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GENDER DIFFERENCES IN READING PERFORMANCE ON DIBELS
READING PROBES, KINDERGARTEN THROUGH FIFTH GRADE IN A
RURAL SCHOOL DISTRICT

A Dissertation
Presented for the
Doctor of Philosophy
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Jaime Lynn Below
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Dedication

This work is dedicated to my family. I want to thank my parents for their encouragement and constant reassurance that I am capable of accomplishing any goal. Mom and dad, I cannot thank you enough for your continuous sacrifices. To my husband Zach, who knew that I would be in school for the first 4 years of our marriage and chose to marry me anyway. Without your infinite patience and sacrifice this project would never have been completed.

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Abstract

In order to determine when and where reading skill differences between males and females emerge, the performance of 1,332 students from a rural school district in East Tennessee was evaluated on five reading measures from the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) across kindergarten through fifth grade. Students were administered Initial Sound Fluency (ISF), Letter Naming Fluency (LNF), Phoneme Segmentation Fluency (PSF), Nonsense Word Fluency (NWF), and Oral Reading Fluency (ORF) measures based on the DIBELS administration schedule.

A two-way repeated measures ANOVA with time of year (fall, winter, spring) serving as the within-subjects variable and gender (male, female) serving as the between-subjects variable was conducted at each grade level for each measure administered. However, in first grade, LNF was only administered at one time (fall). For this measure, an independent t-test was conducted. Significant differences were found in favor of females for all measures administered in kindergarten (ISF, LNF, PSF, NWF). Differences decreased to nonsignificance in first grade for LNF and NWF. While a significant female advantage persisted through first grade for PSF, the effect size decreased. For ORF, a significant female advantage did not emerge until third grade. This difference persisted through fourth grade, but decreased to nonsignificance in fifth grade. Discussion focuses on implications of these findings, limitations of the study, and directions for future research. Particular emphasis is placed on the implications of the findings regarding physiological-maturational and cultural-societal theories of gender differences in reading.

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Chapter I

Literature Review

Nearly a century ago, Ayers (1909) expressed concern over a male deficit in reading achievement as well as a preponderance of males with reading problems in city school systems. Since then, these gender disproportions have been noted in the identification of reading disability (RD) and special education eligibility, with significantly more males being identified (Berger, Yule, & Rutter, 1975; Coutinho & Oswald, 2005; Flannery, Liederman, Daly, & Schultz, 2000; Lovell, Shapton, & Warren, 1964; Wehmeyer & Schwartz, 2001). These differences have also been found in national and international studies (Klecker, 2006; OECD, 2000; University of Minnesota, 2002), as well as in studies measuring more specific early reading skills (Camarata & Woodcock, 2006; Chatterji, 2006; Gates, 1961).

Preponderance of Males with Reading Disability

Even researchers who controlled for ascertainment bias when identifying children with RD by using unbiased and objective measures have found evidence of a male vulnerability. For example, in their study of 2,669 children, ages 7-10 years, Lovell, Shapton, and Warren (1964) used a reading quotient of $<.80$ on the NFER Sentence Reading Test to qualify students as RD. Their study included students from 22 junior schools in England and found a gender ratio of 3.07:1 among 7-8 year old students and 6.78:1 among 9-10 year olds with males being diagnosed with RD much more than their female peers.

Similarly, in their study of 2,802 10-year olds pooled from two large British

surveys, Berger, Yule, and Rutter (1975) found a male vulnerability. The first sample of children (1,660) was identified through the 1970 Inner London Boroughs Survey of Students and the second sample (1,142) was identified through the 1964 Isle of Wight Survey. Each student was individually administered tests of reading accuracy or comprehension. Those scoring two or more standard deviations below their IQ-predicted score or 30 months below their age-expected score were diagnosed as having RD. The study found male to female gender ratios of 3.6:1 and 3.3:1 respectively.

Perhaps the most notable study based on sample size and psychometric rigor was conducted by Flannery, Liederman, Daly, and Schultz (2000). They found a male vulnerability for RD in their study of 32,223 six- to seven-year old children taken from the National Collaborative Perinatal Project (NCPP). Those students who scored 1.5 standard errors of prediction below what was expected based upon their IQ were classified as RD. The study found that 947 males qualified for RD whereas only 463 females qualified based on those standards. This was equivalent to a gender ratio of 2.04:1. Further, to test the hypothesis that the male vulnerability discovered in the study was merely an artifact of statistical bias, the investigators performed a 2 X 3 ANOVA to evaluate the effects of sex and three reading disability categories (none, moderate, and severe) on Full-Scale IQ scores. Tests of the main effect, disability category, were insignificant, suggesting that the results were not confounded by sex differences in IQ scores. In addition, research on gender differences in reading has continued to document a male deficit in reading, at many grade levels, as measured

by standardized measures.

Male Deficits in Reading on Standardized Achievement Tests

One study compared scores in reading for 367,188 eighth-grade students taking the Minnesota Basic Skills Test from 1996 through 2001 (University of Minnesota, 2002). The study found gender differences in reading favoring females for each year included in the study. In addition, the effect size of .17 remained relatively constant from 1996-2001, indicating that the gender gap in reading was not decreasing. While an effect size of .17 is considered small, other nationally representative studies have consistently documented a larger gender difference favoring females.

Since 1969, the National Assessment of Educational Progress (NAEP) has been the only nationally representative and continuing assessment of American students' performance in various subjects. Klecker (2006) performed a secondary analysis of the NAEP data from 1992 to 2003. Klecker tested for gender differences in students' performance on the reading comprehension measure from the sample of students in grades 4, 8, and 12. Females outperformed males every year at all three grade levels. In fourth grade, effect sizes ranged from .13 to .27. In eighth grade the effect sizes were slightly larger, ranging from .27 to .43. In 12th grade effect sizes were similar, ranging from .22 to .44. This study provides evidence for a male deficit in reading performance in the United States. However, this male deficiency has been documented in international samples as well.

The Organization for Economic Cooperation and Development (OECD) is a

collaborative effort among 32 member countries that seeks to assess how well students are prepared to meet the challenges of society in the areas of reading, math, and science. In 2000, The OECD's Program for International Student Assessment (PISA) collected data on 250,000 15 year-old students representing 32 countries. The study assessed reading skills, including students' ability to a) retrieve information, b) interpret different kinds of texts, and c) relate information from text to prior knowledge and experiences. The study found females outperformed males in all 32 countries with an average difference of 32 points (OECD, 2000).

Many researchers have documented a male deficiency in reading. However, in each of these studies, researchers have measured reading broadly, not allowing for analysis of the specific early reading skills that have recently been shown to build upon one another as well as predict later reading achievement scores (Badian, 2001; Rudisill, 1957; Tannenbaum, Torgesen, & Wagner, 2006; Wood, Hill, Meyer, & Flowers, 2005).

The Development of Reading

Growing neurological and cognitive research supports the idea that proficient reading is the result of a hierarchical process of skill development. Thus, skills developed early affect later reading skills development (Adams, 1990; Denton & West, 2002; Johnston, Anderson, & Holligan, 1996; NICHD, 2000; Pugh et al., 2001; Shanahan, 2005).

Pugh et al. (2001) proposed that typical reading development begins with the temporo-parietal circuit of the brain. This area is responsible for auditory-sensory

memory and is critical in the development of phonological, orthographic, and decoding skills. Based on their review of neuroimaging studies, Pugh et al. (2001) concluded that these skills pave the way for later development of word recognition, which is facilitated by the occipito-temporal region of the brain. This hypothesis that reading development begins with auditory processing is supported by research on the cognitive underpinnings of reading done by the National Reading Panel (NRP, National Institute of Child Health and Human Development or NICHD, 2000)

The NRP, a group commissioned by the United States Congress in 1997 to review and report on the scientific literature on reading instruction, screened over 10,000 studies, and published a report in 2000 citing findings in five primary areas of reading; phonemic awareness, phonics, fluency, vocabulary, and comprehension. Orthographic processing, an area not addressed by the NRP, has been added to this discussion because there is evidence that it influences and predicts later reading achievement.

Phonological Awareness. Phonological awareness, a broad concept encompassing phonemic awareness and the awareness of syllables and rhyme, refers to a child's ability to hear and manipulate individual sounds (not letters) within words. In his summary of the NRP report, Shanahan (2005) outlined the development of reading. Shanahan concluded that these phonological awareness skills should be the first to develop and be fostered in the classroom. Shanahan specifically recommended that phonological awareness (e.g., phonemic awareness, syllables, and rhyme) skills be taught before or early on in phonics instruction so that children can

achieve maximum growth.

In a study supporting the role of phonemic awareness in reading, Wood, Hill, Meyer, and Flowers (2005), administered the Phonemic Awareness Cluster (PAC, Stanovich, Cunningham, & Cramer, 1984) and the Lindamood Auditory Conceptualization Test (LAC, Lindamood & Lindamood, 1979) to 220 first-grade students. Scores on both tests were combined to yield the total phonemic awareness score. The purpose of the study was to see how well phonemic awareness could predict students' Woodcock-Johnson Broad Reading Standard Score (WJ, Woodcock & Woodcock, 1977) in first, third, and eighth grade. Multiple regression analyses revealed that phonemic awareness accounted for 88% of the variance on WJ scores in first, third, and eighth grade. Additionally, phonemic awareness had a sensitivity of 93.0, 84.8, and 80.0 for predicting which students would score in the bottom 15% in first, third, and eighth grade respectively.

Phonics. Phonics instruction involves teaching students the correspondence between letters and their sounds in order to successfully translate printed text into pronunciation (Shanahan, 2005). The NRP evaluated 38 studies in which students' instruction had a specific emphasis on phonics. The NRP concluded that systematic phonics instruction increased the speed with which children learned to read relative to those programs using responsive instruction (instruction that places more emphasis on developing fluency and comprehension with familiar texts) or no instruction in phonics (NICHD, 2000).

Rudisill (1957) conducted a study of the intercorrelations between functional

phonic knowledge, reading achievement, spelling achievement, and mental age among 315 children in third grade. Researchers measured phonics ability using a 144 item, nonsense-word reading inventory and correlated performance on the inventory to performance on the Stanford Achievement Test, Primary Reading, Form D. Rudisill found a correlation between phonics and reading of .72 and concluded that phonics skill development contributes a great deal to reading achievement.

Orthographic Processing. Orthography is the system of printed symbols that represent a spoken language (Wagner & Barker, 1994). Orthographic processing refers to a student's ability to identify letters in isolation, in words, or in text (Schumm, 2006). This type of processing involves the use of visual memory and visual representations to correctly spell nonphonetic words. According to Rego (2006), being able to identify letters fluently paves the way for more complex skills such as word recognition and reading comprehension. Although Orthographic Processing was not included in the NRP report, there is ample evidence suggesting that the development of letter naming skills has a great impact on later reading achievement. For example, in a series of reports on 22,000 children in kindergarten and first grade, researchers found that children who scored higher in letter identification tasks (i.e., being able to point to and verbally call-out letter names) at the time of entry performed better at the end of kindergarten and beginning of first grade on tasks involving phonological processing and sight word reading than their less skillful peers (Denton & West, 2002; West, Denton, & Germino-Hausken, 2000).

Badian (2001) administered orthographic processing and phonological

awareness measures to 96 preschoolers and examined the power of the measures to predict reading at first, third, and seventh grade. Badian found that the orthographic measure contributed significant variance to word reading in first grade as well as vocabulary and reading comprehension in third and seventh grade.

Fluency. “Oral reading fluency is the ability to read text aloud with accuracy, speed, and proper expression” (Shanahan, 2005, p. 18). The NRP examined 51 studies of oral reading fluency and concluded that there was substantial evidence that instruction in reading fluency had a positive effect on students’ decoding, word recognition, silent-reading comprehension, and overall reading achievement (NICHD, 2000). Reading fluency increases comprehension by allowing a student to think about entire phrases at once, thereby freeing up their active attention for the process of comprehension (Adams, 1990).

In their study of the role of CBM oral reading fluency in the reading process, Shinn, Good, Knutson, Tilly, and Collins (1992) examined several models of reading using confirmatory factor analysis procedures. In the study 114 third- and 124 fifth-grade students were tested on tasks of decoding, literal comprehension, inferential comprehension, cloze items, written retell, and CBM oral reading fluency. They found that regardless of the factor model employed, CBM oral reading fluency provided a good index of reading proficiency, including comprehension.

Vocabulary. Shannahan (2005) defines vocabulary as a student’s knowledge of word meaning and suggested that the importance of vocabulary can be evidenced by the fact that vocabulary is often a component used in measuring general

intelligence on many cognitive intelligence tests. In their review of 45 studies on the impact of vocabulary instruction, the NRP found that vocabulary instruction improved reading achievement as measured by tests of comprehension.

In a study of 203 third-grade students, researchers studied the relationship between word knowledge and reading comprehension (Tannenbaum, Torgesen, & Wagner, 2006). Hierarchical regression analyses indicated a correlation of .70 between breadth of word knowledge and reading comprehension.

Comprehension. Shannahan (2005) defines comprehension as the act of understanding and interpreting information within text. Anderson, Hiebert, Scott, and Wilkinson (1985) describe it as a holistic act that relies on several factors, including the background of the reader, the purpose for reading, and the context within which reading occurs. In addition, reading comprehension is influenced by the previously developed skills of the reader as evidenced by the studies previously cited (Adams, 1990; Rudisill 1957; Tannenbaum, Torgesen, & Wagner, 2006). This research provides evidence that reading skills acquired early on impact the development of later skills. For this reason, knowing which skills show the largest gender differences may assist educators in providing early intervention in those areas so that subsequent skill development is not affected.

Male Deficits in Specific Early Reading Skills

Because of the hierarchical nature of reading, identifying both when (student grade level) and on which specific reading skills these deficits emerge may have instructional implications (e.g., alter procedures designed to enhance males' specific

skills at specific grade levels) as well as theoretical implications. While fewer studies have focused on gender differences in these specific early reading skills, the studies that have been done also documented a female advantage in reading.

One of the first notable studies documenting a female superiority in reading was done by Gates (1961). In reference to the six critical areas of reading previously discussed, Gates examined fluency, vocabulary, and comprehension. This landmark study measured the performance of 13,114 students in second through eighth grade on the three Gates reading survey tests: Speed of Reading, Reading Vocabulary, and Level of Comprehension. The seven grades were then analyzed on each of the three reading measures yielding a total of 21 comparisons. Gates found a female superiority in mean scores at every grade level on each measure of reading performance. In addition, 18 of the 21 comparisons yielded significant female advantages. Looking at differences across grade levels, gender differences in fluency and vocabulary measures seemed to show a slight increase as grade level increased. Gender differences in comprehension seemed to remain constant as grade level increased. Looking at the size of differences across skills, gender differences seemed to be the greatest in vocabulary, followed by speed, and then comprehension.

Chatterji (2006) conducted a study of 2,296 kindergarten and first-grade students taken from the Early Childhood Longitudinal Study (ECLS), and found that males performed below females on tests of print familiarity, letter recognition, beginning and ending sounds, rhyming sounds, word recognition, receptive vocabulary (e.g., point to the picture of a cat), listening comprehension, and

comprehension of words in context. Additionally, the size of the male deficit increased from $-.17SD$ units below females at kindergarten entry to $-.31SD$ units below females at the end of first grade. While this study does provide evidence for a male deficit on measures of orthographic processing (letter recognition), phonemic awareness (beginning and ending sounds, rhyming sounds), vocabulary (receptive vocabulary), and comprehension, the scores were combined into an overall reading score and therefore differences in each skill were not distinguished. In addition, while these results provide evidence that gender differences are present when children enter school and become greater by the first grade, it did not evaluate children in higher grade levels to see if this pattern changes significantly over time.

Another recent study found growing gender differences across a wide age group of students, but measured a limited number of skills. Camarata and Woodcock (2006) compared the performance of 1,102 females and 885 males ages preschool through adulthood on selected measures of cognitive ability and achievement using the Woodcock Johnson Psycho-Educational Battery- Revised (Woodcock & Johnson, 1989). The results showed that males scored significantly lower on subtests measuring reading and writing fluency. These differences increased through adolescence and dropped off at young adulthood. While this study documents a female advantage that increases from preschool through adolescence, it only provides a measure of one early reading skill previously discussed (i.e., reading fluency). In addition, the study measured reading performance using a standardized, norm-referenced test. These tests can not be administered weekly in the same way that

CBM measures can. Therefore, there is no way to examine differences at several times throughout the school year.

Results of multiple studies suggest that gender differences are present when children enter school and increase or at least remain constant through adolescence, dropping off at young adulthood. While Gates (1961) found the size of the gender differences to be the greatest in vocabulary, followed by fluency, and then comprehension, the other studies did not examine which skills show the greatest gender differences. Chatterji (2006) did not examine the skills individually, and Camarata and Woodcock (2006) only examined one early literacy skill. Therefore, more research is needed to address the question of when differences emerge and the nature of these differences (e.g., patterns of strengths/weaknesses). While the current study does not include a measure of vocabulary or comprehension, it adds a measure of orthographic processing which has not been addressed separately by previous studies. In addition, the current study includes two measures of phonemic awareness (initial sound fluency, phoneme segmentation fluency). These analyses will allow for a more specific examination of this facet of reading.

Theories

There are many hypotheses about the etiology of the male vulnerability in reading. Holbrook (1988) examined the sources of sex differences in reading and concluded that the causes could be broken down into two groups. She named these two categories physiological-maturational and cultural-societal.

Physiological-Maturational. An innate weakness may be the source of the

male deficit in reading. Researchers examining neurological development have found evidence for several sex differences. Some found evidence that differences in sensory processing may cause a male vulnerability (Naour, 2001; Witelson, 1976).

Researchers suggest that the brain uses two different strategies for processing sensory information; sequential processing and simultaneous processing (Das, Kirby, & Jarman, 1979). Sequential processing is more closely associated with the auditory system and refers to the ability to process information in sequence. A child's ability to comprehend language depends on their ability to sequentially store information. Simultaneous processing is more closely associated with the visual system and refers to the ability to integrate parts of information into a meaningful whole. Researchers investigating these two types of processing has found that males tend to perform better on tasks requiring simultaneous (visual) processing relative to tasks involving sequential (auditory) processing (Naour, 2001; Witelson, 1976). Aaron (1982) suggests that deficits in sequential processing often result in an inability to utilize phonetic decoding in reading, therefore, impairing students' ability to perform sequentially oriented word attack skills, which are critical to skillful reading. Thus, if males are more likely to have difficulty with sequential processing, they would be more likely to experience reading difficulty.

Waber (1979) suggests that differences in neural maturation may be the source of processing differences. He posits that learning disabilities are related to excessive delays in the development of the left hemisphere. Geschwind and Behan's (1982) theory of development proposes that increased levels of fetal testosterone in

males (the testes produce additional in utero testosterone) may lead to delays in the development of the left hemisphere. These delays would result in a more common right brain (visual-spatial, simultaneous) dominance in males and make them less capable of performing left brain skills (auditory, sequential, language). Thus, a male deficiency in sequential processing ability may cause their poorer performance in reading.

In a study of 2,200 boys and girls, Naglieri and Rojahn (2001) found support for this theory, but added planning and attention as two other cognitive abilities that may account for a female advantage. They proposed the PASS theory, built on the work of Luria (1973), in which planning, attention, simultaneous, and successive (sequential) cognitive-processing are used as a way to analyze gender differences. Using measures from the Cognitive Assessment System, they found that females outperformed males on the Planning ($p < .001$), Attention ($p < .001$), and Successive ($p < .05$) scales. While males did not perform significantly better on the Simultaneous scale, it was the only scale in which a significant female advantage was not found. These findings support the theory that females are more likely to excel at tasks requiring successive (auditory) processing, but also adds planning and attention as areas in which females hold an advantage. This is important when examining differences in reading as Naglieri and Das (1997a) found those cognitive abilities to be influential in reading comprehension. Other theories posit that the noted gender differences in reading are the result of environmental causes. These theories can be categorized as cultural-societal theories.

Cultural-Societal. One cultural-societal theory is the differential response theory. This hypothesis is based on the assumption that teacher behavior towards students is influenced by both the behavior of a particular student, as well as the teacher's assumptions about what that student usually does or is likely to do. In the case of reading, this hypothesis would suggest that because research supports a female advantage in reading, teachers may hold higher expectations for females that turn into self-fulfilling prophecy (Bank, Biddle, & Good, 1980).

Leinhardt, Seewald, and Engel (1979) explored the self-fulfilling prophecy hypothesis by investigating the assumption that boys tend to score better in math and girls tend to perform better in reading by coding teacher interactions with second-grade students during reading and mathematics instruction. Teachers (n=33) were videotaped during reading and math instruction. Teacher-student interactions were coded according to frequency, content, and time. Reading and mathematics achievement measures were taken in the fall and spring of the school year. Results indicated that teachers made more academic contacts with girls during reading instruction and with boys during math instruction. Teachers also spent more cognitive or instructional time with girls in reading and with boys in math. Although there were no significant differences in initial scores in math and reading, differences favoring females were found in students' end of the year reading achievement scores.

The interest/motivation theory also falls under the cultural/societal category. This theory proposes that the reading environment males encounter upon entering school does not match their interests and thus is the underlying cause for their

disadvantage. Researchers have suggested that general and remedial educators fail to take into account boys' interests when designing curriculum and choosing texts and therefore leave males unmotivated to read (Brozo, 2002; Millard, 1997).

According to research, when students' interests are met and they are motivated to learn they, in turn, process the material at a deeper level. Wigfield and Guthrie (1997) studied whether fourth- and fifth-grade students' motivation for reading would affect the breadth of their reading and the amount of reading they engaged in. Students were administered a measure of reading motivation, a survey indicating how many hours a week they engaged in reading, and a measure of the breadth of information they remembered about what they read. Results from the study indicated that children's reading motivation predicted the amount of reading as well as their breadth of reading.

Paris and Turner's (1995) research on student motivation found that *choice* of text and *control* over learning are two factors critical to producing motivated students. However, choice and control are two ingredients often missing in school-based instruction (Brozo, 2002). For example, Herz and Gallo (1996) found that boys are particularly interested in nonfiction and informational books. However, nonfiction reading in school is often limited to text books, which have been noted as a primary cause for dissatisfaction in reading among both boys and girls (Clary, 2001). Similarly, Coles and Hall (2001) found that boys prefer magazines that contain facts over more narrative reading. When these preferences are not taken into account, males' motivation toward school-based reading is affected (Coles & Hall, 2001).

Researchers have found that this lack of motivation for reading ultimately generalizes to reading done outside of school. For example, Libsch and Breslow (1996) found that females were significantly more likely than males to read between one and five unassigned books per year. Similarly, in their survey of 100 sixth and 100 ninth-grade students, Nippold, Duthie, and Larson (2005) found that males were significantly more likely to report that they spent no time reading for pleasure. This is particularly alarming because reading achievement has been found to be a function of the amount of time and energy students invest in reading activities in and out of school (Cipielewski & Stanovich, 1992). In their study of the relationship between print exposure and children's reading comprehension, they found that the reading growth of third- through fifth-grade students was significantly related to the amount of exposure to print as measured by students' ability to correctly identify titles of books and authors of books. Examinations of the patterns of gender differences in the current study may provide support for the theories discussed.

The Current Experiment

The current study is designed to test for gender differences on the Dynamic Indicators of Basic Early Literacy Skills (DIBELS) probes measuring four of the six early reading skills found to be critical in the development of reading (ie., phonemic awareness, phonics, orthographic processing, and fluency). This study addresses gaps in the past research by examining grade levels as well as specific skills in which gender differences were most salient. In addition, reading performance will be examined using curriculum-based measures (CBM) of early reading skills. CBM

measures are dynamic in nature, meaning they were designed for frequent administrations and to be sensitive to short term effects of instruction. Using CBM, educators can repeatedly assess students' skill development using curricula or pre-developed generic materials (i.e., probes consisting of multiple passages). Monitoring student progress can quickly inform educators whether or not instruction is impacting reading skills. Several studies have found that reading CBM is sensitive enough to detect even small changes in reading development (e.g., Daly & Martens, 1994; Daly, Martens, Dool, & Hintze, 1998; Skinner, Cooper, & Cole, 1997; Skinner, Logan, Robinson, & Robinson, 1997; Skinner, Satcher, Bamberg, Walters-Kemp, Brandt, & Robinson, 1995). For the current study, these repeated, sensitive assessments will allow investigators to look for specific patterns in performance that could not be detected using standardized, norm-referenced assessments. For example, do students enter school with commensurate skill levels or does instruction play a role in gender differences?

Research questions. The study addressed the following questions related to the differential performance of kindergarten through fifth-grade males and females on early reading probes of phonemic awareness, phonics, orthographic processing, and fluency.

1. Will a female advantage in reading be replicated in the current study?
2. On which early reading skills (e.g., phonemic awareness initial sound, phonemic awareness phoneme segmentation, phonics, orthographic processing, or fluency) are gender differences found?

3. Is there a pattern of onset for gender differences?

Conceptual hypotheses. The previous research in the domain of gender differences in reading point to the following directional hypotheses.

1. A female advantage will be found in the current sample.
2. Cognitive researchers have found evidence for a female advantage in auditory (sequential) processing. If this is true, there will be a greater female advantage on the probes measuring phonological awareness (i.e., Initial Sound Fluency, Phoneme Segmentation Fluency) than those measuring orthographic processing (i.e., Letter Naming Fluency)
3. Previous findings suggest that gender differences are present when children enter school and increase until young adulthood. This would point to the finding that females will show better performance in kindergarten and this gender difference will increase through grade 5.

Chapter II

Method

Participants

Participants in this study included 1,332 general and special education students in kindergarten through fifth grade representing three elementary schools in a rural east Tennessee school district. Participants included 662 females (49.7%) and 670 males (50.3%). The number of participants varied from fall, winter, and spring benchmark assessments. Depending upon the specific DIBELS measure, the kindergarten sample ranged from 74-160 males and 61-136 females. In first grade the sample ranged from 74-159 males and 86-152 females. The second-grade sample ranged from 71-73 males and 73-75 females. The third-grade sample ranged from 132-140 males and 149-158 females. The fourth-grade sample consisted of 97-105 males and 109-116 females. The fifth-grade sample included 100-103 males and 88-90 females. While race information was not available for the participants in the current study, 95% of the students in the school district are white, 2.4% are Hispanic, 1.7% are African-American, and less than 1% are Asian or Native American.

Description of Measures

Initial Sound Fluency (ISF) is a standardized, individually administered measure of phonological awareness. It measures a child's ability to recognize the initial sound in a word that is orally presented by the examiner. The test takes approximately 3 minutes to administer, and the score is then calculated to reflect the number of sounds correctly identified in 1 minute. ISF has over 20 alternate forms for

progress monitoring. Elliott, Lee, and Tollefson (2001) examined the technical adequacy of the ISF subtest and found an inter-rater reliability of .89, a test-retest reliability of .74, and an equivalent forms reliability of .64. The concurrent validity of ISF with the Woodcock-Johnson III Test of Achievement (WJ) broad reading score was .42 (Elliott, Lee, & Tollefson, 2001).

Letter Naming Fluency (LNF) is a standardized, individually administered measure of upper and lowercase letter knowledge. Students are presented with a page of upper- and lower-case letters arranged randomly and are asked to name as many letters as they can in 1 minute. It is generally used to measure a child's risk for achieving early-literacy benchmark goals. A student is considered at risk if they score within the lowest 20% of students in their school district. The test takes 1 minute to administer and the score reflects how many letters are correctly identified in 1 minute. Elliott, Lee, and Tollefson (2001) found an inter-rater reliability of .94, a test-retest reliability of .90, an equivalent forms reliability of .80, and a concurrent validity with WJ broad reading of .63.

Phoneme Segmentation Fluency (PSF) is a standardized, individually administered measure of phonological awareness. The measure assesses a child's ability to fluently segment words into the individual phonemes comprising the word. The examiner orally produces the word and the student is required to orally produce the phonemes. PSF takes about 2 minutes to administer and the score reflects the number of phonemes correctly segmented in 1 minute. The measure has over 20 alternate forms for progress monitoring. The inter-rater reliability for PSF is .87, test-

retest reliability is .85, equivalent forms reliability is .84, and the concurrent validity with WJ broad reading score is .44; (Elliott, Lee, & Tollefson, 2001).

Nonsense Word Fluency (NWF) is a standardized, individually administered measure of phonics. The measure assesses a child's knowledge of sound-letter correspondences and their ability to blend letters into words. The student is given a paper with randomly ordered vowel-consonant or consonant-vowel-consonant nonsense words and asked to correctly identify each individual letter sound or read the entire nonsense word. The test takes approximately 2 minutes to administer and the final score reflects the number of letter-sounds correctly produced in 1 minute. Similar to other measures, NWF has over 20 alternate forms for progress monitoring. The DIBELS website states that the one-month, alternate form reliability for NWF is .83 and the predictive validity of NWF given in January of first grade with the WJ broad reading score is .66. (DIBELS Reliability Data, 2007).

Oral Reading Fluency (ORF), also called Words Correct/Minute (WC/M) is one of the most commonly used and thoroughly researched CBM measures. Many researchers have found WC/M to be a good measure of general reading ability and comprehension (Good & Jefferson, 1989; Marston, 1989). Researchers have also confirmed that WC/M correlates with other published and accepted measures of reading performance (Deno, Mirkin, & Chiang, 1982; Fuchs, Fuchs, & Maxwell, 1988). Other researchers have found evidence for the construct validity of these 1-minute reading probes (Shinn, Good, Knutson, Tilly, & Collins, 1992). More specifically, DIBELS measure of Words Correct/Minute, ORF, is a standardized,

individually administered test of accuracy and fluency with connected text. ORF is designed to monitor student progress and identify students who may benefit from additional support. Students are asked to read a graded passage out loud for 1 minute. Words omitted, substituted, and hesitations of more than three seconds are then scored as errors. Any words that the student self-corrects within three seconds are scored as accurate. The number of correct words per minute is the oral reading fluency rate. Researchers examined the technical adequacy of ORF with the Colorado State Assessment Program Reading Assessment (CSAP) and found fall, winter, and spring ORF test-retest reliabilities ranging from .89-.93 and concurrent validity with the CSAP Reading Assessment ranging from .73-.80 (Shaw & Shaw, 2002). Table 1 provides a description of the task involved for each DIBELS measure as well as the early reading skill assessed by the measure.

Procedures

Students were administered ISF, LNF, PSF, NWF, and ORF DIBELS probes based on the DIBELS administration schedule (e.g., kindergartners were administered LNF in the fall, winter, and spring, whereas, first graders were only administered LNF in the fall). See Table 2 for the administration schedule for kindergarten through fifth grade. Probes were administered by school psychologists, classroom teachers, or graduate students in a local school psychology doctoral training program. Training was provided to all administrators prior to testing. Assessments took place during the district's regularly scheduled fall, winter, and spring benchmark assessments throughout the 2005-2006 school year. Assessments were generally conducted in a

Table 1. List of the DIBELS Measures Administered With Descriptions of the Task and Critical Area of Reading Assessed

Probe	Description	Early Reading Skill Assessed
Initial Sound Fluency	The examiner presents four pictures to the child, names each picture, and asks the child to identify the picture that begins with the sound the examiner orally produced.	Phonemic Awareness -initial sound
Letter Naming Fluency	Students are presented with a page of upper- and lower-case letters randomly arranged and asked to name the letters as quickly as they can.	Orthographic processing
Phoneme Segmentation Fluency	The examiner orally presents words of three to four phonemes and asks the student to verbally produce the individual phonemes for each word.	Phonemic Awareness -phoneme segmentation
Nonsense Word Fluency	The student is presented a page with randomly ordered VC and CVC nonsense words and asked to verbally produce the individual letter sound of each letter or verbally produce the entire nonsense word.	Phonics
Oral Reading Fluency	Students read a grade level passage aloud for one minute. Words omitted, substituted, and hesitations of more than three seconds are scored as errors. Words self-corrected within 3 seconds are scored as accurate. The number of correct words per minute from the passage is the oral reading fluency.	Fluency

Table 2. DIBELS Benchmark Administration Schedule

Probe	Kindergarten			Grade 1			Grade 2			Grade 3			Grade 4			Grade 5		
	F	W	S	F	W	S	F	W	S	F	W	S	F	W	S	F	W	S
ISF	X	X																
LNF	X	X	X	X														
PSF		X	X	X	X	X												
NWF		X	X	X	X	X												
ORF					X	X	X	X	X	X	X	X	X	X	X	X	X	X

Note. (X) indicates that the DIBELS Measure was administered to students in that grade during F (fall), W (winter), or S (spring) benchmarks. ISF (Initial Sound Fluency), LNF (Letter Naming Fluency), PSF (Phoneme Segmentation Fluency), NWF (Nonsense Word Fluency), ORF (Oral Reading Fluency).

quiet area of the classroom or in the hallway outside of the classroom. Each assessment was administered individually and took between 1 and 4 minutes to complete. Student performance was then recorded into a database. Students whose gender was not recorded in the database were excluded from the study.

Dependent Measures

The dependent variables assessed in the study included students' initial sound fluency (beginning sounds produced correctly in 1 minute), letter naming fluency (number of letter names correctly produced in 1 minute), phoneme segmentation fluency (number of phonemes correctly produced in 1 minute), nonsense word fluency (number of nonsense words correctly produced in 1 minute), and oral reading fluency (number of words correctly read in 1 minute).

Data Analysis and Design

The current study was a causal-comparative cross-sectional design with sex as the independent variable and score on the reading measure as the dependent variable. A two-way repeated-measures ANOVA with time of year (fall, winter, spring) serving as the within-subjects variable and gender (male, female) serving as the between-subjects variable was conducted at each grade level for each measure administered. However, in first grade, LNF was only administered at one time (fall). For this measure, an independent t-test was run. An alpha level of .05 was set for all analyses. Effect sizes were also calculated for gender differences using partial eta squared. The square root of partial eta squared was calculated and then compared to the qualitative categories defined by Cohen (1988) 0.2 = small, 0.5 = medium, and 0.8 = large.

Chapter III

Results

Initial Sound Fluency

Figure 1 displays the average fall and winter ISF data for male and female kindergarten students. Table 3 provides the summary statistics (*N*, *M*, and *SD*) of these data. Visual analysis of Figure 1 shows that females entered kindergarten with higher average ISF scores than males (11.66 and 8.71 respectively). Both females and males showed improvement when assessed again in the winter (an increase of 11.98 for females and 9.86 for males). Thus, when the final ISF measure was taken, females were still outperforming males.

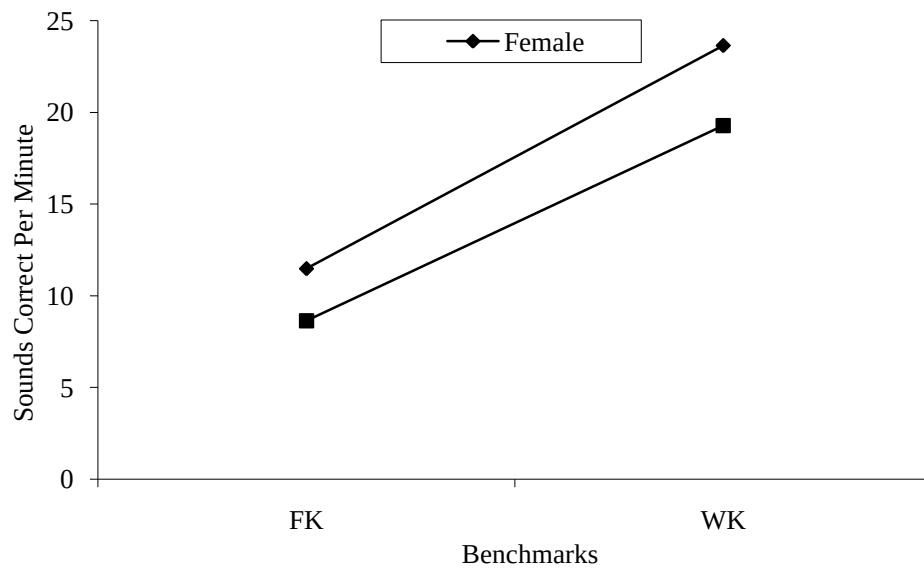


Figure 1. Average Initial Sound Fluency scores for males and females at fall (FK) and winter (WK) benchmarks in kindergarten.

Table 3. Summary Statistics for Initial Sound Fluency Measure

Grade	Gender	Benchmark	N	M	SD
K	F	Fall	56	11.66	8.01
K	M	Fall	72	8.71	6.54
K	F	Winter	56	23.64	13.72
K	M	Winter	72	18.57	10.91

A two-way repeated-measures ANOVA with time of year (fall, winter) serving as the within subjects variable and gender (male, female) serving as the between subjects variable was run for ISF in the kindergarten sample. The main effect of gender was significant, favoring females $F(1, 126) = 5.39, p = .022$. The effect size for this difference was .202 which is considered small (Cohen, 1988). The main effect of time was also significant $F(1, 126) = 144, p = .000$. The effect size for time was 0.731 which is considered moderate (Cohen, 1988). However, the interaction of time x gender was not significant $F(1, 126) = .346, p = .557$.

With respect to gender differences, these results show that females performed significantly better than males on ISF scores, but that these differences were small. Furthermore, both males and females made significant gains in ISF scores from fall to winter, but these gains did not differ significantly. Thus, the first half of kindergarten did not allow males to make up deficits, relative to females, in ISF scores.

Letter Naming Fluency

Figure 2 displays the average LNF data for male and female kindergarten and

first-grade students. Table 4 provides the summary statistics (*N*, *M*, and *SD*) of these data. Visual analysis of Figure 2 shows that females entered kindergarten with higher average LNF scores than males (19.58 and 13.21 respectively). Both females and males showed improvement when assessed again in the winter (an increase of 22.06 for females and 23.30 for males). Both groups made smaller improvements when assessed in the spring (an increase of 7.34 for females and 3.93 for males). When the final LNF measure was taken in kindergarten females were still outperforming males. In the first-grade sample, students were only assessed during the fall benchmark. Visual analysis of Figure 2 shows that females entered first grade with higher average LNF scores than males (46.95 and 45.21 respectively).

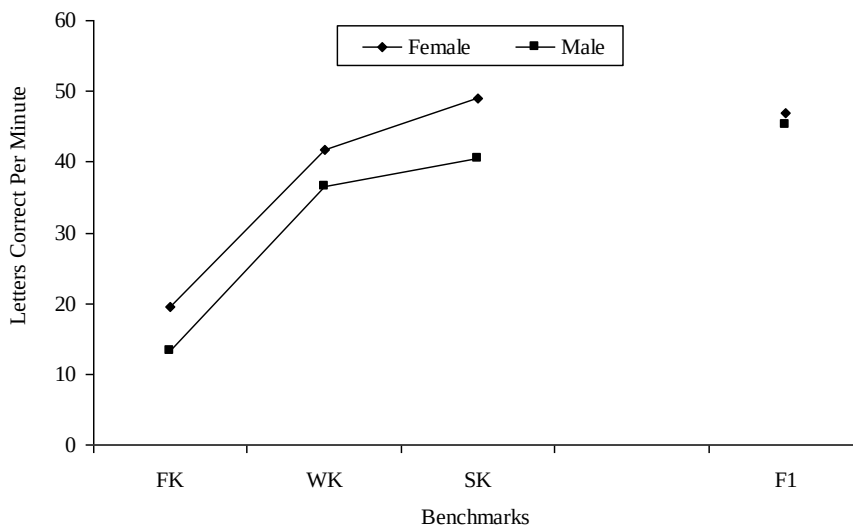


Figure 2. Average Letter Naming Fluency scores for males and females during fall (FK), winter (WK), and spring (SK) benchmarks in kindergarten and fall (F1) benchmarks in first grade

Table 4. Summary Statistics for Letter Naming Fluency Measure

Grade	Gender	Benchmark	N	M	SD
K	F	Fall	55	19.58	16.03
K	M	Fall	71	13.21	11.88
K	F	Winter	55	41.64	16.54
K	M	Winter	71	36.51	14.79
K	F	Spring	55	48.98	17.16
K	M	Spring	71	40.44	14.67
1	F	Fall	152	46.95	14.39
1	M	Fall	159	45.21	14.92

A two-way repeated-measures ANOVA with time of year (fall, winter, spring) serving as the within-subjects variable and gender (male, female) serving as the between-subjects variable was run for LNF in the kindergarten sample. The main effect of gender was significant in favor of females $F(1, 124) = 7.76, p = .006$. The effect size for this difference was .243 which is considered small (Cohen, 1988). The main effect of time was also significant $F(1, 124) = 545.83, p = .000$. The effect size for time was .903 which is considered large (Cohen, 1988). However, the interaction of time x gender was not significant $F(1, 124) = .805, p = .371$.

For the first-grade sample, an independent t-test was run to look for gender

differences during the fall LNF benchmark. Data analysis revealed no significant gender difference in the fall of first grade $t(309) = 2.09, p = .148$.

With respect to gender differences, these results show that females performed significantly better than males on LNF scores in kindergarten, but that these differences were small. Furthermore, both males and females made significant gains in LNF scores throughout the school year, but these gains did not differ significantly. Therefore, males' LNF scores did not catch up with females' scores during kindergarten. First-grade results show that there were no significant differences between males' and females' performance on LNF in the fall. This suggests that the small difference in LNF scores found in kindergarten favoring females was eliminated by the beginning of the first grade. Additionally, Figure 2 shows that males made LNF gains over the summer, while females showed a slight decrease.

Phoneme Segmentation Fluency

Figure 3 displays the average PSF data for male and female kindergarten and first-grade students. Table 5 provides the summary statistics (N , M , and SD) of these data. Visual analysis of Figure 3 shows that in winter of kindergarten females had higher average PSF scores than males (24.71 and 16.32 respectively). Both females and males showed improvement when assessed again in the spring (an increase of 17.14 for females and 17.11 for males). Thus, when the final PSF measure was taken in kindergarten females were still outperforming males. Visual analysis of Figure 3 shows that females entered first grade with higher average PSF scores than males (38.86 and 34.04 respectively). Both groups made improvements when assessed again

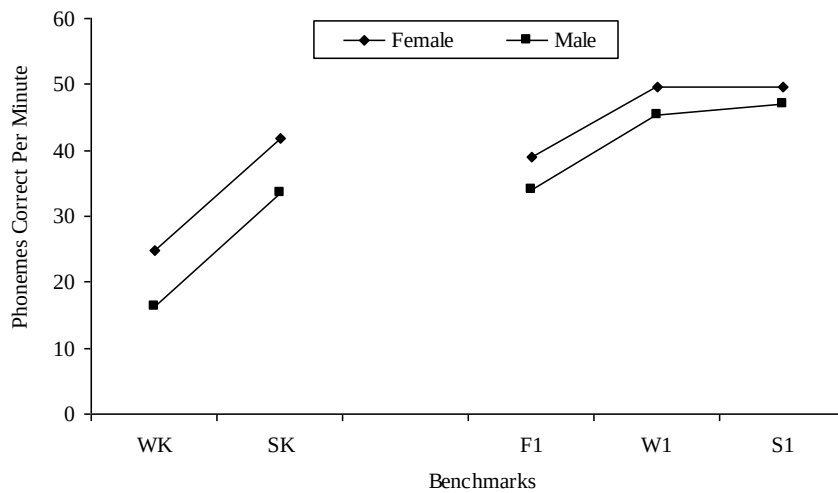


Figure 3. Average Phoneme Segmentation Fluency scores for males and females during winter (WK) and spring (SK) benchmarks in kindergarten and fall (F1), winter (W1), and spring (S1) benchmarks in first grade.

in the winter (an increase of 10.63 for females and 11.35 for males) and much smaller improvements in the spring (an increase of .06 for females and 1.66 for males). When the final PSF measure was taken in first grade, females' average PSF score was still higher than males' score.

A two-way repeated-measures ANOVA with time of year (winter, spring) serving as the within-subjects variable and gender (male, female) serving as the between-subjects variable was run for PSF in the kindergarten sample. The main effect of gender was significant in favor of females $F(1, 129) = 13.67, p = .000$. The effect size for this difference was .310 which is considered a small effect (Cohen, 1988). The main effect of time was also significant $F(1, 129) = 186.93, p = .000$. The

Table 5. Summary Statistics for Phoneme Segmentation Fluency Measure

Grade	Gender	Benchmark	N	M	SD
K	F	Winter	59	24.71	14.85
K	M	Winter	72	16.32	12.86
K	F	Spring	59	41.85	14.92
K	M	Spring	72	33.43	16.32
1	F	Fall	80	38.86	15.66
1	M	Fall	69	34.04	16.24
1	F	Winter	80	49.49	13.48
1	M	Winter	69	45.38	12.51
1	F	Spring	80	49.55	10.84
1	M	Spring	69	47.04	12.43

effect size for time was .769 which is considered moderate (Cohen, 1988). However, the interaction of time x gender was not significant $F(1, 129) = .000, p = .992$.

For first grade, a two way repeated measures ANOVA was run with time of year (fall, winter, spring) serving as the within subjects variable and gender (male, female) serving as the between subjects variable. The main effect of gender was significant in favor of females $F(1, 147) = 4.81, p = .030$. The effect size for this difference was .179 which is considered small (Cohen, 1988). The main effect of time was also significant $F(1, 147) = 75.38, p = .000$. The effect size for time was .582 which is considered moderate (Cohen, 1988). However, the interaction of time x gender was not significant $F(1, 147) = .718, p = .398$.

With respect to gender differences, these results show that females performed significantly better than males on PSF scores in kindergarten, but that these differences were small. Furthermore, males and females in kindergarten made significant gains in PSF scores throughout the year, but these gains did not differ. Therefore, males' PSF scores did not catch up with females' scores during kindergarten. First-grade results show that females scored significantly better than males on PSF scores in first grade, but this difference was small. Both groups made significant gains in PSF scores throughout first grade, but these gains did not differ significantly.

Although main effects for gender were significant and no interaction effects were found, Figure 3 suggests that females had higher PSF following the first semester of kindergarten and these differences grew larger over the course of the

second half of the school year. However, during first grade males' PSF growth rate was greater than females', particularly during the second half of the school year. Thus, by the end of first grade there was little difference between males and females.

Nonsense Word Fluency

Figure 4 displays the average NWF data for male and female kindergarten and first-grade students. Table 6 provides the summary statistics (*N*, *M*, and *SD*) of these data. Visual analysis of Figure 4 shows that in winter of kindergarten females had higher average NWF scores than males (28.78 and 22.47 respectively). Both females and males showed improvement when assessed again in the spring (an increase of 8.56 for females and 5.45 for males). Thus, when the final NWF measure was taken in kindergarten females were still outperforming males. Visual analysis of Figure 4 shows that females entered first grade with higher average NWF scores than males (35.21 and 32.06 respectively). Both groups made improvements when assessed again in the winter (an increase of 16.55 for females and 21.20 for males), with males scores surpassing females. Males and females made further improvements when assessed in the spring with females regaining the advantage (an increase of 5.25 for females and 2.19 for males). When the final NWF measure was taken in first grade females' average NWF scores were higher than males' scores.

A two-way repeated-measures ANOVA with time of year (winter, spring) serving as the within-subjects variable and gender (male, female) serving as the between-subjects variable was run for NWF in the kindergarten sample. For kindergarten, the main effect of gender was significant in favor of females $F(1,129)$

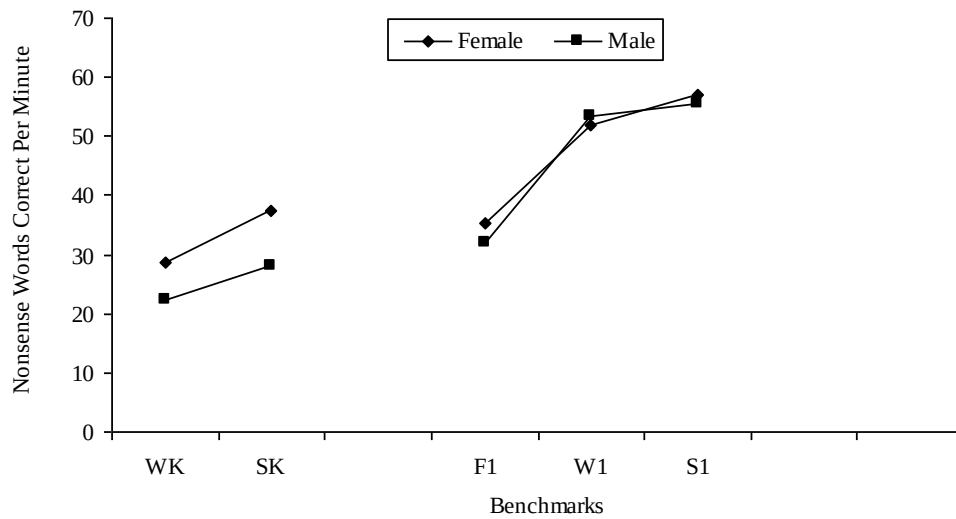


Figure 4. Average Nonsense Word Fluency scores for males and females during winter (WK) and spring (SK) benchmarks in kindergarten and fall (F1), winter (W1), and spring (S1) benchmarks in first grade.

$=8.30$, $p = .005$. The effect size for this difference was .245 which is considered a small effect (Cohen, 1988). The main effect of time was also significant $F(1, 129) = 54.84$, $p = .000$. The effect size for time was .546 which is considered moderate (Cohen, 1988). However, the interaction of time x gender was not significant $F(1, 129) = 2.71$, $p = .102$.

For the first-grade sample, a two way repeated measures ANOVA was run with time of year (fall, winter, spring) serving as the within subjects variable and gender (male, female) serving as the between subjects variable. The main effect of gender was not significant $F(1, 147) = .129$, $p = .720$. The main effect of time was significant $F(1, 147) = 204.72$, $p = .000$. The effect size for time was .763 which

Table 6. Summary Statistics for Nonsense Word Fluency Measure

Grade	Gender	Benchmark	N	M	SD
K	F	Winter	59	28.78	16.95
K	M	Winter	72	22.47	14.95
K	F	Spring	59	37.34	20.00
K	M	Spring	72	27.92	14.08
1	F	Fall	80	35.21	17.82
1	M	Fall	69	32.06	19.04
1	F	Winter	80	51.76	15.45
1	M	Winter	69	53.26	23.98
1	F	Spring	80	57.01	23.20
1	M	Spring	69	55.45	24.98

would be considered moderate (Cohen, 1988). The interaction of time x gender was not significant $F(1, 147) = .254, p = .615$.

During kindergarten and first grade both males and females made significant gains in NWF scores and growth rates did not differ across groups. With regard to gender differences, females performed significantly better than males on NWF scores in kindergarten, but these differences were small. However, by first grade there was no significant difference for gender on NWF scores, suggesting that any differences from kindergarten were eliminated by first grade.

Oral Reading Fluency

Figure 5 displays the average ORF data for male and female first- through fifth-grade students. Table 7 provides the summary statistics (N , M , and SD) of these data. Visual analysis of Figure 5 shows that in winter of first grade females had higher average ORF scores than males (45.77 and 38.18 respectively). Both females and males showed improvement when assessed again in the spring (an increase of 16.85 for females and 14.06 for males). When the final ORF measure was taken in first grade, females were still outperforming males.

Visual analysis of Figure 5 shows that females entered second grade with higher average ORF scores than males (59.09 and 54.65 respectively). Both groups made improvements when assessed again in the winter (an increase of 23.79 for females and 19.76 for males). Males and females made improvements again when assessed in the spring (an increase of 6.18 for females and 8.41 for males). When the final ORF measure was taken in second grade, females were still outperforming males.

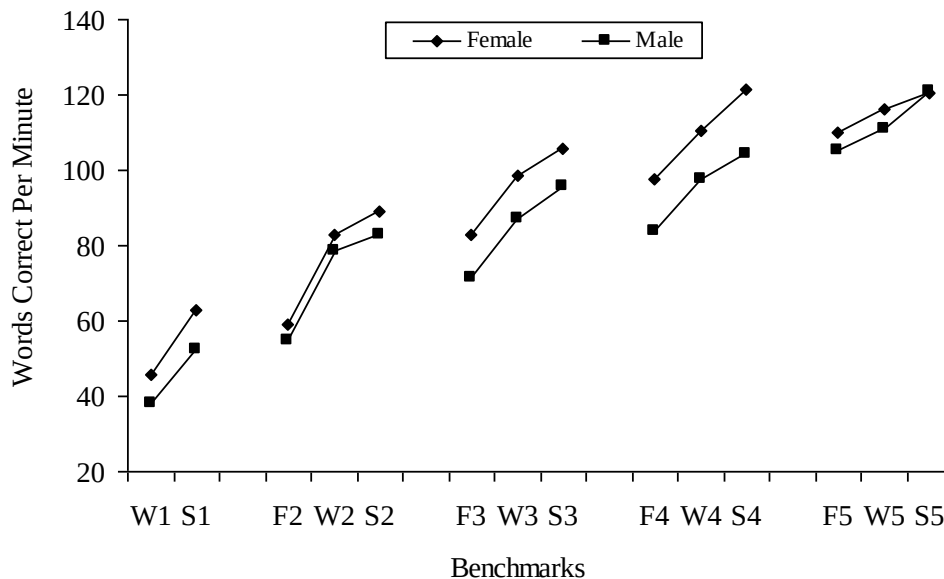


Figure 5. Average Oral Reading Fluency scores for males and females during winter (W1) and spring (S1) benchmarks in first grade and fall, winter, and spring benchmarks in second through fifth grade.

For the third-grade sample, visual analysis of Figure 5 shows that females entered third grade with higher average ORF scores than males (82.70 and 71.65 respectively). Both groups made improvements when assessed again in the winter (an increase of 16.03 for females and 15.58 for males). Males and females made further gains when assessed again in the spring (an increase of 6.98 for females and 8.25 for males). When the final ORF measure was taken in third grade, females' scores remained higher than males' scores.

Visual analysis of Figure 5 shows that females entered fourth grade with higher average ORF scores than males (97.58 and 83.92 respectively). Both males

Table 7. Summary Statistics for the Oral Reading Fluency Measure

Grade	Gender	Benchmark	N	M	SD
1	F	Winter	84	45.77	30.80
1	M	Winter	71	38.18	30.70
1	F	Spring	84	62.62	34.55
1	M	Spring	71	52.24	33.05
2	F	Fall	68	59.09	28.22
2	M	Fall	68	54.65	32.20
2	F	Winter	68	82.88	33.30
2	M	Winter	68	74.41	34.92
2	F	Spring	68	89.06	33.00
2	M	Spring	68	82.82	35.54
3	F	Fall	139	82.70	29.22
3	M	Fall	130	71.65	30.70
3	F	Winter	139	98.73	31.13
3	M	Winter	130	87.23	32.66
3	F	Spring	139	105.71	29.84
3	M	Spring	130	95.48	32.21
4	F	Fall	106	97.58	37.37
4	M	Fall	92	83.92	32.57
4	F	Winter	106	110.63	36.38

Table 7 (continued)

Grade	Gender	Benchmark	N	M	SD
4	M	Winter	92	97.48	34.78
4	F	Spring	106	121.26	42.13
4	M	Spring	92	104.22	39.93
5	F	Fall	87	110.16	39.82
5	M	Fall	96	105.33	40.14
5	F	Winter	87	116.16	41.26
5	M	Winter	96	111.07	39.66
5	F	Spring	87	120.44	38.40
5	M	Spring	96	120.76	40.42

and females made improvements when assessed during the winter benchmark (an increase of 13.05 for females and 13.56 for males). Both groups made improvements when assessed again in the spring (an increase for 10.63 for females and 6.74 for males). When the final ORF measure was taken in fourth grade, females' scores remained higher than males' scores.

Visual analysis of Figure 5 shows that females entered fifth grade with higher average ORF scores than males (110.16 and 105.33 respectively). Both males and females made improvements when assessed again in the winter (an increase of 6.00 for females and 5.74 for males). Both groups made improvements when assessed again in during the spring benchmark with males surpassing females (an increase of 4.28 for females and 9.69 for males). Thus, when the final ORF measure was taken in fifth grade males' average ORF score was slightly higher than females' scores.

A two-way repeated-measures ANOVA with time of year (winter and spring) serving as the within-subjects variable and gender (male, female) serving as the between-subjects variable was run for ORF in the first-grade sample. For first grade, the main effect of gender was not significant $F(1, 153) = 3.06, p = .082$. The main effect of time was significant $F(1, 153) = 292.41, p = .000$. The effect size for time was .809 which is considered large (Cohen, 1988). The interaction of time x gender was not significant $F(1, 153) = 2.38, p = .125$.

For the second-grade sample, a two way repeated measures ANOVA was run with time of year (fall, winter, spring) serving as the within-subjects variable and gender (male, female) serving as the between-subjects variable. For second grade, the

main effect of gender was not significant $F(1, 134) = .853, p = .357$. The main effect of time was significant $F(1, 134) = 406.40, p = .000$. The effect size for time was .867 which is considered a large effect (Cohen, 1988). The interaction of time x gender was not significant $F(1, 134) = .387, p = .535$.

For the third-grade sample, a two-way repeated-measures ANOVA was run with time of year (fall, winter, spring) serving as the within-subjects variable and gender (male, female) serving as the between-subjects variable. The main effect of gender was significant favoring females $F(1, 267) = 8.94, p = .003$. The effect size for this difference was .179 which is considered a small effect (Cohen, 1988). The main effect of time was also significant $F(1, 267) = 690.41, p = .000$. The effect size for time was .849 which is considered large (Cohen, 1988). However, the interaction of time x gender was not significant $F(1, 267) = .213, p = .644$.

For the fourth-grade sample, a two-way repeated -measures ANOVA was run with time of year (fall, winter, spring) serving as the within-subjects variable and gender (male, female) serving as the between-subjects variable. The main effect of gender was significant in favor of females $F(1, 196) = 8.01, p = .005$. The effect size for this difference is .197 which is considered a small effect (Cohen, 1988). The main effect of time was also significant $F(1, 196) = 282.37, p = .000$. The effect size for time was .768 which is considered a moderate effect (Cohen, 1988). However, the interaction of time x gender was not significant $F(1, 196) = 1.67, p = .197$.

For the fifth-grade sample, a two-way repeated-measures ANOVA was run with time of year (fall, winter, spring) serving as the within-subjects variable and

gender (male, female) serving as the between-subjects variable. The main effect of gender was not significant $F(1, 181) = .30$, $p = .583$. The main effect of time was significant $F(1, 181) = 160.85$, $p = .000$. The effect size for time was .686 which is considered moderate (Cohen, 1988). The interaction of time x gender was significant $F(1, 181) = 6.46$, $p = .012$. The effect size for this effect was .184 which is considered small (Cohen, 1988). Visual analysis of Figure 5 suggests that the interaction occurred from winter to spring benchmarks. An independent t-test was conducted to examine whether the average growth rate for males (9.69 wc/m) from winter to spring was significantly different from females' average growth rate (4.28 wc/m). Data analysis revealed significant gender difference in the growth rates from winter to spring of fifth grade, with males outperforming females $t(183) = -2.55$, $p = .012$.

With regard to gender differences, these results show no significant gender differences in ORF scores or in ORF growth rates during the second half of first grade and second grade. Third- and fourth-grade results showed that females' ORF scores were significantly higher than males', both groups showed significant increases in ORF scores, and there was no difference in growth rates (i.e., no interaction effect) across males and females for either year. Thus, by the end of fourth grade males' ORF scores did not catch up to females' scores. Fifth-grade results show no significant gender differences in fifth grade. Males and females made significant gains throughout the year and these gains differed significantly for males versus females. Visual analysis suggests that males made significantly greater gains from winter to spring resulting in higher mean scores for males in the spring. These

data suggest little difference in ORF scores in first and second grades across males and females. However, in third and fourth grade females' ORF scores were higher than males', but by the end of fifth grade males had caught up with females with respect to ORF scores.

Chapter IV

Discussion

This chapter outlines the significant findings of the study. The results are discussed in terms of the implications of this study in reference to the physiological-maturational and cultural-societal theories for explaining gender differences. Applied implications as well as limitations and directions for future research are addressed.

Gender Differences in Reading

The first question posed was whether or not a female advantage would be found in the current sample. Table 9 provides a summary of the gender differences found in the current study. Consistent with previous research significant female advantages were found at some point, on each of the early literacy measures administered (Camarata & Woodcock, 2006; Chatterji, 2006; Gates, 1961; Klecker, 2006; OECD, 2000; University of Minnesota, 2002). On 28 of 30 benchmark assessments, females had higher average scores than males and 7 of 12 analyses yielded significant female advantages. Additionally, males did not show significant advantages on any of the measures administered.

There are several theories which attempt to account for this female advantage. The patterns of gender differences found in the current study have theoretical implications.

Patterns of Gender Differences: Grade Level

Another purpose of this study was to examine the grade level patterns of gender differences. Previous research found gender differences favoring females were

Table 8. Summary of P Values for Gender Differences on DIBELS Measure by Grade

	Initial Sound Fluency	Letter Naming Fluency	Phoneme Segmentation Fluency	Nonsense Word Fluency	Oral Reading Fluency
Kindergarten	.022*	.006*	.000*	.005*	
First		.148 ^a	.030*	.720	.082
Second					.357
Third					.003*
Fourth					.005*
Fifth					.583

Note. (*) denotes a significant gender difference. All significant differences indicate a female advantage. ^a Letter Naming Fluency was administered only once in first grade. Therefore, an independent t-test was run for this analysis. An alpha level of .05 was used for all analyses.

present upon entering school (Camarata & Woodcock, 2006; Chatterji, 2006).

Consistent with previous research, the current study found significant gender differences favoring females when students were assessed in kindergarten (Camarata & Woodcock, 2006; Chatterji, 2006). Females' scores were significantly higher than males' scores on each of the four measures administered in kindergarten.

Previous researchers found that gender differences increased or persisted as grade level increased (Camarata & Woodcock, 2006; Chatterji, 2006; Gates, 1961; Klecker, 2006). The results from the current study were mixed. For example, on LNF, PSF, and NWF gender differences decreased, often to nonsignificance, as grade level increased. Significant differences in ORF favoring females did not emerge until third grade and diminished by fifth grade.

For LNF, significant differences favoring females decreased from an effect size of .243 ($p = .006$) in kindergarten to nonsignificance in first grade ($p = .148$). For PSF, these differences decreased slightly from an effect size of .310 ($p = .000$) in kindergarten to .179 ($p = .030$) in first grade. For NWF, the current study found significant differences decreased from an effect size of .245 in kindergarten ($p = .005$) to nonsignificance in first grade ($p = .720$). However, ORF seemed to follow a different pattern. In first and second grade there were no significant differences between male and female performance ($p = .082$ and $p = .357$ respectively). A significant female advantage emerged in third grade with an effect size of .179 ($p = .003$) and became slightly larger in fourth grade with an effect size of .197 ($p = .005$). However, by fifth grade there were no significant differences ($p = .583$). It is unlikely

that a ceiling effect can account for this finding in fifth grade because previous researchers have found average ORF scores much higher in fifth-grade samples. For example, Howell and Nolet (2000) found instructional placement levels over 140 wc/m for fifth-grade students. This is well above the 120 wc/m achieved in this sample. There are several theoretical implications that can be drawn from these results.

Gender differences in kindergarten would lend support to physiological-maturational theories which suggest that innate differences between males and females are the cause of gender differences in reading (Aaron, 1982; Das, Kirby, & Jarman, 1979; Geschwind & Behan, 1982; Naglieri & Rojahn, 2001; Naour, 2001; Waber, 1979; Witelson, 1976). However, gender differences that emerged in later grades would lend support to cultural-societal theories which suggest that the school environment, reading material, or socialization causes of gender differences in reading skill development. The significant differences favoring females in kindergarten on LNF, PSF, and NWF lend support to the physiological-maturational theories (Aaron, 1982; Das, Kirby, & Jarman, 1979; Geschwind & Behan, 1982; Naglieri & Rojahn, 2001; Naour, 2001; Waber, 1979; Witelson, 1976). Furthermore, because we found these differences decreased as grade level increased, the current study does not support theories which suggest that the school environment, curricula or other factors favoring females contribute to this difference. However, because ORF results were not significant in first and second grade, but emerged in third and fourth grade, cultural-societal theories may account for gender differences in ORF.

Some researchers suggest that females are more likely to read in their free time (Libsch & Breslow, 1996; Nippold, Duthie, & Larson, 2005). If this were true, females' scores should remain more constant than males from spring to fall of the following year because they would be choosing to read more during the summer. This is not supported by the current study. For ORF, females' average spring to fall words correct per minute (wc/m) loss was 7.28 wc/m, whereas males only lost an average of 4.81wc/m. This would suggest that factors outside school do not account for female superiority in ORF. Instead these results provide some support for theories such as differential response to school-based instruction and/or differential interest/motivation to school assignment (Bank, Biddle, & Good, 1980; Brozo, 2002; Clary, 2001; Coles & Hall, 2001; Herz & Gallo, 1996; Leinhardt, Seewald, & Engel, 1979; Millard, 1997). Future researchers investigating this possibility should focus on third and fourth grade. For example, researchers should determine if a gender by reading assignment interaction occurs in these grades (see Brozo, 2002). Perhaps in third grade males begin to develop interests in reading material (e.g., factual information, expository material) that are different from the types of reading they encounter in school (e.g., stories and fiction).

Patterns of Gender Differences: Early Literacy Skill

Researchers investigating cognitive differences between males and females suggest that males may be more likely to process information simultaneously/visual and females sequentially/auditory (Geschwind & Behan, 1982; Naglieri & Rojahn, 2001; Naour, 2001; Witelson, 1976). While the current study did not directly

investigate this question, LNF appears to require visual/simultaneous processing, while PSF appears to require auditory/sequential processing. Thus, current results provide some support for this theory. Although there was a significant female advantage on both measures in first grade, the effect size for those differences were larger for PSF than LNF (.310 and .243 respectively). Additionally, the significant female advantage in LNF was eliminated in the first grade, but persisted for PSF ($p = .148$ and $p = .030$ respectively). So, while females performed significantly better on both simultaneous and sequential processing initially, males were able to eliminate those differences on the task requiring simultaneous processing, but not sequential.

Limitations and Directions for Future Research

Perhaps the greatest limitation of the study was the use of a cross-sectional design. This design was chosen because longitudinal data for the school district were not available at the time of the study. However, cross sectional designs make it difficult to control for variables that may affect differences in reading performance across grades (e.g., differences in curriculum, teachers, socio-economic status). Therefore, it is impossible to know if differences between grades are the result of true age differences or caused by these other variables. Future researchers should use a longitudinal design to control for these threats to internal validity. Additionally, such designs would allow for more reliable examination of the effects of summer break on student performance.

There are also serious threats to external validity associated with the current study. This study used a relatively small sample size when compared to other national

and international studies. Additionally, this sample was taken from a single geographic location. Thus, the current results cannot be generalized to other populations. Future studies should be done using larger, nationally-representative samples of students.

The DIBELS administration schedules also served as a limitation of the study. Because the measures were only administered during certain times there was a limited ability to examine across measures within a particular grade level. For example, it would have been beneficial to observe if in the third- and fourth-grade sample (when ORF was significantly different) significant differences existed on other measures. Additionally, significant female advantages were noted in ISF and PSF during the last benchmark in which they were given. However, across all other measures any significant difference eventually disappeared over time. Thus, future researchers should continue to administer measures (beyond the recommended grade levels based on the DIBELS administration schedule continue) to determine if these differences would have eventually reached diminished.

In the current study we did not measure vocabulary or comprehension, two of the five critical areas of reading identified by the NRP. These measures, particularly comprehension, may have added valuable theoretical implications to the current study. For example, this study suggests that significant gender differences favoring females in ISF, LNF, PSF, NWF, and ORF are decreasing or eliminated by fifth grade. However, several large studies have documented significant female advantages on standardized tests measuring comprehension (Chatterji, 2006; Gates, 1961;

Kecker, 2006; OECD, 2000; University of Minnesota, 2002). Future researchers should determine if a similar pattern exists for comprehension. Perhaps while males are catching up with females on ORF in fifth grade, females are developing their comprehension and vocabulary at a rate that exceeds males. Such studies may also have theoretical implications related to the PASS theory (Naglieri & Rojahn, 2001).

The current study examined students' reading or pre-reading scores in kindergarten through fifth grade. However, it is likely that many students begin receiving instruction in these measures during the preschool years. For this reason, future research should examine these skills in preschool age children.

Practical Applications

Overall, effect sizes obtained in this study were small and gender differences seemed to be decreasing or eliminated by fifth-grade. This may suggest that, although it may take them longer, males will eventually catch up to females with time and adequate instruction. However, this study suggests that phonemic awareness may be innately more difficult for males. Teachers should be aware of these differences and add support for males in phonemic awareness beginning in kindergarten as they may have a more difficult time with this skill. This study also suggests that third and fourth grade may be a critical time for males in reading. It may be important for teachers to focus on matching texts in class to males' interests. This may require less of a focus on fictional texts. However, before such applied recommendation can be made, experiments are needed where reading material is manipulated and learning rates are assessed across males and females.

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