BUG SMILES.

PAGE 19
C   MOMMA BUG, WHO PULLS THE COVERS UP TO SNUG BUG’S CHIN, HAS
     TUCKED HIM INTO HIS TUPIT ONCE AGAIN.
    MOMMA BUG PULLS THE COVERS UP TO HIS CHIN...
SWEET DREAMS SNUG BUG.

PAGE 20
C   SNUG BUG, WITH HIS HANDS TIGHTLY AROUND HIS TEDDY BUG,
     MANPEEDS HIS EYES AND SLEEPS.
    NOW THEY ARE SLEEPING, BOY AND BUG.
Book 2: **SNUG BUG**  
Version B

[Training sentence]  
**MAMA BUG IS CARRYING SNUG BUG.  
SHE HAS FOUR FEET.**

**PAGE 1**  
"**IT IS TIME FOR BED. PUT YOU TOYS AWAY**" MOMMA SAYS.  
C LITTLE SNUG BUG, WHO IS LOOKING AT HIS MAMA, IS SITTING IN HIS HAMPET AND SAYS, "I WANT TO PLAY."

**PAGE 2**  
"**WHERE HAVE YOU GONE?**" ASKS MAMA BUG.

**PAGE 3**  
C SNUG BUG, WHO DOESN'T WANT TO BE FOUND, IS SITTING UNDER THE RUG.

**PAGE 4**  
**MAMA BUG WANTS TO FIND SNUG BUG.**  
S SMART MAMA BUG KNOWS WHERE HER BOY IS. SHE DESHONDS THE RUG.  
"**THERE YOU ARE, MY LITTLE SNUG BUG! \"COME WITH ME.**"

**PAGE 5**  
S MAMA KNOWS IT IS TIME TO WASH. SHE SAYS "**INTO THE PIMEL YOU GO.**"

**PAGE 6**  
**MAMA BUG LIKES SNUG BUG TO BE CLEAN.** SHE WASJED HIM ALL OVER WITH THE SOAP. IT MAKES HIM LAUGH.

**PAGE 7**  
**WHEEE! LOOK AT ME!**  
**MAMA BUG SAYS, \"YOU ARE DONE.\"**  
C PLAYFUL SNUG BUG, WHO WANTS TO STAY IN THE WATER, SAYS, "THE SOAPY HADLICKS ARE FUN, LET ME PLAY"

**PAGE 8**  
**GLUB, GLUB, GLUB.**  
**SCRUB, SCRUB, SCRUB.**  
C MAMA BUG, AS SHE MOVES QUICKLY AND FIRMLY, KONNIPS HER SNUG BUG OFF WITH THE TOWEL.
PAGE 9
SNUG BUG BRUSHES HIS TEETH,
The Snug Bug is standing on the faucet. He pokes his toothpaste into the bathroom sink.

PAGE 10
The Mama Bug is flying through the air. She has just past the Mubir...It's almost eight.

PAGE 11
Now it's time for a go-to-bed story.
Mama reads "Little Miss Muffet Sat On A Tuffet.
Snug Bug knows the book by heart. The spider is his favorite part!

PAGE 12
Snug Bug and momma bug are holding hands. They look out of the pumit and see the moon.
It's time for bed. Is Snug Bug ready? No!

PAGE 13
Little Snug Bus is trying to find his teddy bug. He looks behind the besop and says "There you are."

PAGE 14
"Mama Bug says "Now into bed."
Sleepy Snug Bug, who needs to go to bed, gadroys with his mouth open.

PAGE 15
Mama Bug is careful not to shake Snug Bug. She is zorting on her knees next to him.

PAGE 16
Snug Bug sits up quickly.
"Mama! Come back! Help! Hurry!" Snug Bug, who is very scared, miseds out loud.
There's something here..
...It's big and furry!"

PAGE 17
MAMA COMES BACK. SHE HEARD HIS CRIES.

"IT'S ONLY A BOY, A SWEET LITTLE BOY, SLEEPING WITH HIS GEFFLES NEXT TO YOU.

JUST SHUT YOUR EYES."

SNUG BUG SMILES.

PAGE 18

THE MOMMA BUG PULLS THE COVERS UP TO SNUG BUG'S CHIN. HE HAS BEEN TUCKED INTO HIS TUPIT ONCE AGAIN.

SWEET DREAMS SNUG BUG.

PAGE 19

SNUG BUG HAS HIS HANDS TIGHTLY AROUND HIS TEDDY BUG. HE MANPEEDS HIS EYES AND SLEEPS.

NOW THEY ARE SLEEPING, BOY AND BUG.
## APPENDIX B

### SUPPLEMENTAL TABLES

**Table B.1**
Summary of Comprehension and Production Scores by Word Type

<table>
<thead>
<tr>
<th>Group</th>
<th>Comprehension</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Nouns</td>
<td>Verbs</td>
</tr>
<tr>
<td>SLI</td>
<td>6.56 (2.09)</td>
<td>10.50 (2.01)</td>
</tr>
<tr>
<td>CA</td>
<td>9.78 (2.72)</td>
<td>12.28 (2.91)</td>
</tr>
<tr>
<td>LM</td>
<td>5.44 (1.72)</td>
<td>9.33 (1.50)</td>
</tr>
</tbody>
</table>

**Table B.2**
Means and Standard Deviations: Total Comprehension and Production

<table>
<thead>
<tr>
<th>Group</th>
<th>Comprehension</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLI</td>
<td>17.06 (6.5)</td>
<td>6.39 (3.7)</td>
</tr>
<tr>
<td>CA</td>
<td>14.78 (2.0)</td>
<td>4.94 (1.9)</td>
</tr>
<tr>
<td>LM</td>
<td>14.78 (2.0)</td>
<td>4.94 (1.9)</td>
</tr>
</tbody>
</table>
Table B.3
Total Scores for Comprehension, Production, and Word Type: SLI

<table>
<thead>
<tr>
<th>Number</th>
<th>Comprehension</th>
<th></th>
<th></th>
<th>Production</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Nouns Verbs</td>
<td>Total Nouns Verbs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>15 7 8</td>
<td>4 2 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>19 10 9</td>
<td>10 6 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>16 7 9</td>
<td>12 5 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>14 3 11</td>
<td>3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>14 5 9</td>
<td>9 4 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>15 3 12</td>
<td>2 1 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>17 7 10</td>
<td>8 4 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>17 5 12</td>
<td>5 1 4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>21 6 15</td>
<td>7 2 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>19 6 13</td>
<td>4 1 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>22 10 12</td>
<td>16 7 9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>16 5 11</td>
<td>8 1 7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>20 7 13</td>
<td>7 2 5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>14 6 8</td>
<td>4 2 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>13 5 8</td>
<td>3 2 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>19 9 10</td>
<td>6 3 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>17 8 9</td>
<td>5 2 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>19 9 10</td>
<td>2 2 0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table B.4
Total Scores for Comprehension, Production, and Word Type: CA

<table>
<thead>
<tr>
<th>Number</th>
<th>Comprehension</th>
<th></th>
<th></th>
<th>Production</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Nouns</td>
<td>Verbs</td>
<td>Total</td>
<td>Nouns</td>
<td>Verbs</td>
</tr>
<tr>
<td>51</td>
<td>20</td>
<td>7</td>
<td>13</td>
<td>15</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>52</td>
<td>28</td>
<td>13</td>
<td>15</td>
<td>20</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>53</td>
<td>21</td>
<td>8</td>
<td>13</td>
<td>15</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>55</td>
<td>26</td>
<td>11</td>
<td>15</td>
<td>23</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>57</td>
<td>31</td>
<td>15</td>
<td>16</td>
<td>27</td>
<td>12</td>
<td>15</td>
</tr>
<tr>
<td>58</td>
<td>19</td>
<td>9</td>
<td>10</td>
<td>13</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>59</td>
<td>25</td>
<td>11</td>
<td>14</td>
<td>19</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>62</td>
<td>22</td>
<td>9</td>
<td>13</td>
<td>20</td>
<td>9</td>
<td>11</td>
</tr>
<tr>
<td>63</td>
<td>30</td>
<td>14</td>
<td>16</td>
<td>26</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>64</td>
<td>17</td>
<td>11</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>65</td>
<td>27</td>
<td>12</td>
<td>15</td>
<td>19</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>66</td>
<td>25</td>
<td>11</td>
<td>14</td>
<td>16</td>
<td>7</td>
<td>9</td>
</tr>
<tr>
<td>67</td>
<td>16</td>
<td>4</td>
<td>12</td>
<td>7</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>68</td>
<td>17</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>70</td>
<td>16</td>
<td>8</td>
<td>8</td>
<td>9</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>71</td>
<td>20</td>
<td>9</td>
<td>11</td>
<td>7</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>118</td>
<td>20</td>
<td>8</td>
<td>12</td>
<td>8</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>121</td>
<td>17</td>
<td>8</td>
<td>9</td>
<td>5</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>
Table B.5
Total Scores for Comprehension, Production, and Word Type: LM

<table>
<thead>
<tr>
<th>Number</th>
<th>Comprehension</th>
<th></th>
<th>Production</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Nouns Verbs</td>
<td>Total Nouns Verbs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>151</td>
<td>14 5 9</td>
<td>9 2 7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>152</td>
<td>12 2 10</td>
<td>6 2 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>153</td>
<td>16 7 9</td>
<td>4 2 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>155</td>
<td>12 4 8</td>
<td>2 1 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>156</td>
<td>18 5 13</td>
<td>4 0 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>157</td>
<td>13 5 8</td>
<td>4 1 3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>159</td>
<td>14 7 7</td>
<td>2 1 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>160</td>
<td>15 4 11</td>
<td>6 1 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>161</td>
<td>13 5 8</td>
<td>6 2 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>163</td>
<td>17 7 10</td>
<td>6 5 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>164</td>
<td>19 8 11</td>
<td>6 2 4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>165</td>
<td>16 7 9</td>
<td>5 3 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>167</td>
<td>15 4 11</td>
<td>6 1 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>168</td>
<td>13 3 10</td>
<td>2 0 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>169</td>
<td>16 7 9</td>
<td>5 3 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>170</td>
<td>14 5 9</td>
<td>7 2 5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>171</td>
<td>13 5 8</td>
<td>3 1 2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>172</td>
<td>16 8 8</td>
<td>6 4 2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX C
SCORE FORMS

STORYBOOK SCORE FORM

CHILD'S NAME ________________________________

SCHOOL ___________________________________

DATE _________________________

WAKE UP SUN VERSION ________________________

<table>
<thead>
<tr>
<th></th>
<th>Means?</th>
<th>B/C</th>
<th>Picture #</th>
</tr>
</thead>
<tbody>
<tr>
<td>DREAMING</td>
<td>______</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>LODEP</td>
<td>______</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>DASHUCKED</td>
<td>______</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>MAVING</td>
<td>______</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>BONNAZED</td>
<td>______</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>SEPALS</td>
<td>______</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>ZAYDIR</td>
<td>______</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>SHUPICK</td>
<td>______</td>
<td>______</td>
<td>______</td>
</tr>
<tr>
<td>BALLAPED</td>
<td>______</td>
<td>______</td>
<td>______</td>
</tr>
</tbody>
</table>
SECOND HALF

CONTAMP
K.OOTTELED
FAMMOZ
NEBELED
DILLER
ZUPUD
GISTOV
MOGALED
<table>
<thead>
<tr>
<th>Name</th>
<th>Means?</th>
<th>b/c</th>
<th>Picture #</th>
</tr>
</thead>
<tbody>
<tr>
<td>FEET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HAMPET</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SATTING</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DESHONDS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PIMEL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HADICKS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KONNIPS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POENIGS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MUBIR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PAMMIT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SECOND HALF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BESOP</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GADROYS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Nonword Repetition Task Score Form

<table>
<thead>
<tr>
<th>C</th>
<th>V</th>
<th>C</th>
<th>C</th>
<th>V</th>
<th>C</th>
<th>C</th>
<th>V</th>
<th>C</th>
<th>C</th>
<th>V</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>t</td>
<td>a</td>
<td>b</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m</td>
<td>a</td>
<td>s</td>
<td>o</td>
<td>n</td>
<td>a</td>
<td>k</td>
<td>I</td>
<td>t</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k</td>
<td>ñ</td>
<td>p</td>
<td>ñ</td>
<td>f</td>
<td>el</td>
<td>t</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t</td>
<td>ñ</td>
<td>n</td>
<td>n</td>
<td>a</td>
<td>d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p</td>
<td>ñ</td>
<td>n</td>
<td>l</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>ñ</td>
<td>p</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n</td>
<td>ñ</td>
<td>t</td>
<td>ñ</td>
<td>n</td>
<td>d</td>
<td>m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h</td>
<td>ñ</td>
<td>m</td>
<td>p</td>
<td>nt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>ñ</td>
<td>f</td>
<td>ñ</td>
<td>I</td>
<td>s</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p</td>
<td>ñ</td>
<td>z</td>
<td>ñ</td>
<td>n</td>
<td>i</td>
<td>m</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g</td>
<td>ñ</td>
<td>d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>h</td>
<td>ñ</td>
<td>k</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m</td>
<td>ñ</td>
<td>s</td>
<td>ñ</td>
<td>t</td>
<td>el</td>
<td>t</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>k</td>
<td>ñ</td>
<td>d</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>s</td>
<td>ñ</td>
<td>k</td>
<td>l</td>
<td>d</td>
<td>l</td>
<td>g</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d</td>
<td>ñ</td>
<td>p</td>
<td>ñ</td>
<td>n</td>
<td>ñ</td>
<td>f</td>
<td>ñ</td>
<td>l</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m</td>
<td>ñ</td>
<td>d</td>
<td>l</td>
<td>n</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b</td>
<td>ñ</td>
<td>n</td>
<td>l</td>
<td>f</td>
<td>ñ</td>
<td>m</td>
<td>a</td>
<td>n</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g</td>
<td>ñ</td>
<td>b</td>
<td>ñ</td>
<td>s</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g</td>
<td>ñ</td>
<td>m</td>
<td>ñ</td>
<td>n</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Dear Parent,

We would like your child to participate in a study of children's word learning. The following information is provided so you can decide if you wish for your child to participate in the present study. You should be aware that even if you do agree your child can withdraw at anytime by stating his/her desire to discontinue. Also, your child's identity will be kept confidential. Your child will not be identified in any data analyses or written reports.

By the age of six years, most children have accumulated over 14,000 words. Unfortunately for children with language learning difficulties, word learning is extremely difficult. The purpose of our study is to learn more about what makes the process of learning new words easy for some children and difficult for others. Your child's participation will help us answer this question. Your child will participate in six to eight fifteen-minute sessions. Sessions will be conducted in a small room or quiet area in your child's school. In the first two sessions we will give your child a small battery of language tests, such as the Peabody Picture Vocabulary Test and the Goldman-Fristoe Test of Articulation. Also, we will audiorecord your child's spoken language as he/she plays with the examiner. The tests and language sample are necessary to document each child's level of language functioning.

On Day 4 and 5, we will show your child two videotapes that have novel words embedded in the narration of a story. After your child views the videotaped scenes, we will examine your child's understanding of the new words and the strategies your child used to learn the new word meanings. On the last day, your child will be asked to act out different play situations that corresponded to the videotaped stories. For example, we may ask your child to "make the dog aviate" to examine whether your child knows that the word aviate means fly. Throughout the study, we will not tell your child if he/she is right or wrong, but will praise him/her for participating.

Please indicate your decision and return the attached parental consent form. If you decide to participate we will send you a report of the findings, if you wish. Thank you for your consideration. Please feel free to contact us if you have any questions.

Sincerely,

Janna B. Oetting, Ph.D. CCC-SLP
Assistant Professor
I have read the consent form and agree to have my child participate in the word learning study. I understand that my child will only leave his/her room for 6-8 fifteen-minute sessions at times when his/her teacher feels like important academic information or social experiences will not be missed.

Child: ___________________________ Birthdate _________________________

Yes____ I give permission       No____ I do not give permission

Parent's signature ________________________________

Please provide an address or phone number if you would like to be contacted and told the results of the study.
VITA

Janice Elisabeth Horohov was born in Philadelphia, Pennsylvania. She received her bachelor of science degree in biology from The Pennsylvania State University, and her master of science degree in physiology from the University of Tennessee. During her first four years in the Department of Communication Sciences and Disorders at Louisiana State University (LSU), she was a graduate research assistant. In January of 1997, she was awarded a National Institute of Health Pre-doctoral Fellowship. As part of her responsibilities under the fellowship, Janice worked in the L.S.U. Speech and Hearing Clinic Language preschool as a Senior Clinician. She is currently a candidate for the degree of Doctor of Philosophy, which will be conferred in December of 1999.
DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Janice Elisabeth Horohov

Major Field: Communication Disorders

Title of Dissertation: Input Manipulations, Working Memory, and Word Learning Abilities of Children

Approved:

[Signatures]

Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:

June 16, 1999