PREDICTIVE INDICATORS OF READING SKILLS IN THREE- AND FOUR-YEAR-OLD CHILDREN

By

SUE ANN EIDSON

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

UNIVERSITY OF FLORIDA

2010

In memory of my mother, Elsie Mae Eidson

ACKNOWLEDGMENTS

I thank my father, George T. Eidson, Jr., who has instilled in me a love of learning throughout life and who has been supportive in all my goals. I also thank my loving daughter, Analisa, for her support and love, which have helped me through the past five years. She is a strong individual and has helped in making me a stronger and more positive academic. I also want to thank my extended family for their understanding and support throughout this life change. I could not have done this with out ALL of my family, friends and peers!

I wish to express my deepest thanks to Dr. Linda J. Lombardino, who guided me in the selection of my dissertation topic and then provided me with steady encouragement and wisdom throughout the long process of completing my paper. Without her patience and constructive criticism, I would not have been able to achieve this goal.

I also wish to thank my committee members for their support as well. Dr. Altmann unselfishly gave me ideas about my statistical methods and how to write them clearly and concisely. She also reminded me often of the word, “FOCUS”!! This was a longitudinal study in which many statistical analyses and designs were utilized with her and Dr. Lombardino’s guidance. Dr. Bridget Franks was key in teaching me the cognitive and psychological growth that a child undergoes when learning to read. She was wonderful in sparking my imagination and interest in the neuropsychology of reading and writing development. Dr. Kenneth Logan was so kind to come forward and become a committee member when I needed him most and I will always appreciate his kindness and support throughout the writing process of my dissertation and my years here at the University of Florida.

Finally, I would like to publicly thank all of my tried and true friends who served as my inspiration for picking myself up when things were not going as well as I had thought they should be. They supported and believed in me by supplying me with friendly nudges to move forward when I needed it. My friends have always heard the song in my heart, and sang it to me when my memory failed.

I also thank the God of my understanding for testing my faith and showing me that I can do all things through Christ who strengthens me (Philippians 4:13).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

RM	Rhyme Memory
RJ	Rhyme Judgment
RK	Rhyme Knowledge
SEG	Segmentation of words in sentences
Copy	Copying figures and letters at close proximity
ABCs	Writing ABCs to the best of the child's ability
WLNM	Writing letters in their name
NLNM	Naming letters in their name after writing them
SW	Story Writing
SEQM	Sequential Memory untimed
DWSFWD	Digit word span forward; repetition of spans of digits and words presented orally
DWSBKD	Digit word span backward (working memory task)
VisSTM	Visual short-term memory
SEQM2min	repetition of a sequence of pictures, forms, or digits after a two-minute delay
SEQM5min	repetition of a sequence of pictures, forms, or digits after a five-minute delay
AA	Alphabetic Awareness
LD	Letter Discrimination
LI	Letter Identification
FTDIF	Finger tapping with index finger of dominant hand
FTNDIF	Finger tapping with index finger of nondominant hand
Pincdom	Pincer tapping with thumb and index finger of dominant hand
Pincerndom	Pincer tapping with thumb and index finger of nondominant hand

LC	Language Comprehension
LE	Language Expression
RAN8	Rapid Automatic Naming; the time it takes for a child to name a matrix of eight pictures
RAN12	Rapid Automatic Naming; the time it takes for a child to name a matrix of twelve pictures
1	Whenever a task is followed by a one (RM1), the results are from Year 1 or when the child was age 3
2	Whenever a task is followed by a two (RM2), the results are from Year 2 or when the child was age 4
EFA	Exploratory Factor Analysis

Abstract of Dissertation Presented to the Graduate School
of the University of Florida in Partial Fulfillment of the
Requirements for the Degree of Doctor of Philosophy

PREDICTIVE INDICATORS OF READING SKILLS IN THREE- AND FOUR-YEAR-OLD CHILDREN

By

Sue Ann Eidson

August 2010

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

The purpose of this study was to identify behaviors in three-four-year-olds that predict language and literacy skills at the earliest stages of reading acquisition. It has already been established that several phonological (i.e., rhyme) and nonphonological (i.e., syntax) skills in kindergarteners predict later reading abilities (Badian, 1994, 2000; Catts, 1997; Scarborough & Dobrich, 1990). The main question addressed was "Do similar behaviors predict literacy in young children?" Few studies have examined predictive skills in children younger than five years of age. This major question was approached by studying longitudinal behaviors of 38 children on tasks that are normally distributed at three years and four years of age relative to their performance on the Assessment of Language and Literacy (ALL; Lombardino, Lieberman, Brown, 2005).

Results of the study showed that the best predictors of the ALL Language Index score from exploratory tasks administered to the three–year–olds included Rhyme Judgment (B= .394; t= 2.27; p= .031) and Segmentation (B = .447; t= 2.06; p = .050) when a forced entry procedure was utilized in the analysis. When all highly related correlations were removed from the analysis, the tasks that best predicted the ALL Language Index score at age four included Visual Short-Term Memory (B = .487; t=

3.341; *p* =.002), Rhyme Knowledge (*B* = .352; *t*= 2.595; *p* =.015) and Digit-Word Span Backward (*B* = .255; *t*= 1.907; *p* =.067) which was a moderate predictor.

At age three, the best predictors of the ALL Emergent Literacy Index score included Letter Identification (*B* = .516; *t*= 2.54 *p* = .017) and Rhyme Judgment (*B* = .270; *t*= 1.99 *p* = .056). At four years of age, the best predictors in this area were Rhyme Knowledge (*B* = .512; *t*= 4.123 *p* = .000), Digit-Word Span Backward (*B* = .394; *t*= 3.288; *p* = .003) and Segmentation (*B* = .303; *t*= 2.128; *p* =.042). These findings are in agreement with other literature (Jorm,1983; Case, 1989; Gathercole, et al., 2004; de Jong,1998; Swanson, et al., 2009; Baddeley,2000; Gathercole & Baddeley,1989) that shows the contribution of working memory phonological awareness (Adams, 1990; Goswami & Bryant, 1990; National Reading Panel, 2000; Scarborough, 1998) to the development of literacy.

Findings from this study indicate that short-term memory, sequential memory visual short-term memory and working memory should be studied further as potential predictors. They should be considered as potentially valuable constructs in the early identification of reading disabilities underlying well-known and validated predictors.

.

CHAPTER 1
INTRODUCTION AND REVIEW OF LITERATURE

Introduction

Reading disability is the primary deficit in 80% of all learning disabilities (Lyon, B. Shaywitz, S. and Shaywitz, B., 2003). The National Assessment of Educational Progress (NAEP, 1998) reported that 69% of fourth graders and 67% of eighth graders were reading below proficiency levels. Thirty-eight percent of the fourth graders had not achieved even basic or fundamental skills in reading. In 1998, the Committee on Preventing Reading Difficulties in Young Children of the National Research Council resolved, “the educational careers of 25-40% of American children are imperiled because they don’t read well enough, quickly enough, or easily enough.” (Shaywitz, 2003, p. 30).

While reading disabilities are associated with both environmental and biological factors (Bowey, 2005), poverty is associated with the vast majority of children who are at risk for reading failure (Whitehurst & Lonigan, 1998). In numerous studies, both cognitive (intrinsic factors in the child) and non-cognitive (extrinsic factors) variables associated with reading achievement have been identified (Whitehurst & Lonigan, 1998). The cognitive factors that best predict reading skill are: phonological awareness, letter knowledge, verbal memory, naming, and overall language development. The non-cognitive factors that best predict reading skill are socioeconomic status and home literacy experiences (Badian, 2000).

Identifying and remediating weak foundational skills in children at the earliest stages of schooling is the best approach to preventing reading disabilities. Knowledge of word meanings, concepts of print, phonological awareness, and alphabetic

knowledge provide the foundation for the early stages of learning to read (Whitehurst & Lonigan, 1998; Bowey, 2005; Adams, 2000). These foundational skills are usually developed during the first five years of life. Emergent literacy is described as the rapid period of growth in language acquisition prior to the beginning of formal literacy instruction in kindergarten (Sulzby & Teale, 1991; Snow, Burns, & Griffin, 1998; Lonigan, Burgess, & Anthony, 2000). The development of preliteracy knowledge precedes the more explicit literacy instruction provided in the first grade. Many children enter kindergarten without the prerequisite skills needed to learn to read (Scarborough, 1989; Dickinson & Snow, 1987; Duncan & Brooks-Gunn, 1997; Vernon-Feagans, et al., 2001; Whitehurst & Lonigan, 1998) placing them at risk for meeting the rigorous demands of formal reading and writing instruction.

The development of screening instruments such as the Dyslexia Early Screening Test (Nicolson & Fawcett, 1996), the Phonological Awareness Literacy Screening-Kindergarten (Invernizzi, Meier, Swank, & Juel, 1999) and the PreK edition (Invernizzi, Sullivan, & Meier, 2001), the Test of Early Reading Ability (Reid, Hresko, & Hammill, 1989) and the Preschool Word and Print Awareness Assessment (Justice & Ezell, 2002) have constituted a significant step forward in the systematic early identification and management of children at risk of reading problems. Currently, we can predict which children are “at risk” for later reading disabilities at five years of age but we have very few reliable methods of making this prediction in younger children (Whitehurst & Lonigan, 1998; Scarborough, 2001).

There are many advantages for early identification of reading failure. Children who are identified as being at risk for reading failure at ages three–four years of age have far

less educational ground to make up than those identified in elementary school. Furthermore, the test profile of a preschool child should yield more reliable and precise results than one obtained from an older child whose test performance may have become conflated by extrinsic factors such as different teaching methods or intrinsic factors such as motivation (Muter, 2000).

Teachers working with younger children often report that it is easier to work with younger children who have not established bad habits that must be unlearned before learning more effective strategies than with children who are failing to keep pace with their peers and experience excessive frustration and feelings of failure. In addition, recent research demonstrates a substantial link between early reading failure and later social adjustment problems or delinquent behaviors (Maughan, 1994, 1995).

Finally, early identification has economic advantages. Implementing a two to three times weekly teaching program over a one-year period for a 6–year–old is more economical than having to provide long-term daily assistance to a 10–year–old who is years behind his/her peers in reading ability (Muter, 2000). The literature in language and literacy development unequivocally and overwhelmingly supports the benefits of early identification and instruction.

The long-term goal of this research is to develop a screening instrument to aide preschool teachers in identifying students who are at risk for deficits in emergent literacy development. Toward this end, the immediate goal of this study is to identify tasks that will serve to predict which preschool children are at risk for later language and literacy deficits. This goal is addressed by: 1) developing tasks that are appropriate for normally developing three–year–olds and 2) determining the predictive value of these tasks in

identifying the three–year–old children's language and literacy abilities on standardized test measures one year later.

Review of the Literature

This section addresses topics that have shown empirically to support the development of early literacy. These topics are: phonological awareness; orthographic knowledge/awareness; oral/receptive language skills; rapid automatic naming; emergent writing skills (story writing and name knowledge); fine motor functioning; memory (short term memory, sequential memory (immediate and delayed), and environmental factors.

Cognitive Predictors of Early Reading and Spelling Ability

Phonological awareness

Phonological awareness is the awareness of the sound structure of language in general (Yopp, 2000). Phonological awareness is the skill of knowing that oral language has a structure that is separate from meaning. Phonological awareness is attending to the structure within words. For example, a student with phonologic awareness understands "beg" has one–syllable and three phonemes; "egg" has one–syllable and two phonemes.

Phonological awareness includes the awareness of larger units of sound as well as phonemes, such as syllables and onsets and rimes. It is the ability to generate and recognize rhyming words, to count syllables, to separate the beginning of a word from it's ending, and to identify each of the phonemes in a word (Treiman & Zukowsay, 1991). There is a considerable amount of evidence suggesting that phonological awareness is one of the most important predictors of learning to read in young children. Children with good early phonological awareness go on to show good reading skills

(Bryant, Maclean & Bradley, 1990; Wagner & Torgesen, 1987); children with poor reading skills normally show concomitant weak phonological awareness (Bradley & Bryant, 1978; Snowling, 1981; Swan & Goswami, 1997), and training in phonological awareness can improve reading progress (Bradley & Bryant, 1978; Hatcher, Hulme, & Ellis, 1994; Troia, 1999).

More recently, studies have led researchers to conclude that it is awareness of phonemes, rather than of larger segments such as rimes and syllables, that is most closely predictive of learning to read (Hulme, Hatcher, Nation, Brown, Adams & Stuart, 2002; MacMillan, 2002; Muter, Hulme, Snowling, & Taylor, 1998).

Phonemic awareness (PA) is the ability to recognize that a spoken word is composed of a sequence of individual sounds (phonemes). Children who are unaware that words consist of individual sounds will have difficulty in decoding text. Cunningham (2000) defines phonemic awareness as the ability to examine language independently of meaning and to manipulate its component sounds. Phonological awareness enables children to use letter-sound correspondences to read and spell words.

Next to knowledge of letters, phonemic awareness is a good predictor of children's' first-year reading achievement. Both knowledge of letters and PA, have been found to bear a strong and direct relationship to success and ease of reading acquisition. This awareness is acquired gradually through experiences with spoken and written language. Due to more recent studies concluding that phoneme awareness is the form of phonological awareness most closely related to reading, determining how phoneme awareness develops is important to discuss. If phoneme awareness is not developing in a prereading child (Bryant, Maclean, Bradley, & Crossland, 1990; Fox &

Routh, 1974), the skill should develop rapidly once they begin formal school training (Duncan, Seymour, & Hill, 1997). Some researchers (Goswami & Bryant, 1990; Treiman & Zukowski, 1991) have suggested that awareness of larger phonological segments (i.e., syllables and rimes) is an important precursor to phoneme awareness. Goswami and Bryant (1990) concluded that awareness of syllables and rimes develops 'naturally' in the preschool years, while phoneme awareness develops out of this awareness once children begin to learn to read. There is a good basis of evidence suggesting a reciprocal relationship between the development of reading and phoneme awareness, as described by Goswami and Bryant (1990). Gombert (1992) suggested that learning to read forces children to move from epilinguistic phonological awareness (or global sensitivity to sound similarity), to metalinguistic phonological awareness (or explicit awareness of sound segments). In support of this view, studies examining the phonological awareness of prereaders (Liberman, Schankweiler, Fischer, & Carter, 1974) and illiterate adults (Morais, Cary, Alegria, & Bertelson, 1979) have shown that reading seems to play a role in the development of explicit phonemic awareness. More specifically, learning letters seems to be the element of reading that is causally related to phoneme awareness. A further study (Read, Zhang, Nie, & Ding, 1986) showed that the development of explicit phonemic awareness was limited to languages with an alphabetic writing system concluding that learning of letters plays a central role in the development of phonemic awareness.

Phonological Awareness encompasses larger units of sound as well as phonemes, such as syllables and onsets and rimes. It is the ability to generate and recognize rhyming words, to count syllables, to separate the beginning of a word from

its ending, and to identify each of the phonemes in a word. Cunningham (2000) defines phonological awareness as the ability to examine language independently of meaning and to manipulate its component sounds. Phonological awareness enables children to use letter-sound correspondences to read and spell words.

Many studies have demonstrated that individual differences in children's sensitivity to speech sounds within words are casually related to the normal acquisition of beginning reading skill. Adams (1990) suggested four types of phonological tasks that successfully predict reading skill: 1) rhyming tasks that include knowledge of nursery rhymes and identification of the non-rhyming stimuli in a sequence of three or four words, 2) syllable and phoneme segmentation tasks in which the child taps, counts out, or identifies syllables and/or phonemes within words, 3) sound blending tasks in which the examiner provides the phonemes of a word and the child is asked to put them together, and 4) phoneme manipulation tasks in which require the child is required to delete, add, substitute, or transpose phonemes within words.

Some phonological awareness tasks are demonstrated in children as young as two and three years of age (e.g., syllable blending, syllable segmentation, and a few types of rhyming skill), but they are not necessarily stable abilities at these young ages. Other skills emerge later in reading development and may depend on exposure to print and explicit reading instruction (e.g., phoneme segmentation and manipulation tasks). Phonological sensitivity becomes increasingly stable during the preschool years (Lonigan et al., 1998) and phonological processing abilities are remarkably stable during the primary school years (Wagner, Torgesen, & Rashotte, 1994; Wagner et al., 1997; Lonigan et al, 1998; Muter & Snowling, 1998).

Adams (1990) suggested four types of phonological tasks that reliably predict reading skill: 1) rhyming tasks that include knowledge of nursery rhymes and identification of the non-rhyming word in a sequence of three or four words, 2) syllable and phoneme segmentation tasks that the child taps, counts out, or identifies syllables and/or phonemes within words, 3) sound blending tasks where the examiner provides the phonemes of a word and the child is asked to put them together, and 4) phoneme manipulation tasks that require the child to delete, add, substitute, or transpose phonemes within words. Some phonological awareness tasks are demonstrated in children as young as two and three years (e.g., syllable blending, syllable segmentation, and some aspects of rhyming skill), but they are not necessarily stable abilities at that age (McGuinness, 2005).

Other reading skills emerge later in development and depend on exposure to print and explicit reading instruction (e.g., phoneme segmentation and manipulation tasks) (McGuinness, 2005). Phonological sensitivity becomes increasingly stable during the preschool years (Lonigan et al., 1998) and phonological processing abilities are stable during the primary school years (Wagner, Torgesen, & Rashotte, 1994; Wagner et al., 1997; Lonigan et al, 1998; Muter & Snowling, 1998).

Muter, Snowling, and Taylor (1994) proposed that segmentation (a phonological processing task) may be a more influential phonological skill in the beginning stages of learning to read than rhyming. Muter et al. (1998) studied pre-reading children and found that sound segmentation was strongly correlated with reading and spelling skills at the end of the first year of learning to read, while rhyming was not. By the end of the second year, rhyming had begun to have a predictive effect on spelling. Berninger

(1992) reported that the task of segmentation of phonemes in words was a significant precursor to later word decoding.

Two strong positions exist regarding the developmental course and the precursors of phoneme awareness in the process of alphabetic reading acquisition. One theory claims that phoneme awareness develops as a consequence of experience with print (Morias, Bertelson, Cary, Alegria, 1986). The other theory states that phoneme awareness is contingent upon awareness of larger sublexical units and is a precursor to alphabetic literacy (Bryant, MacLean, Bradley, & Crossland, 1990). They proposed that additional factors, namely the phonology and orthography experiences to which a child is exposed, must be taken into consideration if the development and role of phoneme awareness in reading acquisition is to be more fully understood by preschoolers.

Orthographic awareness

The orthographic system deals with the form of letters and the spelling patterns within words. Orthographic awareness is what the child sees in the written word and remembers. It requires visual perception and is a widely accepted and acknowledged fact that a child's knowledge of the alphabet at the beginning of formal school instruction is one of the best predictors of later achievement in reading and spelling skill (Adams, 1990; Bond & Dykstra, 1967; Chall, 1967; Cunningham, Perry, & Stanovich, 2001). A beginning reader who is unable to recognize and distinguish individual letters of the alphabet will surely have difficulty learning those letters represented in words (Mason, 1990). In the early stages of learning to read and write, young children are creating relationships between the orthographic representations of words and their phonological makeup. The creation of such relationships depends upon knowledge of the phonetic characteristics of the sounds for which letters represent (Ehri, 1992; Rack et al., 1994).

Byrne et al. (1997) found that letter knowledge accounted for more variance in a decoding task in preschool and kindergarten children than did a measure of phonemic awareness. Hulme, Muter, and Snowling (1998) suggested that letter knowledge skill on entry to school was the best single predictor of word recognition one year later. Similarly, (Muter et al., 1998; Justice, 2001) found that letter skill predicted both reading and spelling during the first year at school. Orthographic awareness refers to the child's ability to form a mental representation of the appearance of a letter or word. In addition, orthographic awareness helps preschoolers become aware of the common spelling patterns that exist in a language (Hulme, Muter, and Snowling, 1998; Perry & Stanovich, 2001).

Emergent writing

Emergent writing is characterized by a child's practice of pretending to write a story, the ABCs, or his or her own name, before formal instruction by their caretakers or teachers. After his analysis of the development of print literacy in four-year-old children, Mason (1980) concluded that children begin to use print as a communication tool to recite the alphabet and to become familiar with letters and words found in print. Stuart (1995) proposed that the development of these skills during the preschool period is an important predictor of later reading achievement.

During the period of emergent literacy, children develop expectations that certain types of intonations and wording are used with books and other written materials as their caretakers read to them. Those who are read to frequently and enjoy this activity begin to recite key phrases or longer stretches of words specific to certain books. (i.e., "Do you like my party hat? No, I do not like your party hat. Goodbye! Goodbye!" from "Go Dog Go" by P. D. Eastman (1961).

Between the ages of three and four, children exhibit significant growth in literacy, as they experiment with writing by forming scribbles, random strings of letters or letter-like forms. Many older preschoolers will begin to recognize distinguishable sounds within words read to them. Some four-year-olds use distinguishable sounds in their writing by beginning to use invented spelling with initial consonants (Committee on the Prevention of Reading Difficulties in Young Children, 1998).

Tests that were reviewed before developing the experimental task of Copying were The Process Assessment of the Learner: Test Battery for Reading and Writing-Screening Battery for Grades K - 2 (PAL–RW) (Berninger, 2001) and the Dyslexia Screening Test (DST) (Fawsett & Nicolson, 1996) whereby 6.6-16.6 year-olds copied as many words from a writing passage as possible in one minute. Berninger's Alphabet Writing and Copying domains required prekindergarten to second graders to print an ordered set of alphabet letters within a 15-second time limit. The Copying subtest of the PAL-RW required kindergarteners through fifth graders to copy as many letters in a given sentence within twenty seconds.

Early name writing may represent a child's first step in using printed symbols for meaning. A study by Haney, Bissonnette & Gehnken (2003) investigated the relationship between name writing and early literacy skills in kindergarten students. A measure of name writing proficiency was developed ("Name Writing Scale"). Results revealed that name writing was significantly correlated with word and non-word identification. No significant gender differences were found on the measure of name writing. They stressed the inclusion of name writing assessments in early screening batteries for students at risk for reading difficulties, and to address the hypothesis that

name writing skills may reflect an understanding of the alphabetic principle. Early name writing may represent a child's first step in using printed symbols for meaning. This study investigated the relationship between name writing and early literacy skills in kindergarten students.

Vygotsky (1962) proposed that the awareness of names signifies the point at which language and thought come together to form the basis of intellect. Like developmental milestones in emotion and cognition, name writing follows a predictable developmental course potentially useful in screening for those with some types of developmental delays. By age three, children spontaneously produce scribbles that are distinctly different when attempting to draw from those made when attempting to print (Brenneman, Massey, Machado, & Gelman, 1996; Deford, 1980). Children learn to write in a predictable pattern including circular scribbles, linear continuous scribbles, letter-like symbols, and finally actual letters. Clay (1982) described the developmental process of learning to write which involves trial and error and hypothesis testing becoming more complex with age, as opposed to a rote process of copying models of print.

In addition to being the earliest attempt at print and following a predictable developmental course, name writing is arguably the initial, meaningful print in a young child's environment. One's own printed name is an extremely meaningful piece of text that young children are likely to see in print and be encouraged to learn more words (Clay, 1982).

During children’s initial stages of emergent writing, preschoolers use writing to translate spoken utterances into indistinct, linear, and discontinuous graphic patterns

that resemble the general aspect of print they observe in their environment. What children imitate from the environment serves as a guide to work out constraints on interpretability (Tolchinsky & Teberosky, 1998). For example, in order for a string of letter-like forms to be readable, it must be of a limited number and have sufficient variety. These constraints serve to regulate children's writing, and appear to hold true across languages and scripts (Tolchinsky & Teberosky, 1998).

The developmental stage of formally constrained writing is characterized by the appearance of a sufficient number and variety of letters paired to what the child is trying to express. The child also begins to use the letters in his or her name in different combinations to form other words (see Figure A), modify the number of marks, shapes, and combinations of marks to distinguish one "word" from another, and interpret his or her own text (Treiman, Sotak, & Bowman, 2001; Treiman & Kessler, 2003, Tolchinsky, 2003). At this stage of writing development, personal names play an important role. In numerous studies and in all of the different languages that have been researched, whenever children are required to write their own name along with other words or sentences, the child's name always shows a higher level of development than other areas being assessed. This is true for superordinate features and conventional letters (Chan, 1990; Tolchinsky-Landsmann & Levin, 1987). Personal names constitute the first clearly meaningful text, as names are not forgotten or unchanged in pronunciation (Treiman & Kessler, 2005). Although children may acquire the shapes of letters from other words they have learned, most frequently their own names are the source and point of reference for early letter writing (Brennemann, et al., 1996; Prouin, & Harmon, 2009; Treiman & Kessler, 2005). (See Figures B & C)

In the next stage of writing development, writing becomes a system in which written marks represent the sound of words rather than the meaning of words (phonetization) (Tolchinsky, 2003; Treiman & Bourassa, 2000) During this stage, children become increasingly aware that writing is related to language. At this stage something said (a word or sentence) has a relationship with a graphic pattern. A pair of writing samples from the age of three to four of the same child is illustrated at this stage. (See Figures D and E)

In the following stage, children discover the alphabetic principle, that phonemes represent letters (whenever a particular phoneme occurs in a word, and in whatever position, it is represented by the same letter). This discovery is quickly followed by their production of invented spelling (Ehri & Wilce, 1985; Richgels, 1995; Scott & Ehri, 1990). Invented spelling is an attempt by beginning readers and writers to spell a word when the standard spelling is unknown to them. They use whatever knowledge of sounds or visual patterns they have learned to write a word. Print awareness and letter knowledge are realized through the development of writing and invented spelling (Ehri, 1994; Richgels, 1995; Treiman, 1985; Scott & Ehri, 1990). A child's ability to pretend to write and learn to write their own name are initial examples of emergent writing. Because emergent writing is considered an expressive language act among preschoolers, emergent writing tasks (scribbling and drawing) are appropriate for assessing writing at the preschool level (Justice, 2001).

Language skills

Prereaders exhibit a consistent relationship between phonological sensitivity and vocabulary size. Children with larger vocabularies have more proficient phonological sensitivity (Wagner, et al., 1997) and this relationship begins early in the preschool

period. Verbal ability has been tested instead of general cognitive knowledge to determine the abilities that are fundamental to reading achievement (Stanovich, 1991). Numerous researchers have established that preschool language development predicts later reading achievement in normally developing children (Bryant, McLean, & Bradley, 1990; Lundberg, 1985). Many emergent literacy studies have shown that a young child's vocabulary size is a strong predictor of early reading skill, specifically, phonological sensitivity (Lonigan, et al. 1998, 2000; Wagner, et al. 1997). Earlier, Bowey (1995) found that receptive vocabulary at the beginning of kindergarten predicted 20-27% of the variance in first grade reading achievement.

In terms of grammatical development as a predictor of later reading and spelling achievement, Share, et al. (1984) found that grammatical development at the beginning of kindergarten predicted 17% of the variance on a composite reading achievement factor by the end of first grade (N=479). Researchers also evaluated kindergartener's abilities to correct minor grammatical errors in sentences or rearrange scrambled sentences to form logical ones. However, as noted by Bowey (1994; 2001), judgment tasks require semantic processing and verbal working memory skill but it is not yet clear how different aspects of oral language development (vocabulary, grammatical and phonological skills) contribute to reading. It is also difficult to determine the underlying causal relationships between different concepts in this area. Baddeley, et al. (1998) and Elbro, et al. (1998) argue that tests of language development only reflect the contribution of underlying abilities such as phonological memory or phonological processing ability.

Rapid automatized naming

Rapid automatized naming (RAN) tasks have been the topic of many recent research studies investigating predictors of reading skill. Rapid naming tasks evaluate the speed of word retrieval on serial naming tasks (Wolf, Bally, & Morris, 1986). Stimuli utilized are usually digits, colors, or pictures of familiar objects. Thus, it is assumed that the naming responses are over-learned and/or automatized.

RAN colors and RAN pictures in kindergarten students and school entrants predict later reading ability (Badian, 2000; Catts, et al. 2001). RAN colors predicted 20% of variance in second graders' word identification and 22% of variance in reading comprehension (N=83). De Jong & Vander Lei j. (1999) found that RAN pictures at the beginning of kindergarten predicted 13% of variance in word and nonword reading rate at the end of the second grade. It should be noted that they studied Dutch-speaking children and, in Dutch, a shallow orthography, children learn to read in second grade.

Felton and Brown (1990) demonstrated that rapid automatized naming predicted reading development in the first grade. Manis, Seidenberg, & Doi (1999) suggested that naming involves arbitrary associations between print and sound, whereas phoneme awareness is more related to the learning of systematic spelling-sound correspondences. They noted that, in general, learning arbitrary associations between sounds and letters plays a central role in the development of early reading skill, whereas knowledge of segmental phonology is relevant to later phases of learning to read. Therefore, they concluded rapid naming is a logical predictor of beginning reading ability.

Fine motor functioning

The language-by-hand system (writing) is unique among the language systems in that it involves the fine motor system of the hand (Berninger & Hart, 1992). Several soft neurological signs (handedness and fingertapping) were found to be significantly low in children with specific reading disability (Satz, Friel & Goebel,1975). Dowering, et al. (1981) found that dyslexic children performed deficiently on subtests of the Wechsler Intelligence Scale for Children (Wechsler, 1995), which measured finger agnosia, fingertapping speed and grip strength.The areas of repetition, succession, localization, and recognition of finger movements are related significantly to written production (Berninger & Rutberg, 1992).

The International Dyslexia Association (2000) suggested that an accurate assessment for the diagnosis of dysgraphia (the inability to write) must include posture, grip, position, fatigue, cramping, and tremor of the writing hand, eyed-ness, and handedness.

Fine motor fingertapping is a measure of the child's ability to imitate and execute a fingertapping movement and was first studied by Denckla (1973). This was the only task assessed in this study as the pilot study showed that many of the children quit participating if they could not perform the more difficult tasks (Satz, Rardin, & Ross, 1971; Satz et al. 1975).

Memory

Learning to read is a complex task and many researchers have tried to find the subset of memory that is associated most with learning to read. Primarily, research has been mostly dedicated to the correlation of verbal memory and reading skill. Memory

has been associated with several academic (i.e., reading and writing) and cognitive areas (i.e., problem solving and inference from text).

Short-term memory, or memory span, is the ability to remember a random list of items or numbers that have no relevance to each other. This has been the focus in the analysis of memory skills during the past decade. However, working memory developed from discontent with the limits of the short-term memory concept (Baddeley, 1986). His theory was that working memory is a “place” in the brain with a vibrant quality where operations are carried out on input from the individual’s environment, or from “pure” thought, or a combination of both. Pribram and McGuiness (1992) found that working memory “is the sum of parallel neural processing in all parts of the brain relevant to the task we are aware of at any one time”. Since Baddeley’s (1980) first proposed model of working memory, there has been much debate and additions made to his original theory and model.

Efficient long-term memory occurs when the brain permanently stores memories that can be accessed and retrieved somewhat easily. Vocabulary is stored via long-term memory, as at a very young age, words are heard then acquired and as long as the child continues to hear the words (familiarity from daily conversations) they can easily retrieve them out of context and use them in their expressive language development. This leads to an obvious bias at entry to formal schooling for emergent literacy as many preschoolers who have been raised with decreased literacy input have problems with learning to read and write (Justice, 2001; Stanovich, 1992; Whitehurst & Lonigan, 2001).

Some of the modes of responding to memory assessment tasks are via recognition memory (remembering with a prompt), such as a face, a spoken or printed word, a picture, smell, or anything that brings an association or a complete experience to mind (reading and writing), recall (to remember without a prompt or any kind of support) and spelling (McGuinness, 2005). Responses may be written, verbal or by pressing a switch. A short-term memory task usually involves verbatim repetition of input heard in the exact order. Probably the most utilized type of memory test is the intentional task, whereby the participant is told to remember what they hear or see before assessment. Incidental learning occurs when participants are required to make judgments about a set of words or pictures, then are surprised when they are asked to recall them. McGuinness (2005) states that the meaningful processing involved in incidental learning creates an increase in memory performance, as it is an example of a "meaning to memory" task.

Phonological Memory is the ability to hold sound-based information in immediate memory (short-term memory)—the better the child can hold sound-letter match in memory while decoding, the more ability cognitive resources have for decoding and comprehension. Katz, Healy, and Shankweiler (1983) documented that short-term verbal memory was closely related to the level of reading skills for letters and words (Brady, Shankweiler, & Mann, 1983), or sentences (Mann, Liberman, & Shankweiler, 1980).

Of the three systems of Baddeley's working memory model (central executive, phonological loop, and visuo-spatial sketchpad (1986), the phonological loop was found to be the most important for language and literacy learning. The phonological loop and

store plays a key role in learning the pronunciation of novel vocabulary items (Gathercole & Baddeley,1989; Baddeley, Gathercole & Papagno,1998) and in influencing the acquisition of syntax (Adams & Gathercole, 1995). Snowling, et al. (1994) found a significant correlation between working memory and phonological awareness.

In the beginning phases of reading development, children have minimal understanding of orthographic knowledge but excel in oral vocabulary tasks. Oral vocabulary and metalinguistic knowledge are established predictors of emergent literacy/reading skills and would incorporate the phonological loop and visuo-spatial sketchpad in proper encoding and storage of words/language experienced in their environment. An association of the visuo-spatial sketchpad and phonological loop would also be employed later during the processing of orthographic and phonological input.

Scientific literature has documented that short-term verbal memory is closely related to the level of reading skills for letters (Katz, Healy, & Shankweiler, 1983), words (Brady, Shankweiler, & Mann, 1983), and sentences (Mann, Liberman, & Shankweiler, 1980). Hansen and Bowey (1994) conducted a correlational study of seven-year-olds, whereby both phonological analysis and verbal working memory accounted for unique variance in three reading measures. However, other studies have suggested that short-term verbal memory does not significantly predict reading skills after controlling for phonological abilities (Rohl & Pratt, 1995; Wagner, Torgesen, & Rashotte, 1994).

Environmental Factors

A young child's level of language proficiency and their reading skills are closely correlated with socioeconomic status (SES) of their parents or caretakers, with middle-class children attaining higher levels of language and literacy than lower-class children

(Feagans & Farran, 1982; White, 1982). However, Bryant (1998) found that SES differences in word level reading in young children were mediated partly through pre-existing differences in phonological sensitivity. When phonological sensitivity scores were considered, SES differences were no longer significant in the tests of reading accuracy. Bowey (1995) also suggested that many children from lower socioeconomic groups might be arriving at school with underdeveloped phonological awareness placing them at a serious disadvantage in acquiring early reading skills.

Scarborough and Dobrich (1994) reviewed 31 studies that analyzed the impact of parents' reading on their preschoolers' oral language and literacy development. They concluded that frequency of reading to preschoolers was positively associated with growth in lexical and semantic content of language and in developing literacy, but the association was of modest proportions, with most correlations at or less than .28. However, Senechal, et al. (1998) found that in the study of frequency of storybook reading and teaching reading and writing of words, storybook exposure explained statistically significant unique variance in children's oral language skills, but not in their written language. These authors concluded storybook exposure might enhance children's oral language skills, whereas additional support in the form of reading instruction may be necessary to enhance written language skills.

Improving Screening for Risk of Early Reading Failure

Most children learn to read without any difficulty, but up to 25% of all children experience reading problems in school (Shaywitz, Escobar, Shaywitz, Fletcher, & Makuch, 1992). Four to six percent of the preschoolers are specifically diagnosed with a reading disability (Badian, 1994; Stedman & Kaestel, 1987); these children face almost certain school failure (Badian, 1993, 1998; Felton & Pepper, 1995; Gough, 1996;

Stanovich, 1986). Children who exhibit difficulty with the beginning stage of the reading process rarely become strong readers. Stanovich and Siegel (1994) found that of children identified as exhibiting a reading disability in the early grades (i.e., kindergarten and first grade), 74% continued to be labeled as having a reading disability in the ninth grade.

Many studies have documented the efficacy of early identification and intervention in prevention of school failure, leading to increased interest in preschool and kindergarten screening programs (Ball & Blachman, 1991; Berrieta, et al., 1984; Felton & Brown, 1990; Hurford, et al. 1994; Lundberg, Frost, & Peterson, 1988). Researchers generally have found that standardized tests predicted children at risk for reading failure better than teachers. Reported teacher prediction rates are low, ranging from 15% to 41% correct identification of children at risk (Feshbach, Adelman, & Fuller, 1974; Fletcher & Satz, 1984; Flynn & Rahbar, 1998a; LaTorre, et al.,1982; Stevenson et al., 1976). In contrast, test identification rates are reported to be much higher range from 71% to 80% (Fletcher & Satz, 1984; Flynn & Rahbar, 1998a). Most screening programs test general developmental tasks, such as language skills, resulting in results that are not warranted for designing specific interventions (Satz & Fletcher, 1988; Majsterek & Ellenwood, 1995). The instruments are often used to make inappropriate decisions such as delayed school entrance, retention in grade, or transition programs (Gredler, 1992).

These findings suggest that early detection of risk is important and screening tests should be developed to test known predictors of reading failure and language development. Screeners should also be easy for teachers to administer and aid in the

selection of children who are at risk. Ultimately, screening programs should lead to early intervention and to decreased numbers of children with reading failure.

Recognizing weak foundational skills in children at the earliest stages of development is the best approach to preventing reading disabilities. The development of screening and associated early intervention instruments has constituted a significant commodity in the systematic early identification and management of children at risk of reading problems. Specifically, improving teachers' observation skills for deficits in emergent literacy skills is one key method for early identification. Kindergarten teachers need to know how to observe developmental skills from studies of precursors to reading achievement. They also need to know how to match children's profiles with research-validated interventions in order to intervene effectively and efficiently identify "at risk" individuals and prescribe intervention as soon as possible.

Statement of the Problem

Currently, we are able to identify many children who are "at risk" for later reading disabilities by the end of kindergarten but we have very few reliable methods of making this prediction in younger children. In order to begin to address the issue of early identification and prevention in the preschool population, tasks are needed for younger children to predict their risk for future reading difficulties with a reasonable degree of reliability and validity. This study was designed to develop such tasks for three-year-olds and to determine which of these tasks best predict the children's performance on a standardized test of language and literacy one year later. Tasks were developed to reflect areas in the literature that are associated with future reading ability. These tasks chosen for this study represent the following skill domains: phonological knowledge,

orthographic knowledge, verbal memory, fine motor functioning, receptive and expressive language, and rapid automatic naming.

To address the lack of empirically tested tasks that can be used to test three-year-old children for the purpose of identifying their risk for future reading difficulties, the following experimental questions were investigated:

1. Which experimental tasks meet normality criterion for three-year-olds and again one year later?

2. Which experimental tasks for three-year-olds showed normal distribution and growth one year later?

3. Which of the experimental tasks that meet normality criterion best predict the ALL Language and Emergent Literacy Index scores at age three?

4. Which experimental tasks best predict the ALL Language and Emergent Literacy Index scores at age four?

CHAPTER 2
METHODS

The purpose of this study was to 1) develop a battery of tasks that showed a normal distribution of scores for typically developing three- and four-year-old children and to 2) determine which of these tasks best predicts the performance of three- and four-year-olds on a standardized measurement of emergent literacy and language in preschoolers.

A battery of tasks was developed to test the participants at three and four years of age. These tasks were chosen that represented constructs or skills that have been associated with later language and emergent literacy in previous studies (Whitehurst & Lonigan, 2001; Scarborough, 1998; Bowey, 2005; Ashby & Rayner, 2006). After several months of task development and pilot testing, a battery of experimental tasks was compiled across seven domains: (1) Phonological Awareness, (2) Orthographic Awareness, (3) Emergent Writing, (4) Memory Skills, (5) Language (receptive and expressive) skills, (6) Rapid Automatic Naming ability (RAN), and (7) Fine Motor Functioning.

Children were tested on these experimental tasks at three years of age (36-48.0 months) and again, one year later, when they were four years of age (48.1-60.0 months). During the second year of the study, the preschoolers were also tested on a standardized battery of language and literacy tests.

This chapter includes information on the subjects, examiner, equipment, procedures, stimuli, scoring, and analysis.

Participants

Participants were recruited from several preschool teaching sites in Alachua and Orange/Seminole counties areas in Florida. A total of 38 subjects, 21 females and 17 males, participated in this study. During the first year of testing, participants ranged in age from 37 months to 47 months, with an average age of 43 months. During the second year of testing, participants ranged in age from 48 months to 60 months of age, with an average age of 56 months. Only participants who were tested over the two consecutive years were included in the database for analyses. Children were selected for study if they were reported by their teachers to have a negative history for language/speech deficits, cognitive deficits, or hearing impairment and if this information was confirmed in a parent questionnaire. Parents were asked to complete an informed consent form and a questionnaire from the Assessment of Literacy and Language (ALL, 2005) requesting information on the child's family background, health, language development milestones and emergent literacy skills (See Appendix D). The mothers' educational levels ranged from 14 to 20 years with an average of 16 years of formal schooling.

Prior to recruiting subjects, research approval was granted from the Institutional Review Board (IRB-2) committee at the University of Florida (See Appendix A) for copies of the IRB Protocol #2006-U-0342 for the first year of testing and IRB Protocol #2007-U-0342 for the second year of testing (see Appendix B). Information about the study and an invitation to participate was distributed to the teachers, who were asked to pass flyers on to parents of children. (See Appendix C)

Pilot Study

The experimenter conducted all assessments during the pilot study with 10 three-year-olds. There were no tests used to qualify subjects for participation; however, their caretakers and teachers reported no history of speech, language, or hearing deficits. Data collection took place in a quiet room at the children's preschools or in a quiet room at the child's home. The initial pilot test protocol was administered to each participant and was presented in the same order for each child (See Appendix 2-3 for a copy of the test protocol for the pilot study). The total test time during the pilot testing for three-year-olds was one hour. Some of the children were tested over two-three days depending on their attentiveness and compliancy. The testing never went beyond the duration of 2-3 days in one week. The children were tested between October and December of 2006. Several of the tasks were deemed as being too easy or difficult for inclusion in the final test protocol for the study. These included: Visual Matching (proximal and distal), Nonsense Word Repetition, Rhyme Production in Context (child was read a story and required to complete sentences with a real or nonsense rhyming word) and Rhyme Judgment, as many three-year-olds were able to just guess at the answer and be 50% correct. This task was replaced with Rhyme Production, which required the child to supply a rhyming word for the word stated in a picture, such as "pie". Since many of the three-year-olds had difficulty with the Digit Word Span Backward task, other more basic memory tasks were added to the protocol: Sequential Memory (immediate recall); Sequential Memory after a 2 minute and 5 minute delay, and Visual Short-Term Memory. (See Table 2-1 for the procedures involved in these tasks)

Once the pilot study was completed in December of 2006, the final protocol of exploratory tasks was adopted and testing began with a three-year-old population

whose caretakers had consented to allow their children to take part in the study. Prior to beginning the study, eight undergraduate students were trained by the investigator to administrate the exploratory tasks. Weekly meetings were scheduled for all undergraduate students to meet with the investigator regarding problems with data taking, scoring, and tabulation of scores. One specific undergraduate student was placed in charge of rechecking the scoring and then entering the scores for each child into an Excel spreadsheet. Undergraduate students on the study team checked each other's protocols for efficiency and correctness of scoring. The writing samples in the Emergent Literacy domain were reviewed by a group of undergraduate students, the investigator and the major professor. A rubric for scoring such tasks as Name Writing, Copying, Writing of ABCs, Naming Letters in Name and Story Writing was developed by this group.

Task Development

Rationale. By six years of age, most children demonstrate fairly sophisticated levels of emergent literacy knowledge. Important reading prerequisites are shown in preschool children's emerging abilities to recognize environmentally embedded and contextualized print, to understand the form and function of print, and to perceive relationships between speech and print (Mason, 1980; Goodman, 1986; Dickinson & Snow, 1987). These and other emergent literacy abilities form the foundation for young childrens' imminent entrance into formal literacy instruction.

Preschoolers who are judged to be "at risk" for delayed attainment of literacy include children with language impairment (Boudreau & Hedberg, 1999; Ezell et al., 2000), children reared in poverty (Dickinson & Snow, 1987; Chaney, 1994), children with developmental disabilities (Koppenhaver, et al. 1991; Saint-Laurent, et al. 1998),

and children learning English as a second language (Snow, et al. 1998). Young children with language impairment, for example, demonstrate sufficiently less skill in recognizing commonly occurring environmental print (e.g. Coke ® and Bandaid®) than their typically developing peers (Gillam & Johnston, 1985). Delayed attainment of such skills may serve as warning signals of later difficulties in higher-level literacy development. Speech-language pathologists and early childhood educators are encouraged to identify preschool children experiencing delayed emergent literacy acquisition and to provide the necessary instruction to prevent future reading failure (Boudreau & Hedberg,1999; Ezell, et al. 2000; Justice & Ezell, 2000).

The key preliteracy precursors for successful transition to conventional literacy (Teale & Sulzby, 1986; Chaney, 1992) include: print awareness, word awareness, and phonological awareness. Print awareness refers to children's ability to recognize the function and form of print and the relationship between oral and written language (Hiebert, 1981; Goodman, 1986). Word awareness describes children's ability to recognize words as discrete elements of both print and speech and to discern the relationship between written and spoken words (Tunmer, et al. 1983; Bowey, et al. 1984). Phonological awareness describes young children's ability to identify and manipulate the sounds of a language (Lundberg, et al. 1988; Ball, 1997). Skills across all the dimensions are acquired incidentally and gradually during the preschool period.

In recent years, considerable attention has been directed towards young children's acquisition of phonological awareness. Word and print awareness, in contrast, have received substantially less attention in the developmental literature (Justice & Ezell, 2001). Yet, longitudinal studies have shown that word and print awareness serve as key

predictors of later reading achievement (Adams, 1990) and involve important elements of the foundation of emergent literacy knowledge (Stuart, 1995).

Most studies examining preschool children's word awareness have focused on children's concept of word within oral contexts. Investigations into children's ability to handle word-referent discrimination (Bowey et al., 1984; Chaney, 1992), to understand the meaning of the term "word" (Bowey et al., 1984), and to segment orally presented strings of words (Tunmer et al., 1983; Chaney, 1992, 1994). Such studies have shown that preschool children readily make sophisticated metalinguistic judgments about words, including the ability to discriminate words from sounds and the ability to segment spoken utterances into their respective word elements (Tunmer et al., 1983; Chaney, 1992; Bowey et al., 1984). To date, however, there are limited empirical data regarding preschoolers' word awareness in written language contexts. Word awareness in written language contexts is a necessary competency for beginning reading development, with the concept of "word" and finger-pointing tasks comprising a key element of early reading instruction (Clay, 1979; Invernizzi, et al. 2000).

In contrast to the scarcity of research on word awareness in written language contexts, a number of studies have addressed preschoolers' accomplishment of print awareness, or 'print literacy' (Mason, 1980; Snow, 1983; Goodman, 1986; Chaney, 1992). Like word awareness, print awareness gradually emerges within the preschool period. Print awareness is a sign of children's emergent abilities to think about and interact with written language, consequently representing children's growing understanding of the form and function of print. The understanding that print carries meaning develops between the third and fifth year of life (Mason, 1980). Mason found

that, at this time children undergo a significant transformation in which independent and self-motivated interactions with print exponentially increase. For example, children begin to use print as a communication device, to recite the alphabet, and to recognize letters and words occurring in print. Development of such skills within the preschool period is an important predictor of later reading achievement (Adams, 1990; Stuart, 1995).

Word and print awareness, along with phonological awareness, are considered key building blocks for conventional literacy. Both early childhood educators (Snow, et al. 1998) and speech-language pathologists (American Speech-Language-Hearing Association [ASHA], 2000) have been persuaded to address these skills in prevention, assessment, and intervention activities. A problem faced by educators and therapists is that there are few formal or informal measures available by which to examine preschool children's word and print awareness. Many educators feel limited in their ability to incorporate a systematic emergent literacy focus when working with young children due to the lack of available measures for quantifying these skills (Justice & Ezell, 2001).

Liberman, et al. (1974) first acknowledged the development of an appreciation of the sound structure of language throughout the preschool years. Previous observational data obtained with four- to five-year-old children demonstrated the early availability of rhyme (Dowker, 1989) and supported the hypothesis that rhyme awareness is the earliest stage of metaphonological development. Goswami and Bryant (1990) found that tasks of rhyming skills assess the child's understanding of "onset" and "rime" units within words, such as the "onset" containing the consonant or consonant cluster that precedes the vowel and the "rime" containing the vowel and succeeding consonants (such as t-ake, st-eak, fl-ake, and l-ake). Rhyming tasks have been successfully

performed by children as young as four and five years of age and are predictive of later success in reading (Bradley & Bryant, 1983). In order to assess this area in younger preschoolers (three-year-olds) the following three subtests were added to the Phonological Awareness domain of testing: Rhyme Memory, Rhyme Judgment, and Rhyme Production.

Knowledge of the alphabet at school entry (kindergarten is one of the best predictors of later reading achievement (Adams, 1990). Another area of language processes related to reading acquisition is orthographic processing. Orthographic awareness refers to the familiarity with the written symbols (letters) representing the sounds that children become aware of during the development of phonological awareness. This ability enables kindergarten and first grade readers to delineate between misspelled and correctly spelled written words. (Foorman, 1994; Vellutino, et al. 2000). Orthographic processing refers to the use of orthographic information in processing oral or written language (Wagner & Barker, 1994).

There has been an increasing interest in orthographic processing as a probable predictor of reading acquisition since many studies have shown a low amount of variance that phonological awareness plays in word recognition (Berninger, 1994; Manis, et al. 2000; Stanovich & Siegal, 1994; Roberts & Mather, 1997).

Two issues in assessing orthographic processing in preliterate children include concerns about construct validity of the measures (Vellutino, et al. 1994) and the efficiency of assessing orthographic processing ability in children with minimal or no reading experience (Badian, 1994). Vellutino, et al. (1994) argue that the majority of orthographic awareness tests actually measure word identification or spelling ability

instead of the underlying cognitive systems that control those activities. They also contend that there are no “pure” tasks of orthographic processing as reading involves both orthographic and phonological coding. Once the child has learned to read, they exhibit the ability to perform orthographic processing tasks using their word recognition and spelling knowledge.

A second concern relates to the difficulty of testing this domain in preliterate children. Due to the fact that most of the orthographic awareness tasks involve the child differentiating between real and pseudo words or distinguishing correctly spelled words from misspelled words, these measures cannot be used with preschoolers. Badian (1994) tried to solve this problem with preschoolers by developing a ten-item visual matching task that involved alphanumeric symbols (letter and digit sequences). Badian (1994) found that this orthographic measure was significantly related to first-grade reading skills with letter knowledge controlled. A modified version of the “Visual Matching” subtest found in the Predictive Reading Profile (2001; for kindergarteners and Ffrst graders) was utilized in the exploratory task, Letter Discrimination, which did not contain sequences of letters but a sequence with only one letter out of a field of five different shapes. The Visual Matching task was removed from the protocol as many individual symbols, objects, and individual letters were presented. It was too easy as compared to Badian’s (1994) sequences of alphanumeric symbols.

General cognitive ability has been shown to be only indirectly associated with emergent literacy skills via phonological processing abilities. The speed with which pictures, digits, and letters can be names is a well-documented linguistic correlate of reading ability that is thought to reflect phonological memory or retrieval processes.

Individual differences in what is referred to as rapid automatized naming (RAN) have been shown to predict reading development in the first grade (Felton and Brown, 1990) and in the third and fourth grades (Badian, et al. 1990). Whether a naming difficulty in a poor reader reflects a problem in the process by which representations are retrieved or whether the problem lies in the phonological representations themselves being indistinct or unrefined continues to be an area for debate. However, Manis, Seidenberg, and Coi (1999) proposed a model of reading development in which they indicated that naming tasks account for distinct variance in reading when compared to phoneme awareness because naming involves arbitrary associations between print and sound whereas phoneme awareness is more related to the learning of systematic spelling-sound correspondences. Learning arbitrary association between sounds and letters probably plays a central role in the development of early reading skill and knowledge of segmental phonology and is relevant to both the earlier and later phases of learning to read. Therefore, the Rapid Object Naming tasks (eight and twelve objects) were added to the battery.

Torgesen et al. (2006) concluded that many of the children presenting with phonological processing difficulties also exhibited difficulties in copying letters and words during their assessment and reading remediation program. The Copying subtest measures the accuracy with which the three- and four-year-olds can trace and ultimately copy shapes and letters proximally.

Final Experimental Battery

The final experimental battery is comprised of twelve tasks within seven domains: 1) Phonological Awareness, 2) Orthographic Awareness, 3) Emergent Writing, 4) Memory skills, 5) Language (receptive and expressive) skills, 6) Rapid Automatic

Naming, and 7) Fine Motor Functioning. A rationale for including each domain in the battery follows along with a list of the tests in each domain. Descriptions of all experimental tasks are shown in Tables 2-1 and 2-2.

Phonological Awareness

Phonological awareness refers to the emergent reader's ability to think about and manipulate units in spoken language that are smaller than the syllable (Stahl & Murray, 1998; Stanovich, 1991). Many researchers have adopted various tasks to study the phonological abilities of children in kindergarten and beyond. These tasks include blending of sounds in words, segmenting sounds in words, deleting sounds (e.g., Yopp, 1988; Comprehensive Test of Phonological Processing, 1999). Phonological awareness is one of the most studied topics in cognitive psychology, as it has been found to be critical for the development of proficient reading and spelling skills.

Rhyming tasks have been successfully performed by children as young as four and five years of age and are predictive of later success in reading (Bradley and Bryant, 1983). In order to assess this area in younger preschoolers (three-year-olds), the following three subtests were added to the Phonological Awareness domain of testing: Rhyme Memory, Rhyme Judgment, and Rhyme Production.

To measure phonological awareness, several subtests involving rhyme awareness were included in the final protocol. The Rhyme Memory Task was adapted from The Phonological Awareness Literacy Screening (Invernizzi & Meier, 2002). The child is required to choose a picture that "sounds like" or rhymes with one of three presented pictures. The child was asked to name all of the stimuli in the task. If a child did not know the name of an object, the examiner said the name, then asked the child to imitate during a delayed imitation task. If the child could not spontaneously name any of the

target words, a delayed imitation strategy was used during the testing. The title "memory" was added to this task as the child needed to remember the stimuli for a short time while working memory helps them to analyze the sound segments. Those children who exhibit poor phonological memory are at a deficit when learning phonological awareness, which is critical to reading acquisition (Torgeson, 1996; Gathercole & Baddeley, 1993). The raw scores were tallied on the protocol and then later transferred to the Excel worksheet for later data analysis.

The Rhyme Judgment task was adapted from The Dyslexia Early Screening Test (DEST) (Nicolson & Fawsett, 1996), which is a norm-referenced set of measures for screening abilities in children (four to five through five- to six-year-olds) where difficulties may be related to dyslexia. The "Rhyme Detection" task on the DEST was modified for the younger preschoolers by using two pictures and then having the child indicate whether the two pictures rhyme. Again, the pictures were stated for the child to make sure that vocabulary knowledge was not influencing the score. The raw score of correct responses was tallied and entered into the database.

The Rhyme Production task was adapted from the "Rhyme Production in Words" subtest in the Assessment of Literacy and Language (Lombardino, Lieberman, and Brown, 2005). This task measures a child's rhyme production in words. The examiner says a word ("pie") and then asks the child to think of a word that rhymes (sounds like) "pie". The raw score is tallied and added to the database for later analysis.

Segmentation

Since many of the three year olds were not yet able to segment sounds in CVC words (consonant+vowel+consonant), they were required to sequence words in simple one to three word sentences Therefore, the Segmentation of Sentence to Words

subtest was included in the experimental test battery. The children's ability to segment spoken language units (i.e., sentences into words) was assessed using an adaptation from the Segmentation subtest of the Phonological Awareness Test (PAT; Robertson & Salter, 1997). In the Segmentation task, children were presented with a series of one- to four-word sentences (e.g., "He can swim") and were required to repeat each sentence while placing a block on the table for each word. This subtest required six trial items before raw scores were tallied.

Orthographic Awareness

The letter is the basic unit of reading and writing, and letter knowledge has consistently been shown to be one of the best predictors of later reading success (Adams, 1990; Scarborough, 1998; Stevenson & Newman, 1986). A beginning reader who cannot recognize and distinguish the individual letters of the alphabet will have difficulty learning the sounds those letters represent (Mason, 1980).

Badian (1994) concludes that assessment of orthographic processing/awareness ability in children with little or no reading experience is a problem. Badian (1994) developed a ten-item visual matching task that included alphanumeric symbols (letter and digit strings) to begin to assess early orthographic processing skills in preschool children. Badian (1994) concluded that preschool performance on this orthographic measure was significantly correlated with first grade reading skills, even with letter knowledge controlled.

From Badian's procedure and The Predictive Reading Profile (PRP) (Flynn, 2001), the adapted exploratory tasks included: Alphabet Awareness (singing of ABCs), Letter Identification (receptive), and Letter Discrimination tasks.

It is important to note that the Predictive Reading Profile is a group-administered screening battery which is timed and designed to measure a set of kindergarten-level reading precursors for children between the ages of five and six. On the Letter Discrimination exploratory task, the child was to find the letter in a series of five stimuli containing shapes, letters, numbers, and erroneous writing of letters. Measures were obtained via raw scores. The Letter Identification task was adopted from the ALL (2005) and involved the child pointing to letters named by the instructor. Again, scores were tallied as raw scores (amount correct). The Singing of the ABCs task was adopted from an article written by John A. Smith (May, 2000) where he concluded that singing the ABCs supports early literacy development in the areas of letter names and sounds, phonemic awareness, print conventions, vocabulary, decoding, and writing. Scores for this task was determined on the following scale: sing without errors= 10; 0-5 errors= 8 points; 5-10 errors= 5 points; 10-15 errors= 1 point; cannot sing song= 0 points. The research team decided upon this rubric of scoring after the pilot study of this task.

Emergent Writing

The exploratory task, Copying, consisted of children tracing, copying shapes and letters proximally, and then being judged on their accuracy. The committee got together as a group and would judge the score on the participant's productions. (Please see the rubric for obtaining either a 0, 2, or 3 score on this task in Appendix D)

Early name writing may represent a child's first step in using printed symbols for meaning. A study by Haney, Bissonnette & Gehnken (2003) investigated the relationship between name writing and early literacy skills in kindergarten students. A measure of name writing proficiency was developed ("Name Writing Scale"). Results

revealed that name writing was significantly correlated with word and non-word identification. No significant gender differences were found on the measure of name writing. They stressed the inclusion of name writing assessments in early screening batteries for students at risk for reading difficulties, and to address the hypothesis that name writing skills may reflect an understanding of the alphabetic principle. Early name writing may represent a child's first step in using printed symbols for meaning. This study investigated the relationship between name writing and early literacy skills in kindergarten students. A measure of name writing proficiency was developed (Name Writing Scale). Results revealed that name writing was significantly correlated with word and non-word identification. Suggestions are made for future research to address inclusion of name writing assessments in early screening batteries for students at risk for reading difficulties, and to address the hypothesis that name writing skills may reflect an understanding of the alphabetic principle. Understanding that a word corresponds to a printed symbol may be as important a precursor to reading as being able to segment an orally presented word into phonemes (Olson, 2002). However, Lieberman (1985) considers learning to write as a process of modeling complicated visual-motor skills through direct teaching activities (Lieberman, 1985). Vygotsky (1962) proposed that the awareness of names signifies the point at which language and thought come together to form the basis of intellect. Like developmental milestones in emotion and cognition, name writing follows a predictable developmental course potentially useful in screening for those with some types of developmental delays. By age three, children spontaneously produce scribbles that are distinctly different when attempting to draw from those made when attempting to print (Brenneman, Massey, Machado, & Gelman,

1996; Deford, 1980). Children learn to write in a predictable pattern including circular scribbles, linear continuous scribbles, letter-like symbols, and finally actual letters. Clay (1982) described the developmental process of learning to write which involves trial and error and hypothesis testing becoming more complex with age, as opposed to a rote process of copying models of print.

In addition to being the earliest attempt at print and following a predictable developmental course, name writing is arguably the initial, meaningful print in a young child's environment. One's own printed name is an extremely meaningful piece of text that young children are likely to see in print and be encouraged to learn more words (Clay, 1982).

The Emergent Literacy domain includes Name Knowledge (writing name and then naming each letter in name; the examiner would point to a form and ask child, “Which letter is this?”. The scores on these tasks were determined by percentage correct so as not to penalize children with extremely long names. This exploratory task was adapted from The Name Writing Screen (NWS) developed as a research tool by Haney, Bissonnette, and Behnken (2003) for use with kindergarteners. Interrater reliability was addressed as the entire research committee met and analyzed and checked the score.

Another exploratory task, Writing ABCs, measures the child’s ability to write their ABCs and was adapted from the Wechsler Individual Achievement Test-II (WIAT-II (2001). This test contains a subtest for “Written Expression” which requires four to eighty five year olds to write their ABCs or words as quickly as possible. Scoring included the number of correctly formed letters without proper sequence and the numbers of letters written that were properly named. 0 = no letters written; 1= 2-4 letters

named or properly written; 2= any letters properly written and named (over 4 letters). Again, inter-rater reliability was used as the entire committee met and analyzed and checked scoring of this task.

The final exploratory task, Story Writing, measures the child's ability to write a story as best they could and made sense to them. The children were asked to write a story about their favorite animal. Afterward, they were then asked to identify where it begins and ends and were also asked to read what they had written. The children were given a preschool-sized pencil with an eraser and preschool lined paper. As the child wrote their ABCs and a story (some children refused to write a story but were more excited to write their ABCs), their ability to write from left to right, use some formidable letters on the page, and to name the letters or words they wrote were tallied. They were scored either a 0 or 1 on these tasks. It should be noted that the examiner tape-recorded this part of the session so as to be able to identify the child's idea of what they had written. This exploratory task was adapted from the Predictive Reading Profile: Story Writing (Flynn, 2001) whereby the child is asked to write a story about a favorite animal and is scored on a 10-point scale.

Memory

Research has shown a correlation between verbal memory and reading skill (Berninger, et al. 2006). Of the three systems of Baddeley's working memory model (central executive, phonological loop, and visuo-spatial sketchpad (1986), the phonological loop was found to be the most important for language and literacy learning. Data support that the phonological loop plays a key role in learning the pronunciation of novel vocabulary items (Gathercole & Baddeley, 1989; Baddeley, Gathercole & Papagno, 1998).

Two categories of tasks have been used most frequently to assess phonological memory: verbal memory span and speech repetition. Verbal memory span tasks require children to repeat sequences of words, digits, or other verbal material. In the measurement of short-term memory, children must hold a small amount of information passively in memory for a short period of time and then reproduce it in unmodified form. In contrast, working memory tasks, such as the backward digit span tests, require the child to maintain information while performing some kind of operation on it. Verbal memory span tasks are considered to measure phonological memory only if they require immediate verbatim recall of item sequences without stimulus manipulation (Torgeson, 1996) and include forward word span, forward digit span, and sentence imitation tasks.

The exploratory task chosen was the Digit-Word Span Forward task and was adapted from The Woodcock-Johnson III Tests of Cognitive Abilities: Memory for Words (2001) which measured the child's ability to repeat strings of words. To assess working memory the Digit-Word Span Backward task was utilized. Many of the children at age three had problems learning the task but after a few trials with visual cues, most were able to complete the task with only auditory presentation. They were required to listen to a list of words and then produce them in reversed order.

The Sequential Memory task was adopted when the Digit-Word Span Backward task was found to be too difficult for the three-year-olds during the pilot study. This task required the children to remember a sequence of digits or pictures previously seen and then replicate them either immediately, or after two to five minutes. Currently, there are no screening instruments that include this memory task.

Fine Motor Functioning

Two types of fingertapping task measures were chosen: 1) a measure of the number of times the child is able to tap the index finger of the dominant hand in one minute using a scientific calculator for precision. This procedure was replicated on the nondominant hand. This task was repeated twice on each hand and the results were averaged for each hand as the raw score, and 2) a measure of how long it takes a child to touch their thumb to their index finger ten times (modified pincer grasp) as rapidly as possible. After two trials the number of seconds were averaged giving a total raw score. The same calculations were performed on the nondominant hand.

Language

Developmental relationships between language and literacy skills are often exhibited in beginning readers, preschoolers with language impairments, children of adults with a history of reading difficulties and children having problems with reading development in preschool or kindergarten. Some studies that have included populations of preschool language-disordered children have shown that those children are at risk for developing later reading disabilities (Catts, Fey, & Tomblin, 1997; Rescorla, 1999; Bishop & Snowling, 2004).

Estimates show that about 12% of children beginning kindergarten in the United States and Canada have been diagnosed with language impairment (Beitchman, Nair, Clegg, Patel, Fergusen, Pressman, et al. (1986); Tomblins, Records, Buckwalter, Zhang, Smith & O'Brien, 1997).

For these experimental tasks, both receptive and expressive tasks were administered. The Language Comprehension subtest required that the children repeat differing lengths of sentences in their own age range (sentence length did not extend

more that four words). The other task in this domain utilized findings from earlier assessments of the three-year-old phoneme repertoire (Hodson, 2005); whereby, the child was required to imitate the words and short sentences stated by the therapist.

Rapid Automatic Naming

Performance on rapid automatized naming tasks (RAN) has been found to be a strong predictor of reading acquisition (Bishop & League, 2006; Sunseth & Bowers, 2002; Wolf, Bally, & Mooris, 1986). A reading disabled child will often exhibit reduced rates of speed on this task (Willburger, Fusseneger, Moll, Wood, & Landerl, 2008). Stimuli utilized are usually digits, colors, or pictures of familiar objects to elicit naming responses that are overlearned or automatized. This particular task is used to study underlying cognitive correlates (i.e., accuracy and naming speed) to further analyze if these correlates are crucial to learning to read.

Despite the use of the predictive power of automatic naming speed tasks, RAN measures that involve letters and digits (numbers) are unable to be used with preschool children who do not know the alphabet or numbers. Many incoming kindergarteners are unable to name colors. The exploratory task of Rapid Automatic Naming was adapted from the Comprehensive Test of Phonological Processing: Rapid Object Naming task (1999) and the Dyslexia Early Screening Test–Rapid Naming (1996) which only included pictures of objects.

The experimental tasks chosen for this section consisted of 1) Rapid Automatic Naming of eight familiar pictures (dog, bike, cat, cup, etc.) with a matrix of two rows of four pictures; 2) a Rapid Automatized Naming task consisting of a matrix of twelve familiar pictures (dog, bike, cat, cup, etc.). The children were timed in seconds for each task and were averaged for the final raw score in seconds.

Data Collection Procedures:

Data was collected using the test protocols containing the experimental tasks (See Appendix F). All scores were raw scores or percentage scores reflecting the amount of items correctly completed. Please refer to each domain explained above for the scoring and data collection practices.

Data Reduction

Data were organized using an Excel worksheet by one of the undergraduate research assistants. Data consisted of raw scores, percentages and proportional scores (Writing Letters in Name task and Naming Letters in Name Written by the child). In order to better analyze the percentage scores, they were changed into "proportion values" which is another term for relative frequency. Proportional values are calculated by dividing the number of times an event occurs by the total number of times an experiment is carried out ($rf_n(E)= r/n$ or 30/50=3/5=.6). So if a child only wrote ¾ of their name (the Result (r=3) would be divided by the actual number of letters in their name (n=4), the proportion value would equal .75.

After all of the child's performance scores on the experimental tasks at age three and at age four were documented into the database, the scores were calculated using SPSS (originally, Statistical Package for the Social Sciences) was released in its first version in 1968 after being developed by Norman H. Nie and C. Hadlai Hull. Currently, this program is PASW: IBM PASW (Predictive Analytics SoftWare) (Nie & Hull, 2009) and was used to convert the raw and proportional scores into z-scores (Newton & Rudestam, 1999). A z- score is a "transformation" of a normal probability distribution in such a way that the mean of the distribution will be 0 and the standard deviation is equal to 1. The z score standardizes the distribution. The term "standard normal distribution"

is used to describe this type of curve. Therefore, a z-score of +1 indicates the point on the horizontal axis that is one standard deviation above the mean. These z-scores were then used in all the analyses in the project and are further reported in Chapter Three.

Table 2-1. Tasks for three-year-olds

Domain	Tasks	Description	# of items in task	Scoring Criteria
Phonological Processing	Task 1: Rhyming Knowledge with pictures	Two words were presented to the child both orally and with pictures of the words. For example, the child was presented a picture of a hat and a cat and asked to tell the examiner if the words rhyme or not.	10 items	Basal= three consecutive correct Ceiling= three consecutive incorrect
	Task 2: Rhyme Memory	The child was presented with a stimulus word, such as dog, and then shown a series of three pictures named by the examiner. For example, the child was required to point to the item in the series that rhymed with the stimulus word dog. (frog, pig, can). There are seven items, which include words that rhyme with maximal phonetic differences (i.e., paw/straw); seven items, which contain a final consonant match for rhyming (i.e. night/kite), and then six pairs that contain a vowel match for rhyme (i.e., sad/mad).	four trials and eight test items	Basal: three correct Ceiling: three incorrect
	Task 3: Rhyme Production	The child was read a story containing rhyming stanzas; then the child was required to “fill in” the missing “blank” with either a word or pseudoword that rhymes with the stanza.	two trials; four test items	Basal: two consecutive correct Ceiling: two consecutive incorrect
	Task 4: Segmenting Sentences to Words	The child was asked to match blocks to the number of different words they heard. For example, the examiner states “Joe” and the child must place one block on the table. The examiner then states, “Joe walks” and the child was required to place two different colored blocks on the table. Items that range in length from two-six words.	six trial items; ten test items	Basal: three correct Ceiling: two incorrect in a grouping

Table 2-1. Continued

Domain	Tasks	Description	# of items in task	Scoring Criteria
Emergent Writing	Task 5: Copying	The child was required to copy strokes (horizontal, vertical, crossover patterns, such as "X"), shapes (circle and triangle), numbers, and capital letters that were presented on a test booklet placed in front of him/her with a preschool-sized pencil or crayon.	eight items	Basal: three correct Ceiling: three incorrect
	Task 6: Name Writing	Child asked to write their name on a piece of preschool paper with a pre-pencil	N/A	%age of letters correctly formed
	Task 7: Identifying letters in name	Child required to name the letters in their name that they just wrote	N/A	%age of letters in name correctly named and pointed to
	Task 8: Story writing	Child was given a piece of paper w/ which to draw a picture and then write a story about it on lined paper.	N/A	1= identify beginning and ending of story; 0= no reply or inaccurate answer
	Task 9: ABC writing	Child required to write their ABCs as best they could using preschool lined paper and a larger preschool pencil. No time limit.	N/A	1= identifies beginning and end of story they wrote or ABC sequence; 1=exhibits left to right directionality; 1= names some of letters written

Table 2-1. Continued

Domain	Tasks	Description	# of items in task	Scoring Criteria
Fine Motor Functioning	Task 10. Fingertapping with index finger with both dominant and non-dominant	Child asked to press down on any button on a scientific calculator with their dominant index finger first and then their nondominant index finger as many times as they could in one minute.	N/A	two trials: average in seconds on each of the dominant and nondominant index fingers
	Task 11: Pincer tapping with both dominant and nondominant hands	Child instructed to touch their index finger to their thumb (as in a modified pincer grasp) 10 times. First, they were to perform this action on their dominant hand for two trials and then their nondominant hand over two trials.	N/A	The child's performance of this task was measured as the amount of seconds taken to repeat ten pincer taps. They were given two trials and the measures were averaged.
Orthographic knowledge				
	Task 12: ABC knowledge	Child required to sing the "ABC" song	N/A	10= sings song without errors; 08= 0-5 errors; 05= 5-10 errors; 01= 10-15 errors; no singing of song= 0.
	Task 13: Letter Discrimination	Child required toidentify a letter from a field of five shapes, numbers, and one letter.	eight items	Measured as the number correct (raw score)
	Task 14: Receptive Letter Identification	Using modified ALL protocol, child was required to point to letters named by the examiner	Seven items	The child's performance was measured by the amount of correct items (raw score).
Memory Skills (Verbal Memory)	Task 15: Digit-Word Span Forward	Child required to repeat series of numbers/nouns presented orally. These sequences contained from 2-4 items in a sequence	Ten trials	Basal: three correct; Ceiling= three consecutive incorrect

Table 2-1. Continued

Domain	Tasks	Description	# of items in task	Scoring Criteria
Memory (verbal)	Task 16: Digit-word span backward (Working Memory)	Child required to repeat a series of two-three numbers-animals presented orally in reverse order. For example, the child heard "apple-grapes" and then asked to repeat them backwards, "grapes-apple". This task was first trained with a visual cue for three items before the cue was taken away and data taking began.	10 items	Basal: 2 consecutive correct Ceiling: 2 consecutive incorrect
Memory (visual)				
	Task 17: Short-term visual memory	Child presented with a series of two-four pictures, blindfolded, and then asked to name the missing item when blindfold was removed. One item was removed while child was blindfolded	10 items	Basal: three correct; Ceiling: three consecutive incorrect
	Task 18: Sequential Memory (visual; immediate)	Child presented with series of two-four pictures of familiar animals; then the child was blindfolded, once the blindfold was removed, the child was asked to place pictures in the same place they had seen them initially.	10 items	Basal: 2 correct; Ceiling: 2 consecutive incorrect

Table 2-1. Continued

	Task 19: Sequential Memory after a delay of two minutes	Child was asked to put a set of pictures in order (2-4) that had been correctly reproduced in Task 18. The delay was set at two minutes after Task 18 was completed.	one item	Basal: series correctly reproduced Ceiling: series reproduced with errors
	Task 20: Sequential Memory after a delay of five minutes	Child was asked to put a set of pictures in order (two-four) that had been correctly reproduced in Task 18. The delay was set at five minutes after Task 18 was completed.	One item	Basal: series correctly reproduced Ceiling: series reproduced with errors
Language	Task 21: Listening Comprehension	Child presented with a simple sentence and then asked a question about the contents of the sentence they just heard. For example, "The bird is swimming": "Who is swimming?" No pictures were used with this task.	ten items	Basal: three consecutive correct; Ceiling: three consecutive incorrect
	Task 22: Expressive Language	Child was requested to listen to an age appropriate sentence and then repeat it.	ten items	Basal: 2 consecutive correct Ceiling: 2 consec. incorrect
Rapid Automatic Naming (RAN)	Test 20: Rapid Automatic Naming (8 items)	The child was required to name pictures of animals (cat, dog, cup, bike) presented in a matrix of two rows containing four pictures.	Only eight items in a matrix of 2x4; 2 trials conducted	Each of two trials was measured in seconds and then averaged.
	Test 21: Rapid Automatic Naming (12 items)	The child was required to name pictures of familiar objects (cat, dog, cup, bike) presented in a matrix of two rows containing four pictures.	12 items presented in a matrix of 3x4; two trials conducted	Each of two trials was measured in seconds and then averaged.

Table 2-2. Experimental tasks given at three years of age administered to the same students at four years of age with the addition of the standardized *ALL*

Emergent Literacy Composite Score for *ALL*	Tasks	Description	# of items	Scoring Criteria
	Task 1: Letter Knowledge	Includes three aspects of letter knowledge: letter identification, letter naming, and letter production. In letter identification, the child points to letters named by the examiner; in letter naming, child names letters as the examiner points to them; and, in letter production, the child writes letters, in either uppercase or lowercase, as they are dictated by the examiner	30 items	Ceiling: six consecutive incorrect answers
	Task 2: Rhyme Knowledge	Assessed through two tasks: rhyme recognition and identification of rhyme oddities. Rhyme Recognition: child listens to the examiner name two pictures (i.e., bone/phone*)* and then must determine if the words sound alike. In identity of rhyme oddity, the examiner names three-four pictures and the child identifies which one doesn't rhyme (i.e., cat, *pen**,*** hat).	eight items	Ceiling= six consecutive errors
	Task 3: Rhyme Production	On rhyme production in words task, the examiner says a word (***f****eet*) and the child supplies a rhyming word (e.g., *meet, beat, seat**)*** in rhyme production in context, the examiner reads a story to the child and in each sentence of the story, they must complete the sentence with a real or nonsense rhyming word (e.g., When she turned on the light, she saw a ____.)	25 items	Ceiling= six consecutive incorrect

Table 2-2. Continued

Language Skills Composite Score for *ALL*	Tasks	Description	# of items	Scoring Criteria
	Task 4: Basic Concepts	Examiner presents an oral direction, such as, "Point to the big tree," or "Show me the third turtle". The child then points to the best representation of the concept from a series of three, four or five pictures .	28	Basal: six consecutive 0 scores Ceiling: six consecutive 0 scores
	Task 5: Receptive Vocabulary	Using a picture identification task, the examiner says a word and the child selects a picture out of four choices that best illustrates the word.	20 items	Basal= six consecutive 0 scores Ceiling: six consecutive 0 scores
	Task 6. Parallel Sentence Production	In modified procedure, the examiner describes a picture with a sentence containing a targeted grammatical morpheme or sentence type, such as, irregular past tense or a passive sentence. The child then views a second picture designed to elicit the same-targeted structure.	30 items	Basal: six consecutive 0 scores Ceiling: six consecutive 0 scores
	Task 7: Listening Comprehension	Child is read three stories and then is asked to retell the story and answer questions about it.	21 items	none for discontinuing testing

CHAPTER 3
RESULTS

This study was designed to provide developmental longitudinal data on preschoolers' performance on subtests in the domains of phonological awareness, emergent writing, memory, orthographic awareness, fine motor speed, language, and rapid automatic naming. The four specific objectives of this study were to determine: 1) Which tasks show a normal distribution of scores (i.e., without skewness and/or kurtosis) at three years of age and which show a normal distribution of scores at four years of age? 2) Which tasks show a normal distribution of scores at both three and four years of age? 3) Which tasks that meet normality criterion at three years of age best predict the children's performance on the ALL Emergent Literacy and Language Index scores, and 4) Which tasks that meet normality criterion for the same children at four years of age best predict the children's performance on the ALL Emergent Literacy and Language Index scores?

Testing for Normality of Scores

In order to ascertain which tasks showed a normal distribution of scores at each age level, descriptive statistics, skewness, and kurtosis scores were used to justify normality. Skewness and kurtosis scores (Brown, 1997) show that abnormally skewed and peaked distributions of data may be signs of trouble and that problems may then arise in applying testing statistics. Therefore, each task was analyzed for its skewness and kurtosis values for the three-year-olds and for the four-year-olds in order to make decisions about excluding tasks that were too easy or difficult. Tasks were judged as showing normal distribution based on whether they fell within +/- 1.00 of the mean for skewness, or +/-1.00 from the mean for kurtosis. The descriptive statistics for each of

the tasks measured when the children were three-years-old and when they were four-years-old are displayed in Tables 3-1 and 3-2, respectively.

Most statisticians use the skewness levels for decisions regarding distribution of scores. Typically, the kurtosis levels are only used for a more in-depth analysis of abnormal distributions (Newton & Rudestam, 1999). For this study, both skewness and kurtosis values were used to determine if a task's score met the criteria for being normally distributed. This conservative approach was taken because at the outset of the study, it was unknown which tasks were appropriate for normally developing three-year-old children.

In statistics, skewness is a measure of the asymmetry of the probability distribution of a real-valued random variable and renders a value of the degree of asymmetry of a distribution around its mean (Agresti & Finlay, 1997). As represented by the normal curve, data are not skewed if they fall symmetrically on each side of the mean (68% of the data falls within one standard deviation of the mean with 34% above and below the mean). Positive skewness indicates a distribution with an asymmetric tail extending towards more positive values. Negative skewness demonstrates a distribution with an asymmetric tail extending towards more negative values (Agresti & Finlay, 1997). Normal distributions produce a skewness statistic of around zero. As the skewness departs from zero, a negative value indicates the possibility of a negatively skewed distribution with a concentration of scores on the high end of the scale. In the present data set, skewness values of +/- 1.00 or greater were two standard errors below the mean for a normal distribution and represented scores that were skewed to a significant degree (Newton & Rudestam, 1999). When the score on a task was positively skewed,

the task was considered too difficult for the children; conversely, when a score on a task was negatively skewed, the task was considered too easy.

Kurtosis is a measure of the “peakedness” of the probability distribution of a real-valued random variable. Higher kurtosis means more of the variance is due to infrequent extreme deviations, as opposed to frequent modestly sized deviations (Newton & Rudestam, 1999). Normal distributions produce a kurtosis statistic of around zero as represented by the bell shape of the normal curve. A positive kurtosis value indicates the possibility of a leptokurtic distribution (high peak) and a negative value indicates a platykurtic distribution (flat or concave shape). Values of two standard errors above or below the standard error of kurtosis indicate a significant kurtosis problem in the data. In the present data set, tasks that revealed kurtosis values greater than +/- 1.00 represented curves that were either leptokurtic or platykurtic (Newton & Rudestam, 1999).

Subtests with Normal Distribution at Each Age Level

The first research goal was to ascertain which subtests show a normal distribution of scores (without skewness or kurtosis) at three years of age and which show a normal distribution of scores at four years of age.

The following experimental tasks were normally distributed at three years of age: (1) Rhyme Judgment; (2) Segmentation; (3) Copying,; (4) Visual Short-Term Memory, (5) Sequential Memory; (6) Sequential Memory after two minute delay; (7) Sequential Memory after five minute delay; (8) Fingertapping with Dominant Index Finger; (9) Fingertapping with Non-dominant Index Finger; (10) Letter Identification; and (11) Rapid Automatic Naming (12 items).

Those subtests showing normal distribution at age four included: (1) Rhyming Judgment; (2) Rhyme Knowledge; (3) Segmentation; (4) Copying; (5) Digit-Word Span Backward; (6) Visual Short term Memory; (7) Sequential Memory; (8) Fingertapping with Dominant and Non-dominant Index Fingers; and (9) Rapid Automatic Naming (12 items).

Table 3-3 lists the task scores that were normally distributed and abnormally distributed at each age level. As shown in this table, many of the tasks were normally distributed during the first year of testing but abnormally distributed during the second year and vice-versa.

Comparisons of Performance of Three- and Four-year-olds on Tasks Meeting Normality at Both Age Levels

The second research goal was to find those tasks that were normally distributed at both three and four years of age. Those subtests which were normally distributed at both age levels included: (1) Rhyme Judgment; (2) Segmentation; (3), Copying; (4) Fingertapping with Dominant and Non-dominant Index fFngers; (5) Visual-Short term Memory; (6) Sequential Memory; and (7) Rapid Automatic Naming (12 items). Paired sample t-tests were used to compare the performance of the children at three years of age and four years of age for each of the normally distributed tasks. These data are important because some of these tasks may be suitable measures for screening preschoolers (3- 5- year-olds) who are at risk for later language and/or literacy difficulties). The *p*-value was set at .001 with a confidence level of 99% in order to decrease the probability of a Type Two error (inaccurate rejection of the null hypothesis). The smaller the *p*-value, the stronger the evidence against the null

hypothesis (H_o (phase 1= phase 2 mean) and in favor of the alternative hypothesis (H_α (phase means are not equal).

The results of the paired t-test analyses are shown in Table 3-4. As expected, the preschoolers exhibited a significant increase in their scores on all of the normally distributed tasks between three and four years of age.

Predictors of ALL Literacy and Language Scores at Three Years

The third objective of the study was to predict which normally distributed tasks during the first year of the study (three-year-olds) best predicted the ALL Emergent Literacy and Language Index scores one year later.

Initially, a forced entry regression procedure (i.e., all normally-distributed independent variables are included in the equation and are not deleted from the equation based on any criterion) was utilized for analyzing the three-year-old scores. Four tasks significantly predicted the ALL Emergent Literacy Index score at age three: Letter Identification (*B*= .597*; t*= 3.09; *p*= .005;, Rhyme Judgment (*B*= .391; *t*= 2.82; *p*= .009); Fingertapping with non-dominant index finger (*B*= -.626; *t*= -2.50; *p*= .019); and Fingertapping with the dominant index finger (*B*= .495; *t*= 2.05; *p*= .050). The model data revealed an Adjusted R^2 = .443; *F* (11, 26)= 3.680; *p* = .003. (See Table 3- 5)

Again, all tasks that correlated strongly with other normally distributed tasks at age three were deleted before conducting Multiple Linear Regression analysis. The deleted tasks were Fingertapping with the non-dominant index finger which correlated with Fingertapping with the dominant index finger and Sequential Memory with a Five-Minute Delay which correlated with Sequential Memory with a Two-Minute Delay. In this model, with correlated tasks deleted, Letter Identification (*B* = .516; *t*= 2.54; *p*= .017) and Rhyme Judgment (*B*= .270; *t*= 1.99; *p*= .056) predicted performance on the ALL Literacy

Index score. For this model, the Adjusted R^2 = .356; Model *F* (9,28)= 3.280; *p*= .008. (Refer to Table 3-6)

The same procedure was conducted with the three-year-olds and predictors of the ALL Language Index score. When a forced entry procedure was used in the analysis, Rhyme Judgment (*B*= .394; *t*= 2.28; *p*= .031) and Segmentation (*B*= .447; *t*= 2.06; *p*= .050) predicted the All Language Index scores one year later. For this model, the Adjusted R^2 = .134; Model *F* (11,26)= 1.521; *p*= .183. (Refer to Table 3-7) With all the highly correlated tasks at age three deleted, the regression analysis no longer showed significant predictors with the ALL Language Index score. This model revealed an Adjusted R^2 = .323; *F* (9, 28)= 1.483; *p*= .202.

Predictors of ALL Emergent Literacy and Language Scores at Age Four

The fourth objective of this study was to find which tasks meeting normality criterion for the same children at four years of age best predict the children's performance on the ALL Emergent Literacy and Language Index scores.

Initially, a forced entry regression procedure was conducted to determine which of the ten exploratory task scores in year two of testing (four-year-olds) significantly predicted performance in ALL Index scores. The tasks which were normally distributed for this analysis included: Rhyme Judgment, Rhyme Knowledge, Segmentation, Copying, Fingertapping with Dominant Index Finger, Fingertapping with Non-dominant Index Finger, Digit-Word Span Backward, Visual Short-term Memory, Sequential Memory and Rapid Automatic Naming of 12 items. The findings of the forced entry analysis are presented in Table 3-9 and revealed that Rhyme Knowledge (*B* = .552; t= 3.776; *p*= .001), Digit-Word Span Backward (*B* = .384; *t*= 3.114; *p*= .004) and Segmentation (*B* = .317; *t*= 2.069; *p*= .048) significantly predicted the ALL Emergent

Literacy Index score. This model score included an Adjusted R^2= .563; *F* (10, 27)= 5.769; *p*= .000.

Again, all highly correlated tasks were excluded for the regression analysis and included: Rhyme Judgment, which correlated with Rhyme Knowledge and Fingertapping with Non-dominant Index Finger which correlated with Fingertapping with Dominant Index Finger. The results of this analysis revealed that Rhyme Knowledge (*B* = .512; *t*= 4.213; *p*= .000), Digit-Word Span Backward (*B* = .394; t= 3.288; *p*= .003) and Segmentation (*B* = .303; *t*= 2.128; *p*= .042) predicted the ALL Emergent Literacy Index score. The model scores were as follows: Adjusted R^2 = .581; *F* (8, 29)= 7.422; *p*= .000. (See Table 3-10)

Using the same progression of steps as described above, a forced entry regression procedure was used initially for analyzing which of the normally distributed tasks at age four were significant predictors of the ALL Language Index score. Findings showed that Visual short-term memory *(B*= .513; *t*= 3.198; p = .004) and Rhyme Knowledge (*B*= .350; *t*= 2.123; *p*= .043) significantly predicted the ALL Language index score at age four. Digit-Word Span Backward moderately predicted the ALL Language Index score (*B* = .263; *t*= 1.890; *p* = .070) (See Table 3-11)

When the highly correlated tasks were omitted from the multiple linear regression procedure, the tasks of Visual Short-term Memory (*B* = .487; *t*= 3.341; *p*= .002) and Rhyme Knowledge *(B* = .352; *t*= 2.595; *p* = .015) were strong predictors in this area. Digit Word Span Backward (*B*= .255; *t*= 1.907; *p*= .067) was moderately predictive of the ALL Language Index score at age four. (See Table 3-12)

Correlations

In the three year old group, several of task were significantly correlated at the p< .01** and p< .05* levels. Segmentation correlated with Visual Short-term Memory (r= .43**) and Fingertapping with Non-Dominant Index Finger (r= .42**). To a lesser degree, Segmentation correlated with Copying (r= .41*) and Fingertapping with dominant index finger (r= .40*). Copying correlated with Letter Identification (r= .51) and RAN (12 items) (r= -.323). Fingertapping with the dominant index finger significantly correlated with the Fingertapping with the nondominant index finger (r= .79). Visual-Short Term Memory significantly correlated with Sequential Memory (r= .56**) and Letter Identification (r= .40*). Letter Identification correlated with Sequential Memory (r= .63**) and Sequential Memory with a Five-Minute Delay correlated significantly with Sequential Memory with a Two-Minute Delay (r= .87**). (See Table 3-13)

In the four-year-old group, Rhyme Knowledge significantly correlated with Rhyme Judgment (r= .60**) and Segmentation correlated with Rhyme Judgment to a lesser degree (r= .33*). Copying correlated significantly with Segmentation (r= .54**), Sequential Memory (r= .40**) and RAN (12 items) (r= -.33*). Sequential Memory significantly correlated with Copying (r= .38*). Fingertapping with the dominant index finger correlated with Fingertapping with the nondominant index finger task (r= .63**) and RAN (12 items) (r= -.32*). Digit-Word Span Backward correlated with Sequential Memory (r= .35*) and Visual Short-term Memory correlated with RAN (12 items) (r= .50**). (See Table 3-14)

Summary of Results

The tasks that were normally distributed during the first year of testing included Rhyme Judgment, Segmentation, Copying, Fingertapping with Dominant and Non-

dominant index fingers, Visual Short-Term Memory, Sequential Memory, Sequential Memory after Two- and Five-Minute Delays, Letter Identification and RAN (12 items). Those that were normally distributed during the second year of testing included Rhyme Judgment, Rhyme Knowledge, Segmentation, Copying, Fingertapping with both Dominant and Non-dominant Index Fingers, Digit-Word Span Backward, Visual Short-term Memory, Sequential Memory, and RAN (12 items).

The tasks that were normally distributed at ages three and four included: Rhyme Judgment, Segmentation, Copying, Fingertapping with Dominant Index Finger, Fingertapping with non-dominant index finger, Visual Short-term Memory, Sequential Memory and RAN (12 items). These tasks were utilized for multiple regression analyses. Children's performance on all of these tasks showed significant improvement over the course of one year ($p < .001$). (See Table 3-4)

The experimental tasks that significantly predicted the ALL Emergent Literacy Index score at age three when the highly correlated tasks were removed included *Letter Identification* ($B = .516$; $t = 2.535$; $p = .017$) and *Rhyme Judgment* ($B = .270$; $t = 1.997$; $p = .056$). At age four, when highly correlated tasks were removed Rhyme Knowledge ($B = .512$; $t = 4.213$; $p = .000$), Digit-Word Span Backward ($B = .394$; $t = 3.288$; $p = .003$), and Segmentation ($B = .303$; $t = 2.128$; $p = .042$) were the significant predictors of the ALL Emergent Literacy Index score.

At age three, when the highly correlated tasks were removed, there were no significant predictors of the ALL Language Index scores. At age four, when the highly correlated tasks were deleted, *Visual Short-term Memory* ($B = .487$; $t = 3.341$; $p = .002$) and *Rhyme Knowledge* ($B = .352$; $t = 2.595$; $p = .015$) were the significant predictors of the

ALL Language Index score. However, *Digit-Word Span Backward* (*B*= .255; t= 1.907; p= .067) showed a tendency toward predicting the ALL Language Index score.

It should be noted that only those experimental tasks showing normal distribution were utilized in these analyses. A greater subject population will increase the power of these results. Tasks in the domains of Phonological Awareness and Memory most frequently predicted both the ALL Emergent Literacy and Language Index scores.

Table 3-1. Descriptive Statistics for Tasks Measured at Three Years of Age (N = 38)

Task	Total Possible Points	Range	Minimum	Max	Mean	*SD*	Median	Skewness	Kurtosis
Phonological Awareness									
Rhyming Memory	8	8.00	.00	8.00	3.63	2.94	3.50	.215	-1.38
Rhyming Judgment	10	10.00	.00	10.00	5.74	3.20	5.00	-.233	-.755
Rhyming Knowledge	4	4.00	.00	4.00	.973	1.48	0.00	1.16	-.323
Segmentation	10	9.00	.00	9.00	4.79	2.78	5.00	-.375	-1.06
Emergent Writing									
Copying	22	18.00	4.00	22.00	13.80	4.33	13.00	-.134	-.482
Writing letters in name	1.00	1.00	.00	1.00	.489	.432	.415	.123	-1.79
Naming letters in name	1.00	1.00	.00	1.00	.568	.447	.700	-.205	-1.85
Writing ABCs	4	4.00	.00	4.00	1.62	1.66	1.00	.452	-1.45
Story Writing	5	5.00	.00	5.00	2.08	1.81	2.00	.224	-1.31
Fine motor functioning	N/A								
Finger tapping with dominant index finger		35.5	12.00	47.50	25.82	7.70	25.66	.700	.472
Finger tapping with non-dominant Index finger		19.50	12.50	32.50	22.36	4.75	21.50	.397	-.368
Pincer tapping with dominant hand		8.28	2.72	11.00	4.88	1.78	4.50	1.89	3.79
Pincer tapping with non-dominant hand		7.35	2.65	10.00	4.87	1.66	4.50	1.82	3.74
Memory									
Digit-Word span forward	9	3.00	6.00	9.00	8.26	1.00	9.00	-1.24	.443
Digit word span backward	12	12.00	.00	12.00	2.61	3.72	.000	1.19	.289
Visual short-term memory	6	6.00	.00	6.00	4.03	1.78	4.00	-.894	.147
Sequential memory	8	8.00	.00	8.00	3.87	2.24	4.00	.052	-.690
Sequential memory after two min.	3	3.00	.00	3.00	1.21	1.04	1.00	.306	-1.09
Sequential memory after five min.	3	3.00	.00	3.00	.947	1.14	.000	.689	-1.08
Orthographic Awareness									
Alphabet awareness	10	10.00	.00	10.00	7.61	3.56	10.00	-1.31	.101
Letter discrimination	6	6.00	.00	6.00	4.89	1.39	5.00	-1.65	3.17

Table 3-1. Continued.

Task	Total Possible Points	Range	Minimum	Maximum	Mean	*SD*	Median	Skewness	Kurtosis
Letter identification	5	5.00	.00	5.00	3.74	1.60	4.50	-1.04	-.086
Language									
Language comprehension	8	8.00	.00	8.00	6.74	1.77	7.00	-2.16	5.54
Language expression	10	10.00	2.00	8.00	8.24	2.44	9.00	-2.22	5.43
Rapid automatic naming	N/A								
For eight items		17.00	8.00	25.00	13.16	3.88	12.25	1.14	1.09
For 12 items		22.00	11.50	33.50	21.12	5.62	20.75	.162	-.722

Table 3–2. Descriptive Statistics for Tasks Measured at Four Years of Age (N = 38)

Task	Total Possible Points	Range	Minimum	Max	Mean	*SD*	Median	Skewness	Kurtosis
Phonological processing									
Rhyming Memory	8	7.00	1.0	8.00	6.55	1.72	7.00	-1.61	2.50
Rhyming Judgment	10	7.00	3.0	10.00	8.63	2.12	10.00	.821	-.965
Rhyming Knowledge	4	4.00	.00	4.00	2.74	1.43	3.00	-.980	-.307
Segmentation	10	8.00	2.00	10.00	6.32	2.00	6.00	-.269	-.164
Emergent Writing									
Copying	22	11.00	11.00	22.00	18.84	2.80	20.00	-.824	.155
Writing letters in name	1.00	.75	.25	1.00	.890	.197	1.00	-2.02	3.76
Naming letters in name	1.00	.71	.29	1.00	.934	.179	1.00	-2.66	6.05
Writing ABCs	4	4.00	.00	4.00	3.42	1.244	4.00	-2.03	2.86
Story writing	5	5.00	.00	5.00	4.13	1.36	5.00	-1.75	2.77
Fine motor functioning	N/A								
Finger tapping with dominant index finger		27.00	19.00	46.00	32.22	6.99	30.50	.255	-.698
Finger tapping with nondominant index finger		30.00	15.50	45.50	28.46	6.54	29.00	.175	.561
Pincer tapping with dominant hand		3.50	2.50	6.00	3.60	.754	3.50	1.14	1.43
Pincer tapping with nondominant hand		4.94	2.56	7.50	3.84	.941	3.50	2.23	6.43
Memory									
Digit word span forward	9	4.00	5.00	9.00	8.47	.893	9.00	-2.32	6.27
Digit Word span Backwards	12	12.00	.00	12.00	7.26	3.11	7.00	-.413	.301
Visual short term memory	6	4.00	2.00	6.00	4.68	1.32	5.00	-.723	-.431
Sequential Memory	8	7.00	1.00	8.00	5.40	2.06	6.00	-.428	-.941

Table 3-2. Continued

Task	Total Possible Points	Range	Minimum	Max	Mean	*SD*	Median	Skewness	Kurtosis
Memory									
Sequential Memory after 2 minute delay	3	3.00	.00	3.00	1.53	1.35	2.00	.045	-1.63
Sequential memory after five min.	3	3.00	.00	3.00	1.16	1.24	1.00	.400	-1.54
Orthographic awareness									
Alphabet awareness	10	10.00	.00	10.00	9.26	2.30	10.00	-3.72	13.60
Letter discrimination	6	3.00	3.00	6.00	5.66	.745	6.00	-2.23	4.34
Letter identification	5	1.00	4.00	5.00	4.76	.431	5.00	-1.29	-.359
Language									
Language comprehension	8	2.00	6.00	8.00	7.58	.683	8.00	-1.38	.622
Language expression	10	2.00	8.00	10.00	9.79	.577	10.00	-2.65	5.80
Rapid automatic naming	N/A								
For eight items		20.50	4.00	24.50	9.56	4.36	8.38	1.73	3.57
For 12 items		20.50	8.00	28.50	15.79	5.19	14.50	.607	-.164

Table 3-3. Status of tasks for meeting skewness and kurtosis values for being normally distributed in three- and 4-year-old data

Domain	Subtests for three–year–olds		Subtests for four–year–olds	
	Normal	Abnormal	Normal	Abnormal
Phonological Awareness	Rhyme Judgment Segmentation	Rhyme Knowledge Rhyme Memory	Segmentation Rhyme Knowledge Rhyme Judgment	Rhyme Memory
Emergent Writing	Copying	Write Name Name Letters in Name Write ABCs Story Writing	Copying	Write Name Name Letters in Name Write ABCs Story Writing
Memory	Vis. Short–Memory Sequential Memory SEQM 2 min delay SEQM 5min delay	Digit Word Span Forward Digit-Word Span Backward	Digit Word Span Backward Vis. Short–Memory Sequential Memory	Digit Word Span Forward SEQM 2 min delay SEQM 5min delay
Orthographic Awareness	Letter Identification	Alphabet Awareness Letter Discrimination	N/A	Alphabet Awareness Letter Discrimination Letter Identification
Fine motor function/speed	Finger–tapping index finger (dominant) Finger–tapping index finger (nondominant)	Pincer–tapping (dominant) Pincer–tapping (nondom)	Finger–tapping index finger (dominant) Finger–tapping index finger (nondominant)	Pincer–tapping (dominant) Pincer–tapping (nondom)
Language	N/A	Language Comprehension Language Expression	N/A	Language Comprehension Language Expression
Rapid Auto Naming	12 items	N/A	12 items	8 items

Table 3-4. Comparison of mean differences of normally distributed subtests at ages 3 and 4

		Paired Differences							
					95% Confidence Interval of the Difference				
		Mean	Std. Deviation	Std. Error Mean	Lower	Upper	t	df	Sig.
Pair 1	Rhyme Judgment	-2.89474	3.05614	0.49577	-3.89926	-1.89021	-5.839	37	0.000
Pair 2	Segmentation	-1.52632	3.01112	0.48847	2.51605	-0.53658	-3.125	37	0.000
Pair 3	Copying	-5.05263	4.04667	0.65646	-6.38274	-3.72252	-7.697	37	0.000
Pair 4	Ftdif1 - ftdif2	-6.40015	9.694	1.57257	-9.58649	-3.21382	-4.07	37	0.000
Pair 5	Ftnondomif1 - ftnif2	-6.09288	6.61938	1.0738	-8.26861	-3.91714	-5.674	37	0.000
Pair 6	Vis. Short-Term Mem 1 & 2).	-0.65789	2.0438	0.33155	-1.32967	0.01388	-1.984	37	0.006
Pair 7	Sequential Memory	-1.52632	2.94762	0.47817	-2.49518	-0.55746	-3.192	37	0.000
Pair 8	RAN (twelve items)	5.32658	4.87762	0.79125	3.72335	6.92981	6.732	37	0.000

Note. These values obtained using *p<.001.

Note: “ftdif1 and 2” represent Fingertapping with the dominant index finger and “ftnondomif 1 and 2” represent Fingertapping with non-dominant index finger.

Note: “RAN (twelve objects)” represents Rapid Automatic Naming of twelve items

Table 3-5. Linear Regression Results for ALL Emergent Literacy with 3-year-olds (N= 38) Forced Entry Procedure

Subtest	B	SE	t	Sig.	Tolerance
Rhyme Judgment	.391	.139	2.82	.009	.781
Segmentation	-.035	.174	-.202	.841	.496
Copying	.087	.164	.527	.603	.556
Fingertap (dominant index)	.495	.241	2.05	.050	.258
Fingertap (nondom. index)	-.626	.250	-2.50	.019	.240
Visual Short-term Memory	-.116	.168	-.690	.496	.534
Sequential Memory	.229	.204	1.125	.271	.361
Seqmemory with 2 min. delay	.395	.300	1.320	.199	.167
Seqmemory with 5 min. delay	-.255	.285	-.894	.379	.185
Letter Identification	.597	.194	3.09	.005	.402
RAN with 12 items	-.015	.154	-.094	.925	.632

Note. Adjusted R^2= .443; F (11, 26) = 3.680; p = .003

Table 3-6. Multiple Linear Regression Results for ALL Emergent Literacy at 3 Years. N= 38) without highly correlated tasks

Subtest	B	SE	t	Sig.	Tol.
Rhyming judgment	.270	.135	1.99	.056	.952
Segmentation	-.129	.180	-.713	.482	.535
Copying	.078	.174	.448	.657	.574
Finger-tap (dominant index)	.013	.152	.083	.934	.754
Visual short-term memory	.017	.171	.102	.919	.594
Sequential memory	.257	.219	1.17	.251	.363
Seqmemory with 2 min. delay	.013	.154	.085	.933	.736
Letter identification	.516	.204	2.54	.017	.419
RAN with 12 items	.070	.160	.440	.664	.679

Note. Model Adjusted R^2 = .356. Model F (9,28) = 3.275, p = .008.

Table 3-7. Forced Entry Regression for 3-year-old performance on the ALL Language Index score (N= 38)

Variable	B	Std. Error	t	Sig.	Tolerance
Rhyme Judgment	.394	.173	2.27	.031	.781
Segmentation	.447	.217	2.06	.050	.496
Copying	-.120	.205	-.584	.564	.556
Fingertapping with index finger (dominant hand)	.527	.301	1.80	.092	.258
Fingertap (nondom. hand)	-.441	.312	-1.41	.170	.240
Visual short-term memory	-.339	.209	-1.62	.117	.534
Sequential Memory	-.061	.255	-.240	.812	.361
Seqmemory with 2 min. delay	.254	.374	.679	.503	.167
Seqmemory with 5 min. delay	-.445	.356	-1.250	.222	.185
Letter Identification	.384	.241	1.60	.123	.402
RAN with 12 items	-.165	.192	-.859	.398	.632

Note. Model Adjusted R^2= .134; Model F (11,26) = 1.521, p= .183

Table 3-8. Multiple Linear Regression Results for ALL Language at 3 Years (N = 38) without highly correlated tasks.

Variable	B	SE	t	Sig.	Tol.
Rhyming judgment	.270	1.59	1.694	.101	.952
Segmentation	.348	.213	1.64	.112	.535
Copying	-.099	.205	-.483	.633	.574
Finger-tap (dominant index)	.202	.179	1.127	.269	.754
Visual short-term memory	-.244	.202	-1.209	.237	.594
Sequential memory	-.034	.258	-.133	.895	.363
Seqmemory with 2 min. delay	-.239	.181	-1.320	.197	.736
Letter identification	.301	.240	1.253	.221	.419
RAN with 12 items	-.080	.189	-.422	.676	.679

Note. Model R^2 = .323. Model adjusted R^2 = .105. Model F (9,28) = 1.483, p = .202

Table 3-9. Multiple Linear Regression Results for ALL Emergent Literacy at 4 years (N = 38); Forced Entry Procedure

Variable	B	SE	t	Sig.	Tol.
Rhyme Judgment	-.091	.153	-.592	.559	.504
Rhyme Knowledge	.552	.146	3.776	.001	.552
Segmentation	.317	.153	2.069	.048	.504
Copying	.032	.162	.196	.846	.451
Fingertap- dominant index finger	.207	.155	1.331	.194	.489
Fingertap-nondominant index finger					
Digit-word span backward	-.107	.163	-.655	.518	.444
Visual short-term memory					
Sequential memory	.384	.123	3.114	.004	.776
Rapid Automatic Naming (12 items	.117	.142	.823	.417	.584
	-.080	.135	-.595	.557	.647
	.184	.146	1.259	.219	.552

Note. R^2 for model = .681. Adjusted R^2=.563. F (10,27)= 5.769 p= .000.

Table 3-10. Multiple Linear Regression Results for ALL Emergent Literacy at 4 Years (N = 38); without highly correlated tasks

Tasks	B	SE	t	Sig.	Tol.
Rhyme knowledge	.512	.122	.4.213	.000	.766
Segmentation	.303	.142	2.128	.042	.560
Copying	.017	.139	.126	.900	.590
Fingertap-nondominant index finger	.138	.119	1.162	.255	.801
Digit-word span backward					
Visual short-term memory	.394	.120	3.288	.003	.786
Sequential memory	.144	.131	1.103	.279	.663
Rapid Automatic Naming (12 items)	-.09	.126	-.741	.465	.712
	.196	.139	1.413	.168	.586

Note. Model R^2 = .672. Model adjusted R^2 = .581. Model F (8,29) = 7.422. p = .000

Table 3-11. Forced Entry Linear Regression Results for ALL Language at 4 years (N=38)

Task	*B*	SE	t	Sig.	Tol.
Rhyme judgment	.013	.173	.073	.943	.504
Rhyme knowledge	.350	.165	2.123	.043	.552
Fingertap- dominant index finger	.155	.175	.887	.383	.489
Fingertap-nondominant index finger					
Segmentation	.087	.184	.475	.638	.444
Copying					
Digit word span backward	.237	.173	1.371	.182	.504
Visual short-term memory	-.137	.182	-.752	.459	.451
Sequential Memory	.263	.139	1.890	.070	.776
Rapid Automatic Naming- 12 items	.513	.160	3.198	.004	.584
	.061	.152	.397	.694	.647
	.271	.165	1.641	.112	.552

Note. R^2 for model = .594; Adjusted R^2 = .444; Model F (10.27)= 3.958; p= .002

Table 3-12. Multiple Linear Regression Results for ALL Language at Four Years (N = 38) without highly correlated tasks

Task	*B*	SE	*t*	Sig.	Tolerance.
Rhyme knowledge	.352	.136	2.595	.015	.766
Segmentation	.230	.159	1.451	.158	.560
Copying	-.107	.155	-.692	.494	.590
Digit span backward	.255	.134	1.907	.067	.786
Visual short-term memory	.487	.146	3.341	.002	.663
Sequential memory	.056	.141	.397	.694	.712
Fingertap – dominant index finger	.208	.133	1.566	.128	.801
Rapid Automatic Naming- 12 items	.255	.155	1.642	.111	.586

Note. Model adjusted R^2 = .478; Model F (8,29) = 5.238; p = .000

Table 3-13. Correlations for three–year–olds with normal distribution

Variables	1	2	3	4	5	6	7	8	9	10
1. Rhyme Judgment	–									
2. Segmentation	.006	–								
3. Copying	-.008	.409*	–							
4. Finger-tap dom. index finger	-.084	.399*	.196	–						
5. Finger-tap nondominant index finger	.071	.418**	.241	.786**	–					
6. Visual Short–term memory	-.046	.433**	.257	.28	.133	–				
7. Sequential memory	-.174	.316	.298	.18	.189	.556**	–			
8. Sequential memory with 2–minute delay	.001	.22	-0.08	-.01	.248	.099	.266	–		
9. Sequential memory with 5–minute delay	.114	.261	-.057	-.03	.181	.134	.272	.874**	–	
10. Letter identification	-.088	.244	.511**	.06	.074	.395*	.634**	-.096	-.008	–
11. RAN with 8 items	–.276	-.062	-.102	-0.1	-.091	.183	-.058	.064	-.063	-.057
12. RAN with 12 items	.049	-.002	-.323*	-0.18	-.235	-.269	-.432	-.107	-.156	-.32

Table 3-14. Significant correlations for 4-year-olds

Variables	1	2	3	4	5	6	7	8	9	10
1. Rhyme Judgment	–									
2. Rhyme Knowledge	.600**	–								
3. Segmentation	.327*	0.21	–							
4. Copying	-0.11	-.099	.536**	–						
5. Finger–tap dominant index finger	-.013	-.144	.046	-.039	–					
6. Finger–tap nondominant index finger	-.176	-.252	.027	.207	.629**	–				
7. Digit–word span backward	.187	.205	.356*	.251	.095	.002	–			
8. Visual short–term memory	.17	.228	.264	.302	.012	-0.15	.126	–		
9. Sequential memory	.312	.119	.460**	.382*	.028	-.042	.346*	.276	–	
10. RAN with 12 items	-.145	-.208	-.331*	-.217	-.322*	-.236	-.258	-.498**	-.258	–

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

CHAPTER 4
DISCUSSION

What do We Know About Predictors?

Juel (1988) noted that children's reading performance is highly stable from early in elementary school and Berninger et al. (2002) and Coyne, et al. (2004) stated that more success with prevention and earlier intervention is achieved with younger than with older students. Information of this nature underscores the importance of determining which children are "at risk" for developing reading difficulties so that prevention can be instituted as early has possible. The majority of predictive studies have focused on children in kindergarten with only a few looking into the predictive accuracy of testing batteries administered to preschool children. The current study was an attempt to take prevention one-step further by studying the behaviors of preschool children relative to their performance on a standardized test of literacy and language.

Badian (1988; 1994; 1998) demonstrated that multidimensional assessment batteries show high predictive power in identifying children with reading difficulties up to nine years post initial testing. Studies that have incorporated child performance variables (e.g., phonological awareness, rapid automatic naming, visual matching), demographics, and family history to achieve have identified strong, predictive factors results of broad reading performance (Badian, 1994; Fowler & Cross, 1986). Other studies, which solely included only measures of preschoolers' performance in the areas of emergent literacy tasks, have also identified significant predictors of future reading achievement (Chaney, 1998; Bowey, 1995; Storch & Whitehurst, 2002).

A few norm-referenced and or criterion-referenced diagnostic measures have been developed for kindergarten and preschool children to be utilized for diagnostic

assessment. While these measures have used included adequate psychometric properties and demonstrated simultaneous validity, few have shown a reliable, consistent, and longitudinal predictive capacity, such as, strong correlations with later decoding or comprehension measures, and the power to positively identify “at risk” children (Havey, Story, & Baker, 2002; Phillips, Lonigan, & Wyatt, 2008; Wilson & Lonigan, 2009). Nevertheless, the following assessments are routinely used by trained professionals: Texas Primary Reading Inventory (TPRI: Texas Education Agency, 1999), the Test of Early Reading Ability-3 (Reid, Hresko, & Hammill, 2001), Test of Phonological Awareness-2 (Torgeson & Bryant, 2004); the Assessment of Language and Literacy (Lombardino, Lieberman, & Brown, 2005), the Test of Preschool Early Literacy (TOPEL; Lonigan, Wagner, Torgesen, & Rashotte, 2007), and the Phonological Awareness Literacy Screening in both kindergarten and preschool versions (PALS-K and PALS- PreK; Invernizzi, Juel, Swank, & Meier, 2007; Invernizzi, Sullivan, Meier, & Swank, 2004).

The popular kindergarten-entry “readiness tests” of broad measures of cognition and academic skills have not shown provable validity (Morrison, Griffith, & Alberts, 1997; Shepard, 1997; Stipek, 2002). La Paro and Pianta’s (2000) meta-analysis of thirty-two studies claiming to predict academic outcomes in kindergarten and/or first grade based on academic measures in preschool resulted in an average correlational finding of .43 (range= .08-.72).

A short, an easy to administer screening tool to adequately identify preschool children for later emergent reading and later language difficulties is needed due to time constraints inherent in typical classroom schedules and routines.

In their attempt to examine this issue in emergent literacy screeners, Wilson & Lonigan (2008) used two screening tools: the recently revised Get Ready to Read-Revised (GRTR-R; Lonigan & Wilson, 2008), and the Individual Growth and Developmental Indicators (IGDIs; McConnell, 20). These two screening tools were administered to the preschoolers just before they entered preschool. After two months, when the children had acclimated to their classes and teachers, their emergent literacy skills were assessed using a diagnostic tool, the Test of Preschool Early Literacy (TOPEL; Lonigan, Wagner, Torgesen, & Rashotte, 2007) which was normed on 852 children at three, four and five years of age. In this study, sensitivity settings were generated through receiver operating characteristic curves (ROC) and optimal cut scores were selected for each screening tool's prediction of criterion measures of print knowledge, phonological awareness, oral language, and overall emergent literacy skills prior to data analysis. Both screeners were administered just before the beginning of the preschool year and then three months afterwards. The TOPEL was administered when the children had been in their preschool classes for a month. The researchers found that at optimal cut scores of .90, the GRTR-R was a more accurate screening tool for accurate classification of overall emergent literacy skills than the IGDIs and was less time-consuming for teachers and other professionals to administer. A weakness of the GRTR-R is that its results do not categorize a specific weakness in a specific area of emergent literacy skill (such as, print knowledge, oral language, and/or phonological awareness). Furthermore, numerous instances of false positives occurred when compared to the TOPEL subscales (Wilson & Lonigan, 2008; p.72).

Numerous studies have addressed the question of which emergent literacy skills predict later reading ability in four to five-year olds (Whitehurst & Lonigan, 2001; Scarborough, 2001; Velluntino & Scanlon, 2001; Berninger, & Hart, 1992; Justice, Invernizzi, Meier, 2002); however, knowledge of the development of emergent literacy in three year olds has appeared in the literature only within the last decade (Bowey, 2005; Lonigan, Burgess, & Anthony, 2000). In order to begin to develop a screening tool for preschoolers, the present study was designed to determine (1) which exploratory tasks were most appropriate for normally developing three year olds (i.e., normally distributed) and (2) which of these tasks predicted the children's performance on the ALL's Emergent Literacy and Language Index scores, respectively (ALL; Lombardino, Leiberman, & Brown, 2005). The following four research questions were addressed: (1) Which exploratory tasks showed a normal distribution of scores (i.e., without skewness and/or kurtosis) for three-year-olds and which showed a normal distribution four-year-olds? 2) Which exploratory tasks showed a normal distribution of scores at both three and four years of age? (3) Which tasks that met normality criteria for the three-year-old sample best predicted the children's performance on the ALL Emergent Literacy and Language Index scores, respectively, one year later? and (4) Which exploratory tasks that met normality criteria for the same children at four years of age best predicted their performance on the ALL Emergent Literacy and Language Index scores, respectively?

Tasks with Normally Distributed Scores

Eleven of the exploratory tasks were normally distributed for the three-year-old sample: Rhyme Judgment, Segmentation, Copying, Fingertapping with dominant and nondominant index finger, Visual Short-Term Memory, Sequential Memory, Sequential Memory after a two and five minute delay, Letter Identification, and Rapid Automatic

Naming (12 items). Ten of the exploratory tasks were normally distributed tasks for the same children at four years of age were: Rhyme Judgment, Rhyme Knowledge, Segmentation, Copying, Fingertapping with the dominant index finger and non-dominant index finger, Digit Word Span Backward, Sequential Memory, Visual Short-Term Memory and Rapid Automatic Naming for 12 items. These tasks were used in the correlation and multiple regression analyses to reduce the influence of multicollinearity.

For the three-year-olds, the tasks that were negatively skewed (too easy) were: Digit-Word Span Forward, Alphabetic Awareness (ABC song), Letter Discrimination, Language Comprehension and Language Expression. The tasks that were too difficult for this age level included: Rhyme Knowledge, Pincer-tapping with dominant hand and with non-dominant hand, Digit-Word Span Backward and Rapid Automatic Naming (8 items). The tasks that showed kurtosis (platykurtic) problems were Rhyme Memory, Writing Letters in Name, Naming Letters in Name, Writing ABCs and Story Writing. Those tasks that indicated a high peak, or leptokurtic problem included Pincer-tapping with dominant and nondominant hand, Language Comprehension, Language Expression and Rapid Automatic Naming (8 items).

For the four year olds, tasks that were too easy were: Rhyme Memory, Writing and naming letters in their name, Writing ABCs, Story Writing, Digit-Word Span Forward, Alphabet Awareness, Letter Discrimination, Letter Identification, Language Comprehension and Language Expression. The tasks that were too difficult at this age level included: Pincer-tapping with both dominant and non-dominant hands and Rapid Automatic Naming for eight items. Those tasks that were platykurtic included: Sequential Memory after a two and five minute delay and Letter Identification. Those

that were leptokurtic were Rhyme Memory, Writing Letters and Naming Letters in Name, Writing ABCs, Story Writing, Pincer-tapping with both dominant and nondominant hands, Digit-Word Span Forward, Alphabet Awareness, Letter Discrimination, Language Expression and Rapid Automatic Naming (8 items).

Most studies of phonological sensitivity in preschool children have been limited by small sample sizes at each age level and by the limited number of phonological measures used. Lonigan, et al. (1998) found that, on the average, young children's performance on tasks designed to assess phonological sensitivity was relatively low. However, a number of the two and three-year-old children in their study demonstrated phonological sensitivity at the phonemic level. MacLean, et al. (1987) found that 21% of three-year-olds performed above chance on a rhyme oddity task, and 38% scored above chance on an alliteration oddity task.

Fox and Routh (1975) required 50 children (10 at each age from 3 to 7 years) segment sentences into words, words into syllables, and syllables into phonemes. They found that even some of the three-year-olds could segment syllables into phonemes. In the current study, Segmentation and Rhyme Judgment were the only tasks in the Phonological Awareness domain that were normally distributed at both three and four years of age.

Level & Cantor (1981) and Smith & Tager-Flushberg (1982) found age-related performance differences on a forced-choice rhyme-matching task with preschool-age children. Chaney (1992) administered several phonological sensitivity tasks (i.e., rhyme matching, sentence segmenting, phoneme blending) to 43 three-year-old children but

did not report the relations between performance on the different tasks; however, a composite phonological index was correlated with both age and language scores.

For the four-year-olds, writing skills were much too easy with the exception of the Copying task, which was normally distributed at both age levels. The three-year-olds scores were not skewed but they were platykurtic which indicates a lower, wider peak around the mean (that is, a lower probability than a normally distributed variable of values near the mean) and thinner tails (if viewed as the height of the probability density—that is, a lower probability than a normally distributed variable of extreme values) (Ferreiro & Teberosky, 1982; Harst, Woodward & Burke, 1984; Sulzby, 1986). Most of them were already beginning to write their names and name the letters in their name.

The Digit-Word Span Forward task, which used a range of digits from 1 to 4, was too easy for the three and four-year-olds (which questions just how many digits or words a preschooler can remember as the norm for children at age ten is seven items remembered (Satz, 1975). Visual Short-Term Memory and Sequential Memory tasks were normally distributed for both the three- and four-year-olds. Similarly, the Orthographic Awareness and Language tasks were too easy for the preschoolers studied at both age levels. The Language and Digit-Word Span Forward tasks in particular were so easy that there was a ceiling effect at age three. Future language comprehension and expression tasks will need to include higher levels of vocabulary (Whitehurst and Lonigan, 1998; Snow, 1991; Walker, et al, (1994) and more complex syntactic tasks (Tunmer, Nesdale, & Wright (1987); Tunmer, Herriman, & Nesdale,1988).

On the Rapid Automatic Naming (RAN) (8 objects) task, most children exhibited problems when they first tried the task with eight objects. They exhibited problems with quick retrieval of the objects' names and often named the items in a random manner. However, after being trained to name from left to right across rows, they were able to perform the twelve-item version of the RAN task.

Tasks with Normally Distributed Scores for Both Three- and Four-year-olds

Experimental tasks that were normally distributed at both three and four years of age included: Rhyme Judgment, Segmentation, Copying, Sequential Memory, Visual Short-Term Memory, Fingertapping with the Dominant and Non-dominant Index Fingers, and Rapid Automatic Naming (12 items).

For the four-year-olds, Digit Word Span Backward was the best predictor of the ALL Emergent Literacy Index score while both Visual Short-Term memory and Digit Word Span Backward were the best predictors of the ALL Language Index score. Memory was the most prominent domain that predicted the ALL within this particular subject population. Although memory tasks were strongly correlated with a majority of the tasks in other domains, several tasks did not correlate with any tasks from the Memory domain. These tasks were: Rhyme Memory; Story Writing; and Fingertapping with the Dominant Index finger. The majority of the tasks at age three were more strongly correlated with the ALL Emergent Literacy Index score than with the ALL Language Index score. (See Table 3-13)

Performance of the four year olds showed a more even distribution of correlations between the ALL Emergent Literacy and ALL Language Index scores. (See Table 3-4) The tasks not correlated with the Memory domain at age four included: Segmentation; ABC writing; Story Writing; and Fingertapping of the Index finger in both hands.

Correlations and predictors found in linear regression analyses at both age levels suggest that memory is a key underlying cognitive construct for many skills that are associated with emergent literacy acquisition.

Predictors of the ALL Emergent Literacy and Language Index Scores

Analyses of the three-year old results showed that Letter Identification (*B*= .516; *t*= 2.54; *p*= .017) and Rhyme Judgment (*B*= .270; *t*= 1.99; *p*= .056) significantly predicted the ALL Emergent Literacy Index score. No tasks were shown to be significant predictors of the ALL Language Index score when highly correlated tasks were deleted from the analysis. However, when the forced entry process of multiple regression was used, Rhyme Judgment (*B*= .394; *t*= 2.27; *p*= .031) and Segmentation (*B*= .447; *t*= 2.06; *p*= .050) significantly predicted the ALL Language Index score.

One year later, when the children were four-year-olds, the Rhyme Knowledge (*B*= .512; *t*= 4.123; *p*= .000), Digit-Word Span Backward (*B*= .394; *t*= 3.288; *p*= .003) and Segmentation (*B*= .303; *t*= 2.128; *p*= .042) tasks predicted the ALL Emergent Literacy Index score and the Visual Short-Term Memory (*B*= .487; *t*= 3.341; *p*= .002), Rhyme Knowledge (*B*= .352; *t*= 2.595; *p*= .015) and Digit-Word Span Backward (*B*= .255; *t*= 1.907; *p*= .067) tasks best predicted the ALL Language Index score. These findings are illustrated in Table 4-1.

It is interesting to note that the majority of tasks predicting the ALL Index scores were from the Memory (four tasks) and Phonological Awareness (four tasks) domains. For the three-year-olds, Orthographic Awareness and Phonological Awareness were the core domains that predicted Emergent Literacy. At age four, Memory and Phonological Awareness were the core domains that predicted Emergent Literacy.

The ALL Language Index score showed no significant predictors at age three; however, again, at age four, Memory and Phonological Awareness were the core predictor domains. In general, memory skills were the strongest of both ALL index scores for the four-year olds, supporting the relationship between memory and early literacy in preschool children (Case, 1982; Gathercole, 1998; Luciana & Nelson, 1998; Cowan, 1980). Phonological awareness also played an important role as a predictor of both ALL index scores for both the three and four-year olds.

Memory is a cognitive function that plays a key role in human intelligence (McGrew & Flannagan, 1998; Case, 1985; Case & Okamoto, 1996; Fischer & Bidell, 1998) and studies have shown that working memory is strongly associated with reading skill (Swanson, 1993; Siegel & Ryan, 1989; Wagner & Torgeson, 1987; Gathercole, et al, 2006; Swanson, Cooney, & McNamara, 2004). The term working memory refers to a brain system(s) that provides temporary storage and manipulation of the information necessary for such complex cognitive tasks as language comprehension, learning, and reasoning. Working memory skills capture individual differences in reading (e.g., De Jong, 1998; Swanson, 1994), mathematics (e.g., Bull & Scerif, 2001; Mayringer & Wimmer, 2000; Passolunghi & Siegel, 2001; Siegel & Ryan, 1989), and language comprehension (e.g., Nation, Adams, Bowyer-Crain, & Snowling, 1999; Seigneuric, Ehrlich, Oakhill, & Yuill, 2000).

Short-term storage capacity, sometimes referred to as “memory span” or “simple span”, reflects the capacity to reproduce a sequence of items in the order in which they were represented (Stone & Brady, 1995). The tasks in this study that were representative of this short-term storage capacity included: Digit Word Span Forward

(auditory; verbal); Visual Short-Term Memory; and Sequential Memory (immediate; visual). The finding that the Visual Short-Term Memory task was a key predictor of ALL Emergent Literacy and Language at age four is consistent with previous findings showing that length of verbal memory spans for words and digits is an important predictor of reading achievement (Brady, 1991; Elbro, 1996; Wagner and Torgeson, 1987).

Digit Word Span Backward (working memory) was a significant predictor of both the ALL Emergent and Language Index scores for the four year olds. A few studies have shown that working memory capacity predicts word decoding skill as well as reading comprehension (Leather & Henry, 1994; Swanson, 1994). Working memory capacity and its relationship with early reading acquisition may reflect developmental aspects of establishing letter-sound representations. Developing automaticity for translating graphemes to phonemes and for sight word recognition is a process that continues well beyond the early school years and appears to depend on the efficient storage and processing of phonological information (Seigel, 1993).

Phonemic awareness, one's sensitivity to the sound structure of words and the ability to manipulate sounds in words, has been found to be a core deficit in reading disability (Adams, 1990; Goswami & Bryant, 1990; National Reading Panel, 2000; Scarborough, 1998; Share & Stanovich, 1995; Snow, Burns & Griffin, 1998; Wagner, et al.1993). Most phonemic awareness tests involve some degree of working memory processing. Beginning readers must develop an understanding of the associations between letter names, pronunciations, and the alphabetic principle. This understanding is dependent on working memory for both phonological and orthographic units. As

children begin to decode words, their ability to rehearse new phonological sequences is of critical importance. The number of items that can be retained over a short period of time is often used to measure an individual's "memory span". Hulme and Tordoff (1989) found that speech rate and memory spans are significantly correlated. Hulme proposed that children with higher speech rates could rehearse information faster and remember it more efficiently. However, this phenomenon only occurred when items to be retained were presented auditorily. Henry and Miller (1993) proposed that subvocal rehearsal develops from naming behavior and that a child's increasing speed and ease with naming influences the development of rehearsal and ultimately memory span.

Phonological awareness has been found to be highly related to verbal short-term memory (Storch & Whitehurst, 2004). The phonological loop is important for phonological recoding of orthographic information. Children sequentially transpose letters into sounds until the final letter has been decoded. The temporary storage of all of the sounds making up the word in the phonological loop help the child ultimately recognize the word. The temporary storage of "letter sounds" is dependent on the phonological loop and episodic buffer in case the word is a nonword.

The emergent skill of print knowledge is dependent upon both phonological and orthographic memory. The ability to write one's name requires the integration of phonological, orthographic, and motor memories for writing. The process of labeling letters in one's own name requires the accessing of sounds in one's name (phonological units), and then pairing these sounds with the corresponding letters (orthographic units).

Swanson, Zheng, & Jerman (2009) recently conducted a meta-analysis of the literature on the relationship of working memory and short-term memory to reading

disability. Both working and short-term memory require rehearsal in order to remember items (Unsworth & Engle, 2007; Gathercole, 1998). Tasks involving working memory or controlled processing put high demands on attention. However, short-term memory does not depend on the maintenance of the attention to the same degree (Cowan, 1995; Engle, Kane, & Tuholski, 1999). Both the linear regressions and the majority of correlations of normally distributed tasks at both ages support the conclusion that memory (short-term and working memory) and phonological awareness subserve the acquisition of emergent literacy and language skills at three and four years of age.

Appropriate Screening Tasks for Both Age Levels

In a post-hoc description analysis, frequency tables for all tasks at both age levels were created to determine which tasks might be appropriate for a screening tool at both age levels. Only the tasks on which 50% or more of the children scored between the 60th and 100th percentile were included in this "potential" screening pool of tasks. The following tests met this criterion for the three-year-olds: Naming of Letters in Name, Digit-Word Span Forward, Alphabet Awareness (singing the ABC song), Letter Discrimination, Letter Identification (receptive), Language Comprehension, Language Expression, Fingertapping with Dominant (median= 25.66 seconds) and Non-Dominant Index Finger (median= 21.50 seconds) and Rapid Automatic Naming of 12 items (median= 20.75 seconds). The following tasks met this criterion for the four-year-olds: Rhyme Judgment, Rhyme Knowledge, Writing of one's own name, Naming the letters in their name, ABC writing, Story Writing, Digit-Word Span Forward, Alphabet Awareness (ABC song), Letter Discrimination, Letter Identification, Language Comprehension, Language Expression, Copying, Fingertapping with Dominant Index Finger (median= 30.5 seconds), Fingertapping with Non-dominant Index Finger (median= 29.00 seconds)

and Rapid Automatic Naming with12 items (median= 14.40 seconds). Finally, the following tasks met this criterion at both age levels: Naming of Letters in own name, Digit-Word Span Forward, Alphabet Awareness, Letter Identification, Letter Discrimination, Language Comprehension and Expression, Fingertapping with Dominant and Non-dominant Index Fingers, and Rapid Automatic Naming for 12 items.

Conclusions

These results suggest that including working memory and short-term memory tasks in preschool screening batteries along with tasks of phonological awareness may increase the predictive validity of these procedures for identifying children between 3 and 4 years of age who are at risk for reading difficulties. The role of memory in this regard needs to be studied with a much larger and more diverse population.

Limitations and Weaknesses

The lack of age appropriate language tasks is a primary weakness of this study. Many of the oral language skills were too easy for the three year olds. Furthermore, a much larger group of children should be tested from a greater range of socioeconomic backgrounds. These changes alone could change the predictors for both the ALL Literacy and Language Index scores.

Future Research

For future studies a more diverse population will be sought so that the number of subjects will be more representative of the population (i.e., socioeconomic status, gender, IQ). Children should also be assessed using initial control measures of their receptive and expressive language abilities, as well as, their cognition (nonverbal intelligence test or standardized IQ test) before being administered the experimental protocols. Measurements should include more timed tasks in order to analyze individual

speed of processing which may add more variability of scores. Another addition would be to reevaluate the child over several years, such as, at three years, four years, and six months after the child begins formalized instruction, kindergarten (as suggested by Wilson & Lonigan, 2009) and in the first grade.

Table 4-1. Significant predictors of the ALL.

ALL Emergent Literacy		ALL Language	
3-year-olds	4-year-olds	3-year-olds	4-year olds
Letter Identification	Rhyme Knowledge	N/A	Visual Short-Term Memory
Rhyme Judgment	Digit-Word Span Backward		Rhyme knowledge
	Segmentation		Digit-Word Span Backward

APPENDIX A
LETTER TO PARENTS

UNIVERSITY OF
FLORIDA

Department of Communication Sciences & Disorders

336 Dauer Hall
PO Box 117420
Gainesville, FL 32611-7420
(352) 392-2113
Fax (352) 846-0243

June 9, 2008

Dear Parent,

My name is Sue Ann Eidson and I am currently a doctoral student at the University of Florida in the Department of Communication Sciences and Disorders under the direction of Dr. Linda Lombardino. I have been a practicing licensed speech/language pathologist for the last 30+ years and have decided to go back to school to pursue my doctorate in Speech/Language Pathology.

After many years of practice as a licensed speech/language pathologist, I now am very focused on the early diagnosis of reading disabilities in young preschoolers (specifically 3 and 4 year olds). The IRB approved #2008U-0342 study focuses on the possible early skills of major importance in the development of reading skills. These domains are in rhyming, phonological awareness, copying, and memory skills. This is a longitudinal study and your child will be tested for their pre-reading abilities now and then again in one year.

This testing will take approximately 30-45 minutes with necessary play breaks included. I have enclosed a consent form which describes the rights of you and your child during the study as well as copies of my Florida license and certification by my professional organization, the American Speech/Language/Hearing Association.

Finally, I would like to thank you in advance for your consideration of this request. I will be available to answer any questions you may have at the following phone number: 352/215-9892. If you have any questions or concerns, please feel free to call me at any time!

Sincerely,

Sue Ann Eidson, MS, CCC/SLP

Sue Ann Eidson, MS, CCC/SLP
Doctoral Candidate
University of Florida
Dept. of Communication Sciences and Disorders
27D Dauer Hall
PO Box 117420
Gainesville, FL 32611-7420
352/392-2041; Ext. 293
352/215-9892

APPENDIX B
INSTITUTIONAL REVIEW BOARD 2006-2007

UNIVERSITY OF FLORIDA

Department of Communication Sciences & Disorders

336 Dauer Hall
P.O. Box 117420
Gainesville, Florida 32611-7420
(352) 392-2113
Fax (352) 846-0243

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2006-U-0342
For Use Through 04/12/2007

Informed Consent

Protocol Title: Identifying Preschoolers Who Are At-Risk for Reading Disabilities Please read this consent document carefully before you decide to allow your child to participate in this study.

Purpose of the Research Study: We plan to conduct a study over two years to help us identify children between 3 and 4 years of age who might be "at risk" for a reading disability when they reach grade school.

During the first year, we plan to give a series of test activities that we have developed and determine if these activities are appropriate for children between 3 and 4 years of age. One year later, when the children are between 4 and 5 years of age, we plan to test the children again on a standardized test of emergent literacy.

If the activities given to the children when they are between 3 and 4 years of age are able to predict their scores on a standardized test emergent literacy test given to them when they are between 4 and 5 years of age, we will be successful in identifying preschoolers who might benefit greatly from special instructional strategies that should help lessen the severity or even avoid later reading problems.

What will your child be asked to do in the study?

Your child will be evaluated by a licensed Speech/Language Pathologist. Your child will be evaluated one time when he or she is between 3 and 4 years of age and one time the following year when he or she is between 4 and 5 years of age.

In the first year, your child will tested at your home or at your child's school in one session. Your child will be asked to participate in activities that have been linked to later reading success. These include (1) working memory skills, (2) rhyming skills, (3) copying skills, (4) finger tapping and (4) phonological processing skills.

In the second year, your child will be given a standardized test called ***The Assessment of Literacy and Language*** (*ALL*) in one session. This test is used to help identify children between the ages of 4 and years who are showing signs of spoken language and/or emergent literacy problems.

Your child will be provided with the opportunity to take short breaks between tasks, and will be given longer breaks if needed.

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2006-U-0342
For Use Through **04/12/2007**

Time Required

The two testing sessions (year 1 and year 2) will take between 46 and 60 minutes

Risks and Benefits

There are no risks associated with this study. There is no direct benefit to the child or their family from this study.

Compensation:

There will be no compensation offered for participation in this study.

Confidentiality

Your child's identity will be kept confidential to the extent provided by the law. Your child will be assigned a code number and all reference to your child and their performance in the study will only be identified using the assigned code number. The code number will remain with the child throughout the course of the study. Their anonymous test results may be archived for future research. Your child's name (code number) and your contact information will only appear with the evaluation sheet which will be kept in a file separate from the test materials for reference in one year from the initial visit. This file will be kept in a locked and secured location in the Dept. of Communication Sciences and Disorders. You are asked to keep the University of Florida Speech and Hearing Clinic informed of any address or phone number changes over the course of the study.

Voluntary Participation

The participation of your child in this study is completely voluntary and there is not penalty for not participating.

Right to withdraw from the study:

You have the right to withdraw your child from the study at anytime without consequence.

Whom to contact if you have questions about the study:

Sue Ann Eidson, MS, CCC.SLP; UF Department of Communication Sciences and Disorders; Box 117420; University of Florida; Gainesville, FL 32611-7420

Linda Lombardino, Ph.D.; UF Department of Communication Sciences and Disorders; Box 117420; University of Florida; Gainesville, FL 32611-7420

Whom to contact about rights as a research participant in the study

UFIRB Office; Box 112250; University of Florida; Gainesville, FL 32611-2250; phone: 352/3920433

Agreement:

I have received the procedure described above. I volunteer my child to participate in the procedure and I have received a copy of this description.

Participant:_____ **Date:** _____

Principle Investigator: _____ **Date:**_____

Principle Investigator: _____ **Date:** _____

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2006-U-0342
For Use Through 04/12/2007

Child Assent Form

All children will not be assessed until the caregiver has signed and dated the attached consent form. **All** children will be read a statement about the task and then asked if they wish to participate

"Hi (child's name). My name is Miss Sue Ann and I am here to do some fun activities with you today. Is that okay with you? If you feel tired, let me know and we can stop and take a break. Okay?

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2006-U-0342
For Use Through **04/12/2007**

APPENDIX C
INSTITUTIONAL REVIEW BOARD 2008-2009

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2006-U-0342
For Use Through 05/27/2009

UNIVERSITY OF FLORIDA

Department of Communication Sciences & Disorders

336 Dauer Hall
P.O. Box 117420
Gainesville, Florida 32611-7420
(352) 392-2113
Fax (352) 846-0243

Informed Consent

Protocol Title: Identifying Preschoolers Who Are At-Risk for Reading Disabilities Please read this consent document carefully before you decide to allow your child to participate in this study.

Purpose of the Research Study: We plan to conduct a study over two years to help us identify children between 3 and 4 years of age who might be "at risk" for a reading disability when they reach grade school.

During the first year, we plan to give a series of test activities that we have developed and determine if these activities are appropriate for children between 3 and 4 years of age. One year later, when the children are between 4 and 5 years of age, we plan to test the children again on a standardized test of emergent literacy.

If the activities given to the children when they are between 3 and 4 years of age are able to predict their scores on a standardized test emergent literacy test given to them when they are between 4 and 5 years of age, we will be successful in identifying preschoolers who might benefit greatly from special instructional strategies that should help lessen the severity or even avoid later reading problems.

What will your child be asked to do in the study?

Your child will be evaluated by a licensed Speech/Language Pathologist or a research assistant who is supervised by this professional. Your child will be evaluated one time when he or she is between 3 and 4 years of age and one time the following year when he or she is between 4 and 5 years of age.

In the first year, your child will be tested at your home or at your child's school in one session. Your child will be asked to participate in activities that have been linked to later reading success. These include (1) working memory skills, (2) rhyming skills, (3) copying skills, (4) finger tapping, and (4) phonological processing skills. Some of the tasks will be given orally and some are paper and pencil tasks.

In the second year, your child will be given a standardized test called ***The Assessment of Literacy and Language*** (*ALL*) in one session as well as the test protocol given in Year 1 of the study. This *ALL* is used to help identify children between the ages of 4 and years who are showing signs of spoken language and/or emergent literacy problems.

Your child will be provided with the opportunity to take short breaks between tasks, and will be given longer breaks if needed. If the child is unable to complete the testing during one 45 minute block of time another session will be scheduled for another day.

Time Required

The two testing sessions (Year 1 and Year 2) will take between 46 and 60 minutes

Risks and Benefits

There are no risks associated with this study. There is no direct benefit to the child or their family from this study.

Compensation:

There will be no compensation offered for participation in this study.

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2006-U-0342
For Use Through 05/27/2009

Confidentiality

Your child's identity will be kept confidential to the extent provided by the law. Your child will be assigned a code number and all reference to your child and their performance in the study will only be identified using the assigned code number. The code number will remain with the child throughout the course of the study. Their anonymous test results may be archived for future research. Your child's name (code number) and your contact information will only appear with the evaluation sheet which will be kept in a file separate from the tests materials for reference in one year from the initial visit. You are asked to keep the University of Florida Speech and Hearing Clinic informed of any address or phone number changes over the course of the study.

In the first year, your child will be tested at your home or at your child's school in one session. Your child will be asked to participate in activities that have been linked to later reading success. These include (1) working memory skills, (2) rhyming skills, (3) copying skills, (4) finger tapping, and (4) phonological processing skills. Some of the tasks will be given orally and some are paper and pencil tasks.

In the second year, your child will be given a standardized test called ***The Assessment of Literacy and Language*** (*ALL*) in one session as well as the test protocol given in Year 1 of the study. This *ALL* is used to help identify children between the ages of 4 and years who are showing signs of spoken language and/or emergent literacy problems.

Your child will be provided with the opportunity to take short breaks between tasks, and will be given longer breaks if needed. If the child is unable to complete the testing during one 45 minute block of time another session will be scheduled for another day.

Time Required

The two testing sessions (Year 1 and Year 2) will take between 46 and 60 minutes

Risks and Benefits

There are no risks associated with this study. There is no direct benefit to the child or their family from this study.

Compensation:

There will be no compensation offered for participation in this study.

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2006-U-0342
For Use Through 05/27/2009

Confidentiality

Your child's identity will be kept confidential to the extent provided by the law. Your child will be assigned a code number and all reference to your child and their performance in the study will only be identified using the assigned code number. The code number will remain with the child throughout the course of the study. Their anonymous test results may be archived for future research. Your child's name (code number) and your contact information will only appear with the evaluation sheet which will be kept in a file separate from the tests materials for reference in one year from the initial visit. You are asked to keep the University of Florida Speech and Hearing Clinic informed of any address or phone number changes over the course of the study.

Voluntary Participation

The participation of your child in this study is completely voluntary and there is not penalty for not participating.

Right to withdraw from the study:

You have the right to withdraw your child from the study at anytime without consequence.

Whom to contact if you have questions about the study:

Sue Ann Eidson, MS, CCC.SLP; UF Department of Communication Sciences and Disorders; Box 117420; University of Florida; Gainesville, FL 32611-7420

Linda Lombardino, Ph.D.; UF Department of Communication Sciences and Disorders; Box 117420; University of Florida; Gainesville, FL 32611-7420

Whom to contact about rights as a research participant in the study

UFIRB Office; Box 112250; University of Florida; Gainesville, FL 32611-2250; phone: 352/3920433

Agreement:

I have received the procedure described above. I volunteer my child to participate in the procedure and I have received a copy of this description.

Participant:_____ **Date:** _____

Principle Investigator: Sue Ann Eidson, MS, CCC/SLP **Date:** 5/12/08

Principle Investigator: Linda Lombardino, Ph.D. **Date:** 5/12/08

Approved by
University of Florida
Institutional Review Board 02
Protocol # 2006-U-0342
For Use Through 05/27/2009

Equal Opportunity Employer

APPENDIX D
CLIENT QUESTIONNARE

ALL™
ASSESSMENT OF LITERACY AND LANGUAGE

Caregiver Questionnaire

Child's Information

Child's Name: _____
First Middle Last

Child's Date of Birth: _____ **Age:** _____ **Grade:** _____

Parent(s)'s/ Guardian(s)'s Name(s): _____
First Middle Last

Address: _____

City: _____ **State:** _____ **Telephone:** _____

Name of Person Completing Questionnaire: _____ **Date Completed:** _____

Relationship to Child: _____

Reason for Assessment

What concerns you most about your child's development of language and reading skills? _____

What is your opinion of the classroom instruction that your child is receiving? _____

What do you want this evaluation to accomplish? _____

Child's Medical History

☐ Yes ☐ No Was the pregnancy full term? If **No**, how many months was the pregnancy?

☐ Yes ☐ No Were there any complications during pregnancy? If **Yes**, please explain:

☐ Yes ☐ No Did the mother take any medications during the pregnancy? If **Yes**, please explain:

☐ Yes ☐ No Were there any complications at the time of birth? If **Yes**, please explain:

☐ Yes ☐ No Has your child ever experienced difficulty with ear infections or hearing? If **Yes**, please explain:

☐ Yes ☐ No Has your child undergone surgery or experienced a traumatic physical or emotional event? If **Yes**, please explain:

Does or has your child experience(d) any of the following:

☐ Yes ☐ No Epilepsy/seizures. If **Yes**, please explain: _____

☐ Yes ☐ No Attention Deficit Disorder. If **Yes**, please explain: _____

☐ Yes ☐ No Other neurological problems. If **Yes**, please explain:

Please list any other conditions your child has that could affect his or her progress in school:

Please list any special services or therapy your child has received in the past or is receiving now:

ISBN 01540747 6-4
9 780154 074768

PsychCorp™
To order, call: 1-800-211-8378

1 2 3 4 5 6 7 8 9 10 11 12 A B C D E

Child's Developmental History

Estimate your child's age when he or she first demonstrated these behaviors.

	Age
crawled	
sat	
stood	
walked	

	Age
fed self	
toilet trained	
spoke first words	

	Age
combined two words	
used complete sentences	
carried on a short conversation	

Child's Attentional Behaviors

☐Yes	☐No	Does your child have difficulty paying attention when people are speaking to him or her?
☐Yes	☐No	Does your child have difficulty sustaining attention in tasks and play activities?
☐Yes	☐No	Is your child easily distracted?
☐Yes	☐No	Does your child often fidget or squirm in his or her seat?
☐Yes	☐No	Does your child often lose things?
☐Yes	☐No	Is your child often forgetful in daily activities?
☐Yes	☐No	Does you child have difficulty waiting in lines or waiting for his or her turn?
☐Yes	☐No	Does your child have difficulty paying attention to details or make careless mistakes in schoolwork or other activities?

Child's Oral Language Skills

Sound Production

☐Yes	☐No	Can you and other family members understand your child's speech?
☐Yes	☐No	Can people unfamiliar with your child understand him or her?
☐Yes	☐No	Does your child sound like other children his or her age?

Word and Sentence Production

☐Yes	☐No	Does your child omit small words from sentences (e.g., *the, on, in, to, for, is, are*)?
☐Yes	☐No	Does your child omit parts of words (e.g., *-ed* from *walked*, *-s* from *cups*, *-s* from *makes*, and *-ing* from *jumping*)?
☐Yes	☐No	Does your child have difficulty repeating new words or repeating long words?
☐Yes	☐No	Does your child repeat over and over words or sentences that he or she hears other people say?
☐Yes	☐No	Does your child ever have difficulty saying complete sentences that you think he or she should be able to say?
☐Yes	☐No	Does your child use question words (e.g., *Where, How much*)?
☐Yes	☐No	Does your child use negative words (e.g., *don't, isn't, can't*)?
☐Yes	☐No	Does your child use a variety of simple sentence types?
☐Yes	☐No	Does your child join sentences together using *and, but, or* (e.g., *Mary jumped rope, and Tom played ball.*)?

Listening Comprehension

☐Yes	☐No	Does your child act like he or she does not understand what people are saying to him or her?
☐Yes	☐No	Does your child often seem confused when you give instructions?

Vocabulary

☐Yes	☐No	Does you child learn new words easily?
☐Yes	☐No	Does your child have difficulty recalling words that he or she knows?
☐Yes	☐No	Does your child use a variety of words such as nouns, verbs, adjectives, and adverbs?

Storytelling

☐Yes	☐No	Does you child seem to have difficulty retelling the story of a personal event, a favorite book, or a TV episode?
☐Yes	☐No	Does your child have difficulty explaining how to do something that he or she does regularly?

Child's (Pre)Literacy and Emergent Literacy Skills

Print Concepts Including Book Handling

☐ Yes	☐ No	Can your child identify different parts of a book (e.g., cover, first page, title)?
☐ Yes	☐ No	Can your child point to separate words on a page?
☐ Yes	☐ No	Does your child know that reading starts at the left and goes to the right?
☐ Yes	☐ No	Can your child match letters and words?

Alphabet Knowledge

☐ Yes	☐ No	Can your child identify the letters from his or her name?
☐ Yes	☐ No	Can your child print one or more letters in his or her name?
☐ Yes	☐ No	Can your child point to a few letters correctly on a page?
☐ Yes	☐ No	Can your child name a few letters correctly on a page?
☐ Yes	☐ No	Can your child name all the letters in the alphabet?
☐ Yes	☐ No	Can your child write his or her name?
☐ Yes	☐ No	Can your child write all the letters in the alphabet?
☐ Yes	☐ No	Can your child read a few words that he or she has seen in print before?

Phonics Knowledge

☐ Yes	☐ No	Can your child match letters to the sounds they make?
☐ Yes	☐ No	Can your child attempt to sound out a word that he or she has not seen before?

Phonological Awareness

☐ Yes	☐ No	Does your child enjoy reciting nursery rhymes?
☐ Yes	☐ No	Can your child tap out the syllables in simple words such as *cow-boy, base-ball*?
☐ Yes	☐ No	Can your child tell you when two words rhyme like *sat* and *hat*?
☐ Yes	☐ No	Can your child tell you the number of syllables in words such as *tel-e-phone* (has 3 syllables)?
☐ Yes	☐ No	Can your child tell you if two or three words begin with the same sound?
☐ Yes	☐ No	Does your child try to spell simple words (e.g., writes *bl* for *ball*)?
☐ Yes	☐ No	Can your child tell you the number of sounds in a simple word like *baby* (has four sounds)?
☐ Yes	☐ No	Can your child tell you which word is left when you take *cup* off of *cupcake*?

Child's Interest in Reading or Reading Related Activities

Please circle the response that best describes your child's behavior.

Does your child show interests in books?	☐ frequently	☐ sometimes	☐ almost never	☐ never
Does your child ask you what certain words mean like labels or signs?	☐ frequently	☐ sometimes	☐ almost never	☐ never
Does your child try to sound out printed words?	☐ frequently	☐ sometimes	☐ almost never	☐ never
Can your child read words?	☐ more than 10	☐ more than 5	☐ a few	☐ no
Do you read stories to your child?	☐ everyday	☐ almost everyday	☐ sometimes	☐ never
Does your child ask you to read stories to him or her?	☐ everyday	☐ almost everyday	☐ sometimes	☐ never
How many hours per week do you read to or with your child at home?	☐ 4 or more hours	☐ about 2–3 hours	☐ less than one hour	

***continued** on next page*

Can your child remember some of the stories that you have read to him or her?	☐ remembers well	☐ has difficulty remembering	☐ we don't read stories
Can your child read a simple book without your help?	☐ can read some pages	☐ can read a few words	☐ cannot read any words
How do you feel that your child is doing in his or her development of (pre)reading skills compared to his or her age mates?	☐ better than most	☐ about the same as most	☐ poorer than most

Family History of Communication Difficulties

Have any of your child's family members had difficulty:
(If **Yes**, please explain.)

			Family Member	Comments
☐ Yes	☐ No	Hearing		
☐ Yes	☐ No	Speaking clearly as a child		
☐ Yes	☐ No	Putting sentences together as a child		
☐ Yes	☐ No	Learning the alphabet		
☐ Yes	☐ No	Learning to read		
☐ Yes	☐ No	Learning to spell		
☐ Yes	☐ No	Writing sentences		
☐ Yes	☐ No	School work in general		

Have any of your child's family members received or are they receiving:
(If **Yes**, please explain.)

☐ Yes	☐ No	Speech and language therapy
☐ Yes	☐ No	Special school services for reading
☐ Yes	☐ No	Other special school services

Parent's Education History

Please indicate highest level of education completed.

	Mother	Father
Less than high school (K–11)		
High school or GED		
Some college or technical school		
Bachelor's degree		
Graduate degree		

Mother's occupation: _____

Father's occupation: _____

APPENDIX E.
RUBRIC FOR GRADING COPYING AND WRITING

Rating Scale - Proximal Copying

Rating Scale for Traced Items:

2 points: minimal space between dotted line and child's tracing

1 point: same for but large difference in dotted line and child's tracing

0 points: scribble; not attempt; additional lines, loses form by straying more than1 inch outside of the dotted line

Rating Scale for free form copying

2 points: same shape and form

1 point: same shape; added marks; rotated; distorted markings; used existing lines

0 points: scribbling; not attempt; no resemblance to target form

APPENDIX F
EXPERIMENTAL TASKS PROTOCOL I

Protocol 1: **Subject:** _____ **Birthdate:** _____ **CA:** _____ **Preschool:** _____

I. Phonological Subtests

a) Rhyming

Subtest One: (basal= 3 correct; ceiling= 3 incorrect); two repetitions allowed; praise feedback allowed

Item	Stimulus	Response	Score
T1	**Boy**	**toy**-moon-cloud	+ -
T2	**Hug**	duck- **rug**-sun	+ -
T3	**Whale**	***mail***-sink-foot	+ -
1	**Paw**	**straw**-cake-door	1 0
2	**Nest**	nail-**vest**-dog	1 0
3	**Bee**	ice-**key**-book	1 0
4	**Train**	fish-**rain**-box	1 0
5	**Clock**	**rock**-park-truck	1 0
6	**Flag**	bug- tag- egg	1 0
7	**Rat**	**cat**- nut- plate	1 0
8	**Sad**	black- **mad**- hat	1 0
Total Score			

Subtest 2:

Item	Response	Score
T1	toy boy	+ -
T2	truck plant	+ -
1	fish play	1 0
2	door foot	1 0
3	cry sky	1 0
4	beak creek	1 0
5	pot knot	1 0
6	bay cloud	1 0
7	eight farm	1 0
8	hen pen	1 0
9	snack tack	1 0
10	sand cat	1 0
Total score		

Task 3: Rhyme Knowledge

Directions: We're going to do something different again. I'm going to say a word and I want you to tell me another word that rhymes with the one I say. Point to the ***pie*** and say: ***Pie***. Tell me a word that rhymes with ***pie.*** If child responds incorrectly, say: Some words that rhyme with ***pie*** are ***by, fly,*** and ***sigh***. If child responds correctly, say: That's right! _____ rhymes with ***pie***.

Point to the ***bug*** and say: ***Bug***. Tell me a word that rhymes with ***Bug.*** If child responds incorrectly, say: Some words that rhyme with ***Bug*** are ***hug, mug,*** and ***rug***. If child responds correctly, say: That's right! _____ rhymes with ***bug***.

If child responds correctly, say: That's right! _____ rhymes with ***pie***.

Trial Item 1	Responses	Score
T1. Pie		+ -
T 2. Bug		+ -
1. Feet		1 0
2. Dog		1 0
3. Plate		1 0
4. Cap		1 0
Total Score		

Task 4 Segmenting Sentences into Words

Items needed: different colored blocks; felt board/construction paper
Directions: Say to the student: ***I am going to say some words and I want you to pick up a different block for every word you hear. Let's try one…"Mary (or child's name)".*** Examiner places one block on the felt board then clears the felt board.

"Now you try one."

"Mary walks." (Child places two blocks on the felt board. If correct, ***"Very good. That's right. I said two different words".*** If incorrect, training continues with the following trials. Continue testing until child misses 2 in succession.
Trial Items

Item	Stimulus	Response	Child Response	Score
T1	**Mary**	1 block		1 0
T2	**Mary walks.**	2 blocks		1 0
T3	**Baby.**	1 block		1 0
T4	**Baby cries.**	2 blocks		1 0
T5	**Dog.**	1 block		1 0
T6	**Dog barks.**	2 blocks		1 0

T7	**I fell.**	2 blocks		1 0
T8	**Mother eats apples.**	3 blocks		1 0
T9	**I love candy.**	3 blocks		1 0

Continue testing until child misses 2 in a grouping.

Item	Stimulus	Response	Child Response	Score
1a	Dog.	1 block		1 0
1b	Dog barks.	2 blocks		1 0
2a	Mary jumps.	2 blocks		1 0
2b	I jump.	2 blocks		1 0
3a	Come here, Don.	3 blocks		1 0
3b	Bob loves school.	3 blocks		1 0
4a	Yesterday, I fell down.	4 blocks		1 0
4b	What is your name?	4 blocks		1 0
5a	Let's eat a pizza together.	5 blocks		1 0
5b	When does the bus come?	5 blocks		1 0
Total Score				

Task 5 Visual Matching (Proximal)

Items needed: Stimulus packet; student answer booklet; preschool-sized pencil or crayon

Instructions: "We are going to play a matching game. In each row, I want you to point to the pictures, shapes, letters, numbers that look the same as what you see up here Let's try one…"

"Find the one that looks like the one up here".

Item	Response	Score
T1	**wagon**	1 0
T2	**clock**	1 0
T3	**stop sign**	1 0
T4	**Ronald McDonald**	1 0
1	**dog**	1 0
2	**cupcake**	1 0
3	**flower**	1 0
4	***McDonald's*** Sign	1 0
5	***Walk*** sign	1 0
6	***Burger King*** sign	1 0
7	**=**	1 0

8	**A**	1 0
9	**T**	1 0
10	**E**	1 0
11	**p**	1 0
12	**V**	1 0
Total score		

Task 6: Copying

Materials: preschool pencil with eraser; answer booklet; lined preschool paper

Directions: Say to the student, "I'm going to show you some lines. I want you to look at each and copy it as well as you can".

Item	Response	Score
T1	**curved line (trace)**	0 1 2
T2	**straight line (trace)**	0 1 2
1	**circle (trace)**	0 1 2
2	**vertical line (copy)**	0 1 2
3	**circle (copy)**	0 1 2
4	**X (copy)**	0 1 2
5	⊥	0 1 2
6	**A**	0 1 2
7	**E**	0 1 2
8	**V**	0 1 2
10	I	0 1 2
Total Score		

Task 7: Name Knowledge

Materials Needed: answer booklet; preschool pencil preschool crayon

Directions: I want you to write your name on this line right here (beginning point will be marked with an "X"); Great job! Now name these letters for me… (Examiner points to each letter…not necessarily in order for the child to name).

Scoring: (Letters written…correct or not)

Percentage Correct: _____

___ ___ ____ ___ ___ ____ _____ ____ ___ __

Scoring (Naming letters):

Percentage Correct: _____

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

Task 8: Written Knowledge

Writing ABCs:

- number of correctly formed letters without proper sequence 0 1 2

___ ____ ___ ___ ___ ___ ___

- number of letters/forms correctly named 0 1 2

___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

Task 9: Finger Tapping

Exercise 1:

Materials Needed: Clown face; stopwatch.
Directions: ***I want you to push down on this clown's nose as many times as you can with your pointy finger until I say stop.*** (May need to shape/demonstrate the procedure if the participant does not understand the instructions).

Directions for tester: You will need to set the stopwatch to 10 seconds and then count how many times the child "taps" the nose in a 10 second count.

Dominant index finger: (10 seconds)

Trial	# of taps
Trial 1	
Trial 2	
Average	

Nondominant Index Finger: (10 secs)

Trial	# of taps
Trial 1	
Trial 2	

Average	

Mean Difference between dominant and nondominant index finger:

_____

Fingertapping Exercise II:

Materials: stopwatch

Activity: (Repetition task….child required to touch index finger to thumb 10x; record the time it takes for the child to complete 10 touches is recorded; record the dominant index finger then nondominant index finger).

Directions: Say….”You will need to touch your “pointy finger” to your thumb 10 xs.” (May need to shape/demonstrate the procedure if the participant doesn’t understand).

Dominant index finger:

Trial	time in seconds
Trial 1	
Trial 2	
Average	

Nondominant Index Finger: (10 secs)

Trial	time in seconds
Trial 1	
Trial 2	
Average	

Mean Difference between dominant and nondominant index finger:

_____

IV. Memory Skills

Task 10: Short Term Memory skills

a) Digit Span Forward

Instructions for child: *I am going to say some numbers/words and you will need to say* ***just what I say.*** *Let's try one:*

Item	Stimulus	Response	Score
T1	**1**		+ -
T2	**2-6**		+ -
T3	**fish-cat**		+ -
1	**1-4**		1 0
	4-9		1 0
	cat-fish		1 0
2	**2-5-7**		1 0
	6-8-1		1 0
	fish-cat-cow		1 0
3	**6-9-2-1**		1 0
	3-5-8-2		1 0
	fish-cat-cow-dog		1 0
Total			

Administration and Scoring: At least 2 lists of random digits are given at each list length, stating at Length 2. If both sequences at each length were correctly repeated, the length of the next list is increased by one, and a further two lists given. If the child fails to correctly repeat either of the two items at one length, no further lists were given. When the child correctly recalls one of the two lists, a third list at that length is given. If the third list was correctly repeated, two trials at the next length are given. If the child fails the third item, testing stops. Span is scored as the maximum length at which the child correctly recalls at least two sequences.

Task 11: Working Memory; Digit-Word Span (backward)

Task A-11: Instructions: I am going to say some numbers and you will need to say the numbers backwards. "Let's try one".

You may train with colored blocks, animal picture cards or index cards with numbers for visual cues. Use of picture cards can be used with the word span. Discontinue testing when 4 consecutive errors occur.

Item	Correct response	Response	Score
T1 4-8	8-4		1 0
T2 4-6	6-4		1 0
T3 cow-cat	cat-cow		1 0
T4 bird- fish	fish-bird		1 0
If a child fails all of the four trials, discontinue testing			
1) 1-4	4-1		1 0
cat-dog	dog-cat		1 0
5-3	3-5		1 0
4-9fish-snake	snake-fish		1 0
4-9	9-4		1 0
bird-ball	ball-bird		1 0
2) fish-bird-cow	cow-bird-fish		1 0
2-5-7	7-5-2		1 0
ball-bike-cow	cow-bike-ball		1 0
6-8-1	1-8-6		1 0
snake-ball-bus	bus-ball-snake		1 0
4-9-1	1-9-4		1 0

V. Orthographic Awareness

Task 12: Alphabet Awareness

Directions: Child required to sing the *Alphabet Song.*

Can sing the song without errors: 10
Can sing the song with 0-5 errors: 08
Can sing the song with 5-10 errors: 05
Can sing the song with 10-15 errors: 01
Cannot sing the song or doesn't know it: 0

Score: _____

Task 13: Letter Discrimination

Directions: Child required to find the letter in a field of five stimuli.

Item	Response	Score
T1	A	1 0
T2	B	1 0
1	P	1 0
2	E	1 0
3	C	1 0
4	D	1 0
5	S	1 0
6	Z	1 0
Total score		

Task 14: Letter Naming (using the *ALL* protocol)

Directions: Therapist: "I want you to point to some letters. Look at these." (Point to the appropriate row as you prompt the child). "Point to or Show me the letter _____." There are no trial items in this task.

Item	Response	Score
1	**A**	**1 0**
2	**c**	**1 0**
3	**x**	**1 0**
4	**o**	**1 0**
5	**Z**	**1 0**
6	**B**	**1 0**
7	**W**	**1 0**
Total score		

VI. Language Skills

Task 15: Story writing:

Task 15-A:
Directions: Child will be asked to write a story and then identify where it begins and ends.
Materials needed: preschool lined paper and a preschool sized pencil with an eraser.

Scoring:

a) child identifies beginning of story (1) (0)
b) child identifies end of the story (1) (0)

Task 15-B:
Directions: Child will be asked to write their "ABCs" on the lined paper and then asked to "read" them.

Scoring:
a) exhibits left to right directionality (1) (0)
b) writes letters on the page (1) (0)
c) names the letters that they wrote (1) (0)

Task 16. Listening Comprehension (Receptive Vocabulary). Present the child with a simple sentence and then ask them a question about the statement they just heard. Give 1 point for each correct response and 0 for incorrect responses or no response. Discontinue testing after 3 consecutive error responses or if the trial items are in error.

Trial 1. The duck is swimming. "Who is swimming? _____ (1 , 0)

Trial 2. Daddy is driving a car. "What is Daddy driving? _____ (1, 0)

Item 1. The dog is big. "Who is big?" _____ (1, 0)

Item 2. The kitty is playing. "Who is playing? _____ (1, 0)

Item 3. The baby likes milk. "What does baby like? _____ (1, 0)

Item 4. The puppy is sleepy. "Who is sleepy?"_____ (1, 0)

Item 5. The boy plays ball. "What does the boy play?" _____ (1, 0)

Item 6. The bug is in the jar. "Where is the bug?" _____ (1, 0)

Item 7. The car is little. "What is little?" _____ (1, 0)

Item 8. The pudding is too hot. "Is the pudding too hot?" _____ (1, 0)

Score: _____

Task 17: Language Expression/Sentence repetition

Child will be required to imitate the following sentences. 2 repetitions allowed.

Instructions: Therapist directs the child to ***"Say what I say."*** If the child doesn't understand this first directive, use the following directive using a stuffed animal or doll. ***Do you know how to play "Telephone"? I'll show you. I will say something into your ear and then you say what I say to the elephant with the big ears next to you. Be sure to say it loud enough so he can hear. Let's see if he can say what we say!! I bet he can!!!***

Trial 1: "Baby" (+) (-)
Trial 2: "Hello puppy" (+) (-)

(1;9)
Item 1: Kitty. (+) (-)
Item 2: I sleep. (+) (-)
Item 3: I play. (+) (-)

(2;0)
Item 4: I like juice. (+) (-)
Item 5: It is mine. (+) (-)

Item 6: The cat is jumping. (+) (-)
Item 7: Can he play ball? (+) (-)

(3;0)
Item 8: What is your name? (+) (-)
Item 9: He likes toast and milk. (+) (-)
Item 10: He is not running fast. (+) (-)

Score: _____
Comments on Articulation:
_____

Task 18: Rapid Naming

The child will be trained to name objects in a matrix as quickly and as accurately as possible. The instructor will train by doing the procedure two times before asking the child to do the rapid naming. Be sure to remind the child to name the objects as fast as they can.

Trial One:

Dog Cup Cat Bike

Item I: 8 objects

dog cup bike cat

cup bike cat dog

Trial One: _____seconds Errors: _____

Item 2: 8 objects

dog cup bike cat

cup bike cat dog

Item Two: _____seconds Errors: _____

Average: _____

Item 3: 12 objects

cup cat bike dog

bike dog cup cat

cup dog cat bike

Item 3: ____ secs. Errors: _____

Item 4: 12 objects

cup cat bike dog

bike dog cup cat

cup dog cat bike

Item 4: ____ secs. Errors: _____

Average: _____

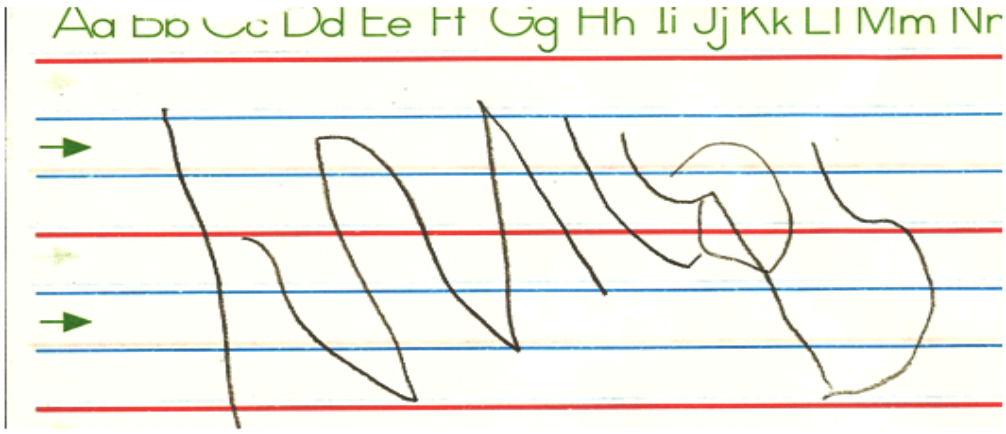

Figure F-1. 42 month old writing sample of her trip to disney world

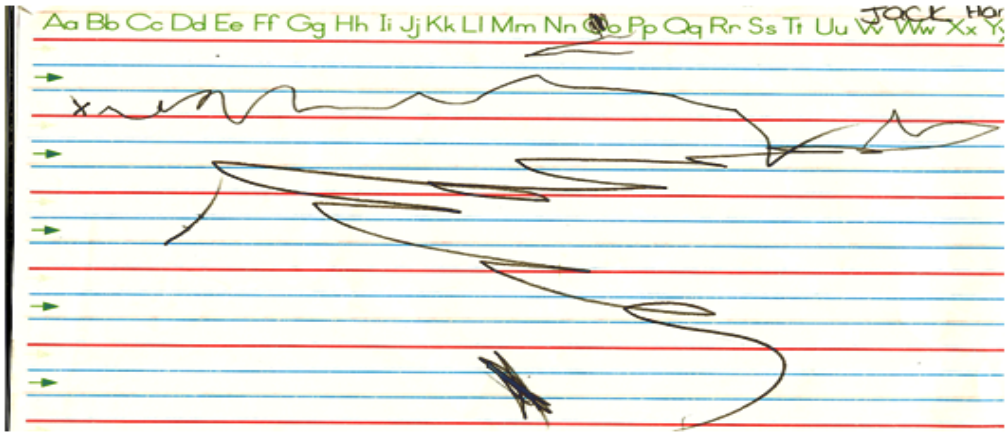

Figure F-2. Undifferentiated writing; writing of child's name and story (38 month old)

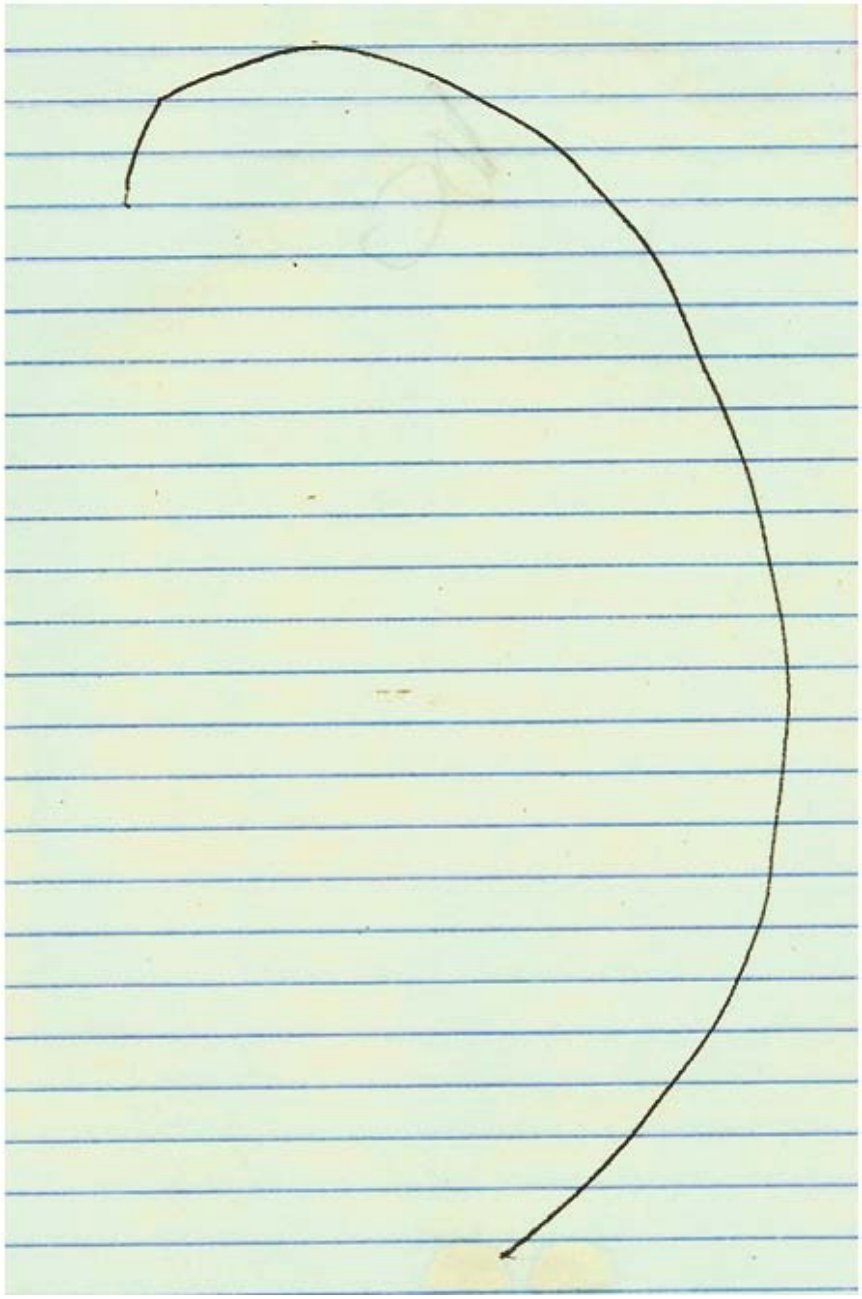

Figure F-3. Undifferentiated writing sample; story writing (36 months)

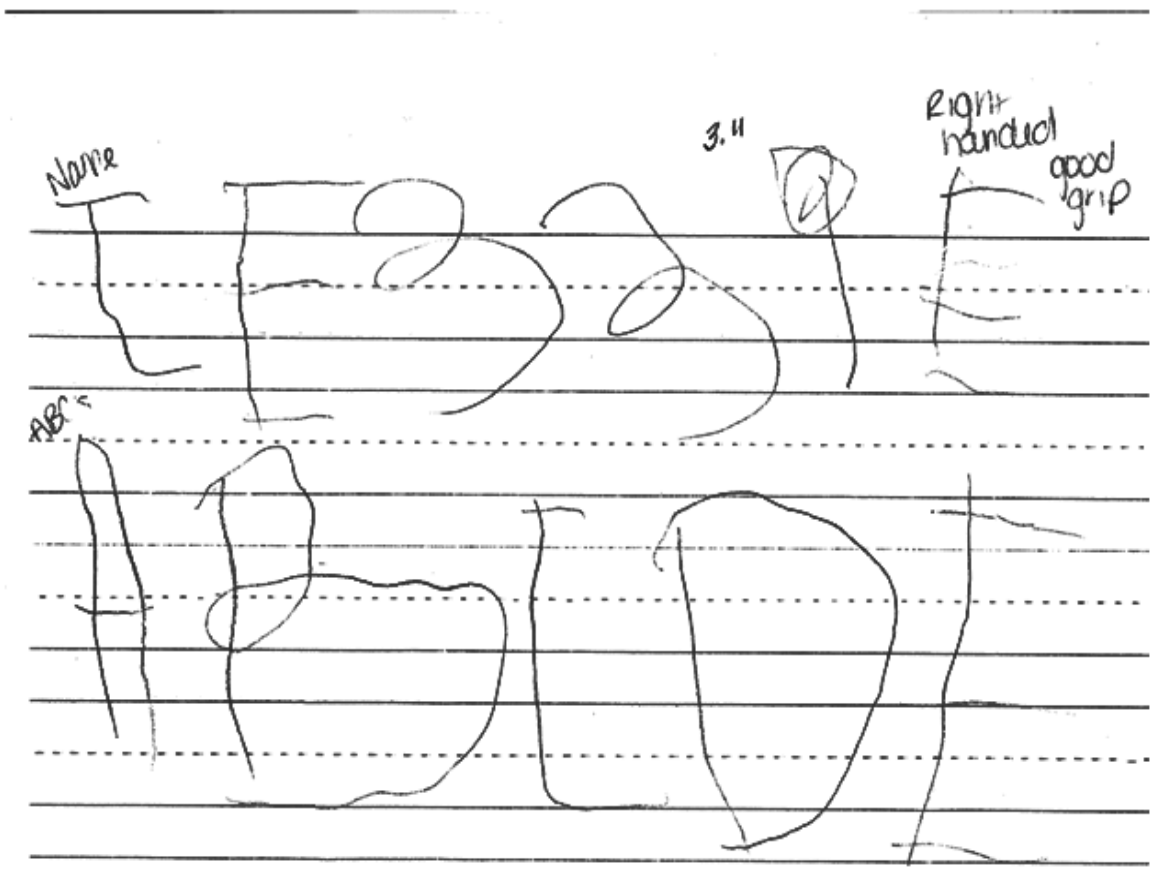

Figure F-4. 47. month old writing sample

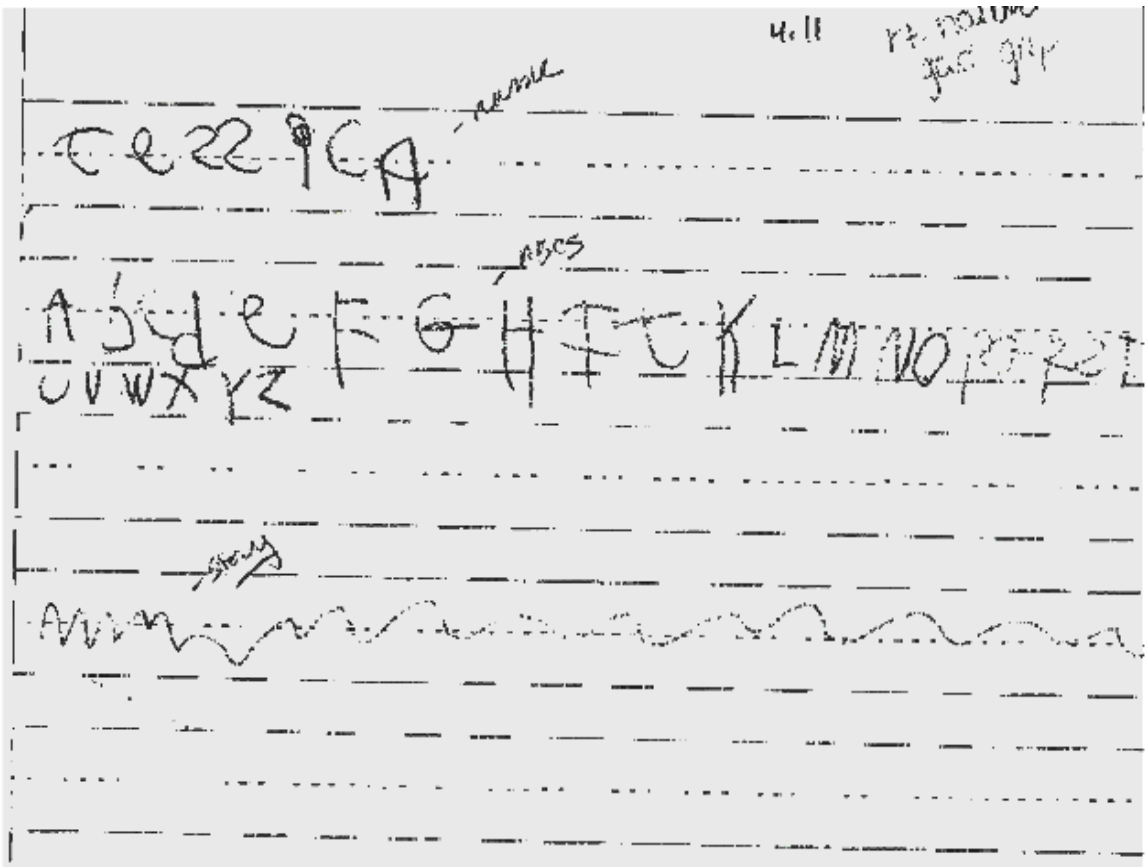

Figure F-5. Same child at 4.11

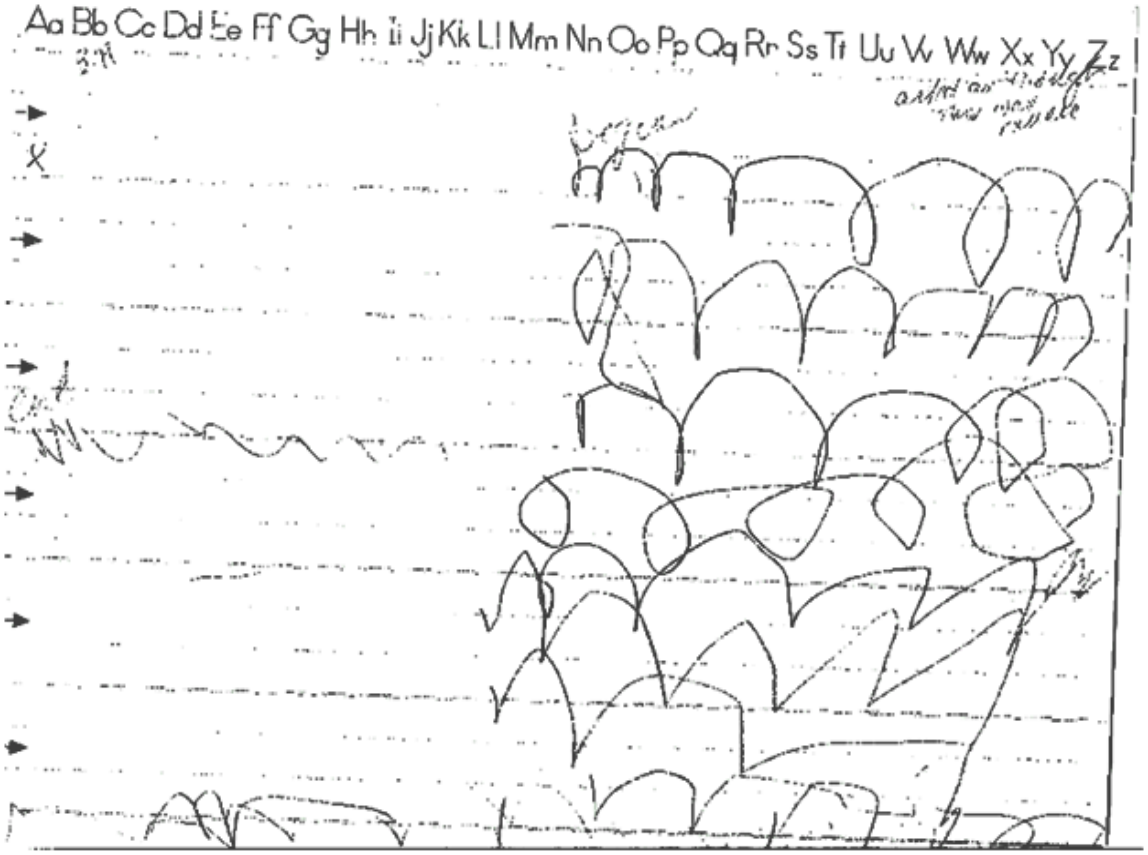

Figure F-6. 46 month old writing sample

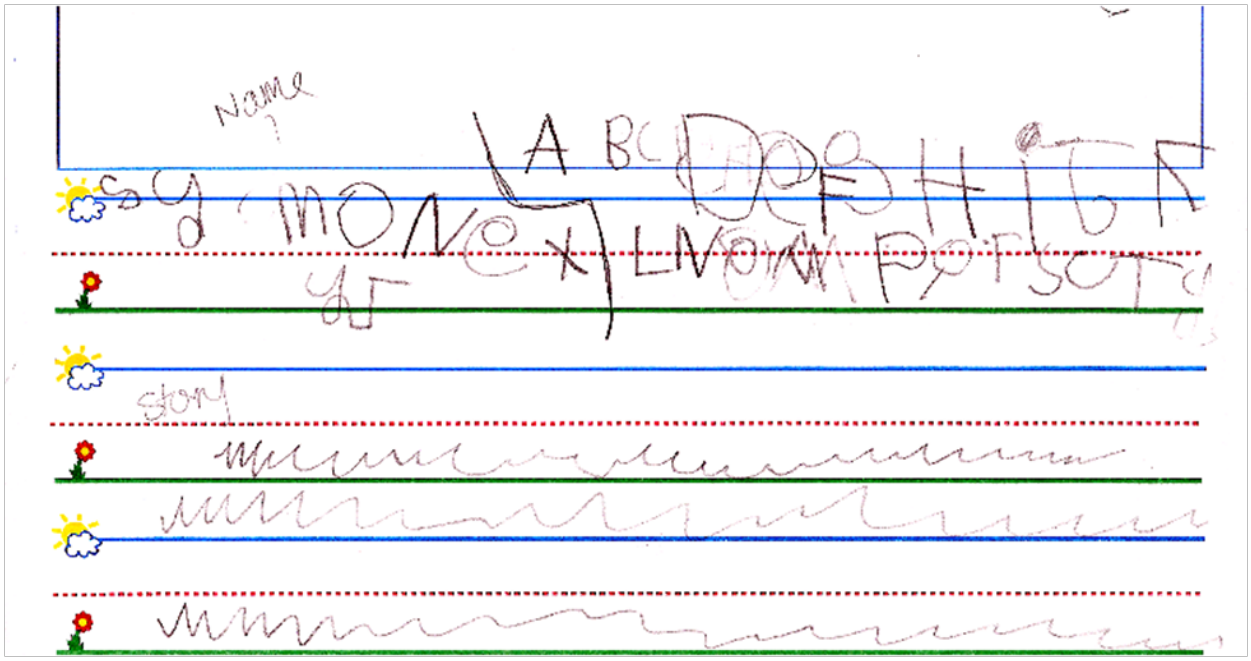

Figure F-7. Same child writing sample at 4.10

LIST OF REFERENCES

Adams, M. J. (1990). Beginning to read: Thinking and learning about print. Cambridge, MA: MIT Press.

Adams, M. J., and Bruck, M. (1993). Word recognition: The interface of educational policies and scientific research. *Reading and Writing: An Interdisciplinary Journal; Volume five:* 113-39.

Adams, A. M., & Gathercole, S. E. (1995). Phonological working memory and speech production in preschool children; *Journal of Speech and Hearing Research, 38,* 403-404.

Agresti, A. & Finlay, B. (1997). *Statistical Methods for the Social Sciences: Third Edition,* Prentice-Hall, Inc.; Upper Saddle River, NJ 07458.

Agresti, A. & Finlay, B. (1997). Comparing groups: Analysis of variance methods, pp. 438-448; In *Statistical Methods for the Social Sciences: Third Edition,* Prentice-Hall, Inc.; Upper Saddle River, NJ 07458.

American Speech-Language-Hearing Association (2000). Roles and responsibilities of speech-language pathologists with respect to reading and writing in children and adolescents. Rockville, MD: Author.

Anthony, J. L., Williams, J. M., McDonald, R., Corbitt-Shindler, D., & Francis, D. J. (2006). Phonological representation, access, memory and awareness: The structure of phonological processing abilities in English speaking preschool children. Manuscript submitted for publication.

Ashby, J., Rayner, K. (2006). Literacy development: Insights from research on skilled reading. In D. K. Dickinson and S. B. Neuman (Eds.), *Handbook of Early Literacy Research: Volume 2* (pp. 52-63). New York: Guilford Press.

Baddeley, A. (1986). *Working Memory;* New York: Oxford University Press.

Baddeley, A. (1992). Working Memory; *Science*; January, 255 (5044); 556-559.

Baddeley, A. D., Gathercole, S. E., Papagno, C. (1998). The phonological loop as a language-learning device*; Psychological Review, 105,* 158-173.

Baddeley, A. D. (2000). The episodic buffer: A new component of Working Memory? *Trends in Cognitive Sciences, 4,* 417-422.

Badian, N. A. (1994). Preschool prediction: Orthographic and phonological skills, and reading; *Annals of Dyslexia, 44,* 3-25.

Badian, N. (2000). *Prediction and prevention of reading failure.* York Press, Inc.; Baltimore, Maryland.

Ball, E.W. (1997). Phonological awareness: Implications for whole language and emergent literacy programs. *Topics in Language Disorders, 17*, 14–26.

Beck, I. L., McKeown, M. G. (1991). Social studies texts are hard to understand: Mediating some of the difficulties; *Language Arts; 68;* 482-490.

Berninger, V. W., Hart, T. M. (1992). A neuropsychological perspective for reading and writing acquisition; *Educational Psychologist, Vol. 27*. Pp. 415-434.

Berninger, V. & Rutberg, J. (1992). Relationship of finger function to beginning writing: Application to diagnosis of writing disabilities. *Developmental Medicine and Child Neurology, 34,* 198-215.

Berninger, V., Abbott, R. (1994). Multiple orthographic and phonological codes in literacy acquisition: An evolving research program. In V. Berninger (Ed*.), The varieties of orthographic knowledge I: Theoretical and developmental issues* (pp. 277-317), Dordrecht, The Netherlands: Kluwer.

Berninger, V. (2000). Development of language by hand and its connections to language by ear, mouth, and eye. *Topics of Language Disorders, 20*, 65-84.

Bloom, P. A., Barss, J. N., & Conway, L. (1994). Children's knowledge of binding and coherence: Evidence from spontaneous speech; *Language, 70(1),* 53-71.

Boudreau, D. M. and Hedberg, N. L. (1999). A comparison of early literacy skills in children with specific language impairment and their typically developing peers. *The American Journal of Speech- Language Pathology, 8,* 249–60.

Bowey, J. A., Tunmer, W. E. and Pratt, C. (1984). Development of children's understanding of the metalinguistic term 'word'. *Journal of Experimental Psychology,76,* 500–12.

Bowers, B. G., & Wolf, M. (1993). Theoretical links among naming speed, precise timing mechanisms and orthographic skill in dyslexia; *Reading and Writing, five,* 69-85.

Bowey, J. A. (2000). A case for early onset-rime sensitivity training in at-risk preschool and kindergarten children; In N. Badian (Ed.) *Prediction and Prevention of Reading Failure*, pp. 217-245; York Press, Inc.

Bowey, J. A. (2005). Predicting individual differences in learning to read; In M. J. Snowling and C. Hulme (Eds.) *The Science of Reading: A Handbook*, pp. 155-172, Blackwell Publishing, Ltd.

Brady, S. A., Shankweiler, D., and Mann, V. A. (1983). Speech perception and memory coding in relation to reading ability, *Journal of Experimental Child Psychology, 35*, 345-367.

Bradley, L. & Bryant, P. (1978). Difficulties in auditory organization as a possible cause of reading backwardness; *Nature, 271,* 746-747.

Bradley, L., and Bryant, P. E. (1983). Categorizing sounds and learning to read: A causal connection; *Nature; 301:* pp. 419-521.

Brown, J. D. (1996). *Testing in Language Programs*. Upper Saddle River, NJ: Prentice Hall.

Bryant, P. E.; MacLean, M., Bradley, L., and Crossland, J. (1990). Rhyme, alliteration, phoneme detection and learning to read. *Developmental Psychology 26*: 429-38.

Bryant, P. E., Maclean, M. & Bradley, L. (1990). Rhyme, language, and children's reading. *Applied Psycholinguistics, 11*, 237-252.

Burgess, S. R. & Lonigan, C. J. (1998). Bidirectional relations of phonological sensitivity and pre-reading abilities: Evidence from a preschool sample. *Journal of Experimental Child Psychology, 70*, 117-141.

Burgess, S. (1999). The influence of speech perception, oral language ability, the home literacy environment, and prereading knowledge on the growth of phonological sensitivity: A 1-year longitudinal study. *Reading Research Quarterly, 34,* 400-402.

Byrne, B., Fielding-Barnsley, R., Ashley, L., & Larsen, K. (1997). Assessing the child's and the environment's contribution to reading acquisition: What we know and what be don't know. In B. A. Blachman (Ed.), *Foundations of reading acquisition and dyslexia* (pp. 265-285). Mahwah, NJ: Erlbaum.

Case, R.D. Kurland, M., Goldberg, J. (1982). Operational Efficiency and the Growth of Short-Term Memory Span. *Journal of Experimental Child Psychology*; 33:386-404.

Catts, H. W. (1989). Phonological processing deficits and reading disabilities. In A. G. Kamhi & H. W. Catts (Eds.), *Reading disabilities: A developmental language perspective* (pp. 101-132). Boston: Allyn & Bacon.

Catts, H. S., Wilcox, K. A., Wood-Jackson, C., Larrivee, L., & Scott, V. G. (1997). Toward an understanding of phonological awareness. In C. K. Leong & R. M. Joshi (Eds.), *Cross-language Studies of Learning to Read and Spell: Phonologic and Orthographic Processing*. Dordrecht: Klüwer.

Catts, H. W., Fey, M. W., Zhang, X., & Tomblin, J. B. (1999). Language basis of reading and reading disabilities: Evidence from a longitudinal investigation. Scientific *Studies of Reading, three,* 331-361.

Chaney, C. (1989). I pledge a legeance tothe flag: Three studies in word segmentation. *Applied Psycholinguistics, 10 (three):* 261-282.

Chaney, C. (1992). Language development, metalinguistic skills, and print awareness in three-year-old children. *Applied Psycholinguistics, 13,* 485-514.

Chaney, C. (1994). Language development, metalinguistic awareness, and emergent literacy skills of three-year-old children in relation to social class. *Applied Psycholinguistics, 15*, 371–94.

Clay, M. (1979). *The early detection of reading difficulties: a diagnostic survey with recovery procedures.* Portsmouth, NH: Heinemann.

Cowan, N. (1997). The Development of Working Memory; In *The Development of Memory in Childhood,* ed. Nelson Cowan. Hove, East Sussex, Eng.: Psychology Press.

Cunningham, P. (2000). *Phonics They Use: Words for Reading and Writing, (3rd ed.)* New York, NY: Longman.

Cunningham, A. E., Perry, K. E., Stanovich, K. E. (2001). Converging evidence for the concept of orthographic processing; *Reading and Writing; 14, (5-6*), pp. 549-568.

Daneman, M. & Carpenter, P. (1980). Individual Differences in Working Memory and Reading. *Journal of Verbal Learning and Verbal Behavior*; 19:450 - 466.

***de Jong, P. F.** (1998). Working memory deficits of reading disabled children. *Journal of Experimental Child Psychology, 70,* 75-96.

Denckla, M. (1973).Development of speed in repetitive and successive finger movements in normal children. *Developmental Medicine and Child Neurology, 15,* 635-645.

Dickinson, D. K. and Snow, C. E. (1987). Interrelationships among pre-reading and oral language skills in kindergarteners from two social classes. *Early Childhood Research Quarterly, 2*, 1–25.

Doehring D.G.& Hoshko I.M. (1997). Classification of reading problems by the Q-technique of factor analysis. *Cortex. Sept;13 (three*):281-94.

Doehring, D.G., Trites, R., Patel, P., Feidorowicz, D. (1981) *Reading disabilities: the interaction of reading, language, and neuropsychological deficits.* New York: Academic Press.

Dowker, A. (1989). Rhyme and alliteration in poems elicited from young children; *Journal of Child Language 16:* 181-202.

Duncan, G., & Brooks-Gunn, J. (Eds.). (1997).*Consequences of growing up poor*. New York: Russell Sage.

Duncan, L. G., Seymour, P. H. K. & Hill, S. (1997). How important are rhyme and analogy in beginning reading? *Cognition, 63,* 171-208.

Dysgraphia: Information provided by the International Dyslexia Association, 2000. Just the Facts: Information provided by the **International Dyslexia Association.** *International Dyslexia Association Fact Sheet #82-01/00, 2000.*

Ehri, L. C. (1988). Movement in word reading and spelling : How spelling contributes to reading. In J. Mason (Ed.), *Reading and Writing Connections*. Newton, MA: Allyn & Bacon.

Ehri, L. C. (1997). Reconceptualizing the development of sight word reading and its relationship to recoding. In P. H. Gough, L. C. Ehri, & Treiman, (Eds.). *Reading acquisition* (pp107-143*).* Hillsdale, NJ: Lawrence Erlbaum Associates IWC.

Ezell, H. K. and Justice, L. M. (2000). Increasing the print focus of adult-child shared book reading through observational learning. *American Journal of Speech-Language Pathology, 9,* 36–47.

Ferreiro, E., & Teberosky, A. (1982). *Literacy before schooling*. Exeter, NH: Heinemann.

Fox, B., & Routh, D. K. (1974). Analysing spoken language into words, syllables and phonemes. *Journal of Psycholinguistic Research, 4*, 331-341

Gathercole, S., and Baddeley, A. (1989). Development of vocabulary in children and short-term phonological memory. *Journal of Memory and Language 28*: 200-213.

Gathercole, S. (1998). The Development of Memory. *Journal of Child Psychology and Psychiatry* 39:3 - 27.

Gerken, L., Jusczyk, W., & Mandel, D. R. (1994). When prosody fails to cue syntactic structure: 9-month-olds' sensitivity to phonological and syntactic phrases; *Cognition, 51(3):* 237-265.

Gillam, R. B. and Johnston, J. R. (1985). Development of print awareness in language-disordered preschoolers. *Journal of Speech and Hearing Research, 28*, 521–26.

Gombert, J. E. (1992). *Metalinguistic development.* Chicago: Harvester Wheatsheaf.

Goodman, Y. M. (1986). Children coming to know literacy. In Teale, W. and Sulzby, E. editors, *Emergent literacy*, Norwood, NJ: Ablex.

Goswami, U., and Bryant, P. E. (1990). *Phonological Skills and Learning to Read*. London: Erlbaum Associates.

Goswami, U. (2000). Phonological representations, reading development and dyslexia: Towards a cross linguistic theoretical framework; *Dyslexia, 6,* 133-151.

Hart, B. & Risley, T. R. (2002). *Meaningful Differences in the Everyday Experience of Young American Children.* London: Brookes Publishing Company.

Harste, J. E., Woodward, V. A., & Burke, C. L. (1984). Language stories and literacy lessons. Portsmouth, NH: Heinemann.

Hiebert, E. H. (1981). Developmental patterns and interrelationships of preschool children's print awareness. *Reading Research Quarterly ,16*, 236–60.

Hulme, C., Hatcher, P. J., Nation, K., Brown, A., Adams, J. & Stuart, G. (2002). Phonemic awareness is a better predictor of early reading skill than onset-rime awareness. *Journal of Experimental Child Psychology, 82,* 2-28.

Invernizzi, M., Meier, J. D., Swanks, L., & Juel, C. (1999). *Phonological Awareness Literacy Screening: Kindergarten.* Charlottesville: The University of Virginia.

Invernizzi, M. A., Robey, R. R. and Moon, T. R. (2000). *Virginia's early intervention reading initiative: Technical manual and report.* Charlottesville, VA: University of Virginia.

Invernizzi, M., Sullivan, A., & Meier, J. D. (2001). *Phonological Awareness Literacy Screening: Pre-Kindergarten.* Charlottesville: The University of Virginia.

Invernizzi, M., & Meier, F. (2002). *PALS: Phonological Awareness Literacy Screening.* Charlottesville, VA; University Printing Services.

Jorm, A. F. (1983). Specific reading retardation and working memory: A review. *British Journal of Psychology, 76*, 311-342.

Justice, L. M., and Ezell, H. K. (2001). Word and print awareness in four-year-old children; *Child Language Teaching and Therapy; 17*, 207-225.

Justice, L. M., Invernizzi, M. A., Meier, J. D. (2002). Designing and implementing an early literacy screening protocol: Suggestions for the Speech-Language Pathologist; *Language, Speech, and Hearing Services in Schools; 33*, 84-101.

Koppenhaver, D. A., Coleman, P. P., Kalman, S. L. and Yoder, D. E. (1991). The implications of emergent literacy research for children with developmental disabilities. *American Journal of Speech- Language Pathology (1)*, 38–44.

Liberman, I. Y., Shankweiler, D., Fischer, F. W., and Carter, B. (1974). Explicit Syllable and phoneme segmentation in the young child. *Journal of Experimental Child Psychology 18*: 202-212.

Liberman, I. Y. & Shankweiler, D. (1991). Phonology and beginning reading: A tutorial. In L. Rieben & C. A. Perfetti (Eds.), *Learning to read: Basic research and its implications* (pp. three-17). Hillsdale, NJ: Erlbaum

Lombardino, L. J., Lieberman, R. J., Brown, J. C. (2005*). Assessment of Literacy and Language* (ALL); Psychological Corporation: Harcourt Assessment Company.

Lonigan, C., Burgess, S. R., Anthony, J. L., & Barker, T. A. (1998). Development of phonological sensitivity in 2-five year old children; *Journal of Educational Psychology, 90,* 294-311.

Lonigan, C. J., Bacon, K. D., Phillips, B. M., Cantor, B. G., Anthony, J. L., & Goldstein, H. (2000). Evaluation of a computer-assisted instruction phonological sensitivity program with preschool children at-risk for reading problems. Manuscript submitted for publication.

Lonigan, C. J., Burgess. S. R., Anthony,J. L. (2000). Development of emergent literacy and early reading skills in preschool children: Evidence from a latent variable longitudinal study; *Developmental Psychology, 36,* 596-613.

Lonigan, C. J. (2006). Conceptualizing phonological processing skills in prereaders. In D. K. Dickinson & S. B. Neuman (Eds.), *Handbook of early literacy research: Volume 2 (pp. 77-89)*. New York: Guilford Press.

Luciana, M., and Nelson, C. A. (1998). The Functional Emergence of Prefrontally-Guided Working Memory Systems in Four-to Eight-Year-Old Children. *Neuropsychologia*; 36:273 - 293.

Lundberg, I., Frost, J. and Petersen, O. P. (1988). Effects of an extensive program for stimulating phonological awareness in preschool children*. Reading Research Quarterly,* 23*,* 264–84.

Lyon, G., Shaywitz, S. and Shaywitz, B., (2003). Defining Dyslexia, Comorbidity, Teachers' Knowledge of Language and Reading: A Definition of Dyslexia. *Annals of Dyslexia.*

Macmillan, M. B. (2002). Rhyme and reading: A critical review of the research methodology. *Journal of research in Reading, 25,* 4-42.

McGuinness, D. (2005). Verbal memory and reading. From *Language development and learning to read: The scientific study of how language development affects reading skill* (pp. 283- 327).

Mason, J. M., (1980). When children do begin to read: An exploration of four-year-old children's letter and word reading competencies. *Reading Research Quarterly, 15,* 203-227.

Maughan, B. (1995). Annotation: Long term outcomes of developmental reading problems. *Journal of Child Psychology and Psychiatry, 36,* 357-371

Metsala, J. L., & Walley, A. C. (1998). Spoken vocabulary growth and the segmental restructuring of lexical representations: Precursors to phonemic awareness and early reading ability. In J. L. Metsala & L. C. Ehri (Eds.), *Word recognition in beginning literacy* (pp. 89-120). Mahwah, NJ: Erlbaum.

Morias, J., Bertelson, P., Cary, J., Alegria, J. (1986). Literacy training and speech segmentation, *Cognition, 24*, 45-64.

Muter, V., Snowling, M., and Taylor, S. (1994). Orthographic analogies and phonological awareness: Their role and significance in early reading development. *Journal of Child Psychology and Psychiatry 35:* 293-310.

Muter, V., Hulme, C., Snowling, M. and Taylor, S. (1998). Segmentation, not rhyming predicts early progress in learning to read. *Journal of Experimental Child Psychology 71:* three-27.

Muter, V., & Snowling, M. (1998). Concurrent and longitudinal predictors of reading: The role of metalinguistic and short-term memory skill. *Reading Research Quarterly, 33,* 320-337.

Muter, V. (2000). Screening for early reading failure. In N. Badian (Ed.), *Prediction and Prevention of Reading Failure (pp1-30).* Timonium, MD: York Press.

National Assessment of Educational Progress (1998). *1996 reading report card for the nation and the states.* Washington, D. C.: U.S. Department of Education.

National Early Literacy Panel. (2004, November). *The National Early Literacy Panel: A research synthesis on early literacy development.* Paper presented at the annual meeting of the National Association of Early Childhood Specialists/SDE, Anaheim, CA.

Newton, D. R. & Rudestam, K. E. (1999). Traditional approaches to statistical analysis and the logic of statistical inference; In *Your Statistical Consultant: Answers to your data analysis questions;* pp. 37-8; Sage Publications, Inc.; California 91320.

Newton, D. R. & Rudestam, K. E. (1999). *Your Statistical Consultant: Answers to your data analysis questions;* pp.53-65 ; Sage Publications, Inc.; California 91320.

Newton, D. R. & Rudestam, K. E. (1999). *Your Statistical Consultant: Answers to your data analysis questions;* pp.53-65 ; Sage Publications, Inc.; California 91320.

Nicolson, R. I., & Fawcett, A. J. (1996). Dyslexia Early Screening Test. London: Psychological Corporation.

Ninio, A., & Snow, C. E. (1996). *Pragmatic Development;* Boulder, CO: Westview.

Patterson, K., & Coltheart, V. (1987). Phonological processes in reading: A tutorial review, In M. Coltheart (Ed.), *Attention and Performance XII* (pp. 421-447). Hillsdale, NJ: Erbaum.

Perfetti, C. A., Beck, I., Bell,L., Hughes, C. (1987). Phonemic knowledge and learning to read is reciprocal: A longitudinal study of 1st grade children; *Merrill-Palmer Quarterly (33)(three),* 283-319.

Peterson, R. W. (1994). School readiness considered from a neuro-cognitive perspective; *Early Education and Development,* 5 *(2);* 120-140.

Pratt, C., Tunmer, W. E., Bowey, J. A. (1984). Children's capacity to correct grammatical violations in sentences; *Journal of Child Language, 11(2),* 129-141.

Rack, D. K., Hulme, C., Snowling, M. F., & Wightman, J. (1994). The role of phonology in young children learning to read words: The direct-mapping hypothesis. *Journal of Experimental Child Psychology, 57,* 42-71.

Read, C., Zhang, Y., Nie, A., & Ding, B. (1986). The ability to manipulate speech sounds depends on knowing alphabetic spelling. *Cognition, 24,* 31-44.

Reid, D. K., Hresko, W. P., & Hammill, D. D. (1989). *Test of Early Reading Ability (2nd ed.).* Austin, TX: Pro-Ed.

Rescorla, L. R. (1999, July). *Outcomes of late talkers: Academic and language skills at age 13.* Paper presented at the meeting of International Association for the Study of Child Language, San Sebastian, Spain.

Saint-Laurent, L., Giasson, J. and Couture, C. (1998). Emergent literacy and intellectual disabilities. *Journal of Early Intervention, 21*, 267–81.

Satz. P., Friel, J., Goebel, R. (1975). Some predictive antecedents of specific reading disability: A three-year follow-up. *Annals of Dyslexia; Vol. 25, (1)*; pp. 91-10.

Scarborough, H. S., & Dobrich W. (1994). Early syntactic development of dyslexic children. *Developmental Review, 14,* 245-302.

Scarborough, H. S. (1998). Early identification of children at risk for reading disabilities: Phonological awareness and some other promising predictors. In *Specific Reading Disability: A View of the Spectrum*, B. K. Shapiro, P. J. Accardo, and A. H. Capute, (Eds.), Timonium, MD: York Press.

Scarborough, H. S. (2001). Connecting early language and literacy to later reading (dis)abilties. In S. B. Neuman & D. K. Dickinson (Eds.), *Handbook of early literacy research (pp. 97-110).* New York: Guilford Press.

Share, D. L. (1995). (1995). Phonological recoding and self-teaching: Sine qua non of reading acquisition. *Cognition, 55*: 151-218.

Shaywitz, S. (2003). *Overcoming Dyslexia*. Knopf, Borzoi Books.

Snow, C. (1983). Literacy and language: Relationships during the preschool years. *Harvard Educational Review, 53,* 165–89.

Snow, C. E., Burns, M. S., and Griffin, P. (Eds.), (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academy Press.

Snowling, M. J. (1981). Phonemic deficits in developmental dyslexia. *Psychological Research, 43,* 219-234.

Snowling, M., Chiat, S., and Hulme, C. (1991). Words, nonwords and phonological processes: Some comments on Gathercole, Ellis, Emslie & Baddeley. *Applied Psycholinguistics 112*: 369-373

Snowling, M. F., Hulme, C., Smith, A., & Thomas, J. (1994). The effects of phonemic similarity and list length on children's sound categorization performance; *Journal of Experimental Child Psychology, 58*, 160-180.

Stahl, S. A., & Murray, B. A. (1998). Issues involved in defining phonological awareness and its relation to early reading. In J. Metsala & K, C, Ehri (Eds.), *Word recognition in beginning literacy* (pp. 65-88). Mahwah, NJ: Erlbaum.

Stanovich, K. E. (1984). The interactive-compensatory model of reading: A confluence of developmental experimental and educational psychology; *Remedial and Special Education; five;* 11-19.

Stanovich, K. E. (1991). The psychology of reading: Evolutionary and revolutionary developments. *Annual Review of Applied Linguistics, 12*, 3-30.

Stanovich, K. E. (1992). "Are we overselling literacy?" In C. Temple & P. Collins (eds.) *Stories and Readers: New perspective on literacy in the elementary classroom,* Norwood, MA. Christopher-Gordon, pp. 209-31.

Stanovich, K. E. (1992). Speculations on the causes and consequences of individual differences in early reading acquisition. In P. B. Gough, L. C. Ehri, & Treiman (Eds.), *Reading acquisition* (pp. 307=342), Hillsdale, NJ: Erlbaum.

Stuart, M. (1995). Prediction and qualitative assessment of five- and six- year old children's reading: a longitudinal study. *British Journal of Educational Psychology, 65*, 287–96.

Sulzby, E. & Teale, W. H. (1991). *Emergent Literacy*; pp. 727-757 in *Handbook of Reading Research, Vol. 2;* Barr, M. L., Kamie, P., Masenthal, & P. D. Pearson, eds.; New York: Longman.

Sulzby, E. (1986). Writing and reading: Signs of oral and written language organization in the young child. In W. H. Teale & E. Sulzby (Eds.) *Emergent literacy: Reading and writing* (pp. 50-87). Norwood, NJ: Ablex.

Swan, D. & Goswami, U. (1997). Phonological awareness deficits in developmental dyslexia and the phonological representations hypothesis. *Journal of Experimental Child Psychology, 66,* 18-41.

Swanson, H. L., Zheng, X., Jerman, O. (2009). Working memory, short-term memory, and reading disabilities: A selective meta-analysis of the literature. *Journal of Learning Disabilities, (42)3,* 260-287.

Teale, W. H., & Sulzby, E. (1986). *Emergent literacy*. Norwood, NJ: Ablex.

Tolchinsky, L., and Teberosky, A. (1998). The development of word segmentation and writing in two scripts. *Cognitive Development, 13*, 1-21.

Torgeson, J. K., & Davis, C. (1996). Individual difference variables that predict response to training in phonological awareness; *Journal of Experimental Child Psychology, 63,* 1-21.

Torgeson, J. K., Alexander, A., W., Wagner, R. K., Rashotte, C. A., Voeller, K. S., & Conway, T. (2001). Intensive remedial instruction for children with severe reading disabilities: Immediate and long-term outcomes from two instructional approaches. *Journal of Learning Disabilities, 34,* 33-58.

Torgesen, J., Wagner, R.; Rashotte, Carol; Rose, E., Lindamood, P.; Conway, T.; Garvan, C.; (2007). Preventing Reading Failure in Young Children with Phonological Processing Disabilities: Group and Individual Responses to Instruction; *Journal of Education Psychology*, In Press.

Treiman, R. & Zukowski, A. (1991). Levels of phonological awareness. In S. Bradey & D. Schankweiler (Eds.) *Phonolgical processes in literacy.* Hillsdale, NJ: Lawrence Erlbaum.

Tunmer, W. E., Bowey, J. A. and Grieve, R. (1983). The development of young children's awareness of the word as a unit of spoken language. *Journal of Psycholinguistic Research, 12,* 567–94.

Troia, G. A. (1999). Phonological awareness intervention research methodology. *Reading Research Quarterly, 34,* 28-52.

Troia, G. A. (2004). Phonological processing and its influence on literacy learning; In *Handbook of Language and Literacy, pp. 271- 301;* Stone, C. A., Silliman, E. R., Ehren, B. J., Apel, K., (Eds.), New York: Guilford Press.

Vellutino, F. R., & Scanlon, D. M. (1991). The preeminence of phonologically based skills in learning to read. In S. A. Brady & D. P. Shankweiler (Eds.), *Phonological processes in literacy: A tribute to Isabelle Y. Liberman*) pp. 237-252. Hillsdale, NJ: Erlbaum.

Vernon-Feagans, L., Hammer, C. S., Miccio, A., & Manlove, E. (2001). Early language and literacy skills in low-income African American and Hispanic children. In S. B. Neuman & D. K. Dickinson (Eds.), *Handbook of early literacy research (pp. 192-210).* New York: Guilford Press.

Wagner, R. K. & Torgesen, J. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin, 101*, 192-212.

Wagner, R. K., Torgesen, J. K., and Rashotte, C. A. (1994). The development of reading- related phonological processing abilities: New evidence of bidirectional causality from a latent variable longitudinal study. *Developmental Psychology 30:* 73-87.

Wagner, R. K., Torgeson, J. K., Rashotte, C. A., Hecht, S. A., Barker, T. A., Burgess, S. R., Donahue, J., and Garon, R. (1997). Changing relations between phonological processing abilities and word-level reading as children develop from beginning to skilled readers: A five-year longitudinal study. *Developmental Psychology. 33;* 468-479.

Wagner, R., Torgeson, J. & Rashotte, R. (1999). *Comprehensive Test of Phonological Processing (CTOPP)*; Pearson: PsychCorp.

Walley, A. C. (1993). The role of vocabulary development in children's spoken word recognition and segmentation ability. Special Issue: Phonological Processes and Learning Disability; *Developmental Review, 13 (three):* 286-310.

Wechsler Intelligence Scale for Children; D Wechsler (1995); Psychological Corporation; Harcourt Brace & Company.

Whitehurst, G., Lonigan, C. (1998). Child Development and Emergent Literacy; *Child Development*; Vol. 69, No. three; June 1998; pp. 848-872.

Whitehurst, G., Lonigan, C. (2001). Emergent literacy: Development from prereaders to readers; In S. B. Neuman and D. K. Dickinson (Eds.), *Handbook of Early Literacy Research: Volume 1;* pp. 11-42. The Guilford Press, New York.

Yopp, H. K. (1988). The validity and reliability of phonemic awareness tests. *Reading Research Quarterly, 23*, 159-177.

Yopp, H. K. & Yopp, R. H. (2000). Supporting phonemic awareness development in the classroom. Reading Teacher, 54 (2), 130-143.

BIOGRAPHICAL SKETCH

Sue Ann Eidson was awarded her doctoral degree from the University of Florida Department of Communicative Sciences and Disorders in the spring of 2010. Over the course of thirty-five years of clinical practice her research interests lie in the diagnosis and treatment of acquired alexia, developmental dyslexia, and Hispanic persons with these diagnoses, diagnosis and treatment of Spoken and Written Language Disabilities, assessment and treatment of Developmental Dyslexia; Working Memory in the young child and its influence on the acquisition of reading, writing and the acquisition, assessment, and intervention for English Language Learners (Hispanic) with reading, writing and language problems.

She has also taught and supervised graduate students at the University of Florida and the University of Central Florida in the area of Communication Sciences and Disorders.

After graduating, she plans on carrying on her research at a university with more bilingual and low socioeconomic preschool students in the area of reading disability prediction and characteristics in the young child and focusing more on the underlying constructs of emergent literacy and emergent writing.