A

DO BEGINNING READERS REMEMBER ORTHOGRAPHY?

by

DONNA-MARIE WRIGHT

A dissertation submitted to the Graduate Faculty in Educational Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

2004

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

UMI Number: 3127931

Copyright 2004 by
Wright, Donna-Marie

All rights reserved.

INFORMATION TO USERS

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

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

UMI®

UMI Microform 3127931
Copyright 2004 by ProQuest Information and Learning Company.
All rights reserved. This microform edition is protected against unauthorized copying under Title 17, United States Code.

ProQuest Information and Learning Company
300 North Zeeb Road
P.O. Box 1346
Ann Arbor, MI 48106-1346

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

©2004

DONNA-MARIE WRIGHT

All Rights Reserved

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

This manuscript has been read and accepted for the Graduate Faculty in Educational Psychology in satisfaction of the dissertation requirements for the degree of Doctor of Philosophy.

April 26, 2004
Date

Linnea C. Ehri
Chair of Examining Committee

April 26, 2004
Date

Carol Kehr Tittle
Executive Officer

Dr. Linnea Ehri

Dr. Carol Title

Dr. David Rindskopf
Supervisory Committee

THE CITY UNIVERSITY OF NEW YORK

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

Abstract

DO BEGINNING READERS REMEMBER ORTHOGRAPHY?

by

Donna-Marie Wright

Adviser: Professor Linnea Ehri

This study investigated beginning readers' memory for doubled letters in the initial and final positions in the spellings of words. Forty kindergartners and first graders were classified as partial or full alphabetic phase readers based on several pretests, which measured participants' phonological and orthographic ability. Partial and full alphabetic phase readers were randomly assigned to learn to read one of two equivalent word sets consisting of phonemically accurate words spelled with single initial consonants, single final consonants, double initial consonants, double final consonants or a CVC spelling. Recall memory, recognition memory and transfer of orthographic patterns were assessed.

Results indicated that although there were developmental differences favoring full phase readers, both phase groups significantly recalled orthographic features. Three days latter readers in both phases had a beyond-chance recognition of double final consonants, but neither reader phase group was able to generalize training. Full alphabetic phase readers significantly recalled more initial and final double consonants, more single consonants, and vowels than partial phase readers. But, partial and full phase readers recalled double letters in the initial and final positions. Findings support Ehri's (1992, 1994, 1995) theory that full alphabetic phase readers process and recall more vowel information than partial alphabetic phase readers. Results also indicated that phase readers' retention of training words was dependent on whether the words had illegal or

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

legal English spellings and that orthographic patterns are mapped to memory from the onset of the reading acquisition process. This corroborates Cassar and Treiman's (1996, 1997) finding that even children in late kindergarten are able to distinguish between legal and illegal English spellings.

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

ACKNOWLEDGEMENTS

In following a cultural tradition, I thank God Almighty for granting me the energy to continue in spite of unforeseeable circumstances.

In following a family tradition, I thank the 'old people' whose memory reminded me there has been far greater a sojourn before and like mine, in spite of it all.

Tradition addressed, Dr. Ehri, thank you for developing the visual-phonological route theory, the word reading phase theory, and your refusal to leave alternate explanations dormant, to later become a tripping stone.

To my colleagues Alpana, Alba, and Kathy who never hesitated to answer a question, listen to my impatience, or offer a helping hand, thank you.

To all the families that blessed me with the ultimate gift of teaching their child to read, thank you. It is clear to me that your choice is the reason I stand here today with a wealth of experience that cannot be quantified.

To my friends who saved me when my forever smile lost its gleam, thank you for being there without having to be asked. Within true friendship lay emotional expression that need not be qualified.

It is said it takes a village to raise a child. I thank my family for literally, as my life would have it, delivering my two children, babysitting my two children, and for removing each of life's crosses from my heart. My greatest desire is that each of you is given an equivalent blessing to what you unselfishly gave to me- a vision of unending possibility.

Abeni and Naeem, thank you for all of the nights you went to sleep early when I first began the doctoral program. Thank you for all of the nights you slept at my feet when I began planning the pilot study. But, most of all, Abeni thank you for becoming as you

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

have stated, "Crazy lady, your best friend's here." Truly, I have been a crazy lady. But, remember it was your father who suggested I enter a doctoral program and his love has been our anchor, in spite of it all.

Aunt Dolls and Mommy thank you for praying over my soul so that I could not forget it! Sandra, Lurraine, Andrea, Fayette, Sunshine, 'Caricom', Sharon, Carl, Donna, Wayne, Aunt Herline and Winston thank you for whispering in my ears so I would always hear it! Dr. Lowden, thank you for providing the time to make it possible. And, to my father thank you for living your short life in a manner that I would always know it was real – an unending possibility!!!

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

Table of Contents

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

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

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

Appendices

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

List of Tables

Table

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

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

List of Figures

Figures

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

Introduction

The purpose of this study was to identify the point during reading acquisition when orthography, or spelling, is mapped to memory in sight word acquisition. Orthography is synonymous with spelling and refers to the basic workings in the letter recognition network. Sight word reading, according to Ehri (1995), is indicated by the absence of pauses between phonemes or syllables and the rapid reading of words, which are pronounced correctly rather than decoded phonologically.

Determining the point when beginners acquire orthographic knowledge is theoretically, educationally, and developmentally important. Orthography is an integral component of the word reading process. The spellings of words clarify phonemes by providing a means of conceptualizing and symbolizing words as sequences of separate sound segments (Ehri, 1980). Additionally, general and specific knowledge of particular letter sequences result eventually in a superiority of perceptual units (orthographic patterns) applied to an abstract graphemic code (Henderson & Chard, 1980). Harris and Hodges (1995) in the Literacy Dictionary define a grapheme as:

> a written or printed representation of a phoneme, as b for /b/ ...in English; a grapheme can be a single letter or a group of letters. It includes all of the ways in which the phoneme may be written or printed (p.101).

Graphemes serve as "functional bridges" in the mapping between orthography and phonology (Rey & Jacobs, 2000).

Knowledge of orthographic structure is theorized as making a crucial contribution to

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

reading fluency. Yet, there are many unanswered questions about the relationship between orthography and reading acquisition. At which point in learning to read is orthography remembered? Is it retained in memory from the first instance of reading? Is the retention of orthography dependent on the position of the orthographic pattern within the word (e.g., initial or final position)?

The visual-phonological route theory was the theoretical basis for this study (Ehri, 1991). It suggests that there is a single route to sight word reading acquisition. As a connectionist view of word reading, it hypothesizes that starting in early reading systematic connections are made between letters in word spellings and sounds in word pronunciations. Adopting a connectionist view, Adams (1998) explains, "When the reader fixates on a word, the visual percepts of the letters directly stimulate its corresponding letter recognition units" (p. 109). Furthermore, Adam states, "[T]he associative links between individual letter recognition units are responsible for the automatic and holistic manner in which we perceive whole, familiar words...."(p. 113).

Another view of word reading is offered by dual route theory (Baron, 1986; Humphreys & Evett, 1985). It was one of the first theories to systematically offer an explanation of sight word acquisition. It suggests that two equally viable paths, a lexical and nonlexical route, lead to sight word reading acquisition. This theory posits that developmentally nonlexical access occurs first, and lexical access follows. When readers use the lexical route, they access phonology through semantic knowledge of the orthographic lexicon. A lexical route has lexical words, defined by Harris and Hodges (1995) in the Literacy Dictionary as words with semantic content, for instance *book,*

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

read, or *think.* When readers use the nonlexical route, they translate spelling-to-sound correspondences. The term *spelling-to-sound rule* is synonymous with the terms *letter-to-sound* and *grapheme-phoneme correspondences.* Findings of various studies challenge the premise that there are two routes to sight word acquisition (Campbell & Besner, 1981; Coltheart, 1996; Coltheart, Gesner, Jonassen & Davelaar, 1979; Ehri and Wilce, 1985; Ehri & Wilce, 1987a; Glushko, 1979; Harm & Seidenberg, 2001; Marcel, 1980; Seidenberg, Waters, Barnes & Tanenhaus, 1984; Shalice, Warrington & McCarthy 1983;).

The visual-phonological theory includes the premise that as a reader develops, orthographic and phonological connections are formed in memory, resulting in four phases of sight word acquisition: the *prealphabetic, partial alphabetic, full alphabetic,* and *consolidated phases* (Ehri, 1991) and then fluent reading occurs (Ehri and McCormick, 1998). More recent, Ehri (2000) outlined the types of spellings expected in the word reading phases that precede fluent reading. Ehri's phases of sight word reading acquisition are based on developmental knowledge of the alphabetic principle (i.e., understanding and applying grapheme-phoneme correspondences). As word reading develops, it evidences increasingly more complete grapheme-phoneme connections allowing retention of sight words in memory. Whereas the novice reader remembers partial connections, the most advanced reader remembers multiletter patterns (Ehri, 1991, 1992, 1995; Ehri, 2000).

Research suggests that orthographic sensitivity emerges before the last word reading phase. This construct has been operationalized in a variety of ways:

a) exposure to print as indicated by recognizing titles or authors of books(Cunningham &

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

Stanovich, 1990, 1998), b) decoding unfamiliar words (Bowey & Underwood, 1996; Ehri & Robbins, 1992; Goswami, 1986, 1988; Peterson & Haines, 1992), c) finding target letters or words embedded in a larger set (Badian, 1994b, 2001; Juola, Shadler, Chabot & McCaughey, 1978), d) inventing spellings of words (Beers & Henderson, 1977; Gentry, 1982; Morris & Perney, 1984; Treiman, 1993; Treiman, Berch & Weatherson, 1993; Treiman, Zukowski & Richmond-Welty, 1995) and e) identifying legal English spellings (Cassar & Treiman 1996, 1997; Ehri & Robbins, 1992; Foorman, Francis, Fletcher & Lynn, 1996; Henderson & Chard, 1980; McCaughey, Juola, Schadler & Ward, 1980; Reitsma, 1983; Treiman, Goswami & Bruck, 1990). Of these researchers, only Cassar and Treiman investigated multiletter pattern memory in beginning readers. Additionally, of these tasks, only those involving invented spelling or identification of legal English spellings directly allow one to assess the types of orthographic patterns that are known and unknown. Only the Cassar and Treiman studies included invented spelling and legal English spellings tasks.

None of the research on orthographic sensitivity used a word learning task to assess memory for spellings, even though a word learning task embodies the most natural way that spellings are learned. Words are learned because they are read, and eventually their spellings become mapped to memory.

Furthermore, in research on beginning orthographic knowledge, participants have never been grouped using Ehri's phase theory. Participants have been characteristically grouped and compared based on non-ability factors of age and/or the single ability factor of grade (Badian, 1994b, 2001; Beers & Henderson, 1977; Bowey & Underwood, 1996;

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

Cunningham & Stanovich, 1990, 1998; Henderson & Chard, 1980; Juola, et al., 1978), grade and language awareness or facility (Morris & Perney, 1984), grade and reading level or ability (Ehri & Robbins, 1992; Foorman et al., 1996; Goswami, 1986, 1988; Reitsma, 1983: Treiman, Goswami & Bruck, 1990; Treiman et al., 1995) and grade and spelling level (Cassar & Treiman, 1997). Use of age, grade, language awareness or facility and reading level cannot provide descriptors of specific word reading or spelling ability, especially on the primer level. But phase theory can provide information on primer level word reading and spelling ability, because it incorporates the primer level reader.

The present study was intended to explore partial and full alphabetic phase readers' memory for multiletter patterns. Ehri's (1991, 1992, 2000) theory of sight word acquisition was used to distinguish two levels of beginning sight word learning ability. Word reading phases were based on participants' phonological and orthographic knowledge. Participants were trained to read words that were phonemically familiar, yet were given unique orthographic features (initial or final consonant singleton, initial or final consonant doublet, or a CVC spelling). It was anticipated that based on reader phase classification participants would demonstrate varying degrees of recall, recognition, and transfer. Findings were expected to have significant theoretical and developmental implications.

The current research represents an initial step in studying the visual/orthographic aspects of the visual-phonological route theory. This study attempted to elucidate the relationship between theories of spelling and sight word acquisition while clarifying the point at which orthography develops. As such, this study is an extension of the Cassar and

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

Treiman (1996, 1997) investigation into beginning readers' knowledge of multiletter (doublet) legal and illegal English spellings. This is its theoretical and developmental importance.

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

Chapter 1

Literature Review

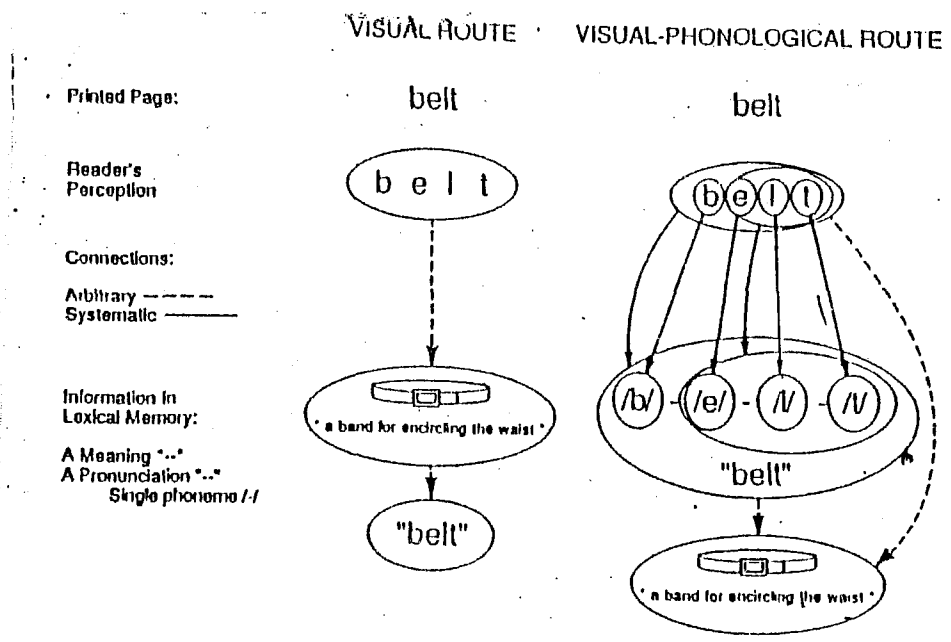
Elements of the Visual-Phonological Theory of Word Learning

Ehri (1991) developed the visual-phonological route theory. It suggests that letter-sound correspondences play an important role in reading words from memory. It posits a visual-phonological route into memory, consisting of specific connections between visual cues seen in the word and its pronunciation stored in memory. The strength of connections is based on readers' knowledge of letter-to-sound correspondences and other orthographic regularities that link print to speech. The visual-phonological route theory was developed as a response to the inadequacies of the dual route theory.

The dual route theory, a major alternative explanation to sight word acquisition, postulates that there are two parallel, non-reciprocal equally viable routes available to read words (Humphrey & Evett, 1985). According to this theory, the *lexical route* (a visual route) accesses phonology either via stored semantic knowledge, or directly from the orthographic lexicon. The *nonlexical processing route* operates by translating the word's graphemic code into a phonological code based on a small set of spelling-to-sound rules. Baron (1986) characterized word recognition in early reading as involving a developmental shift from indirect access to (nonlexical) to direct access (lexical). The strength of the connections in dual route theory is uncertain as is evident from Ehri's graphic representation comparing the dual route's visual route to the visual phonological-route theory (see Figure 1). Evidence for the visual-phonological route theory comes from studies investigating the separateness of the two routes and studies investigating

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

Figure 1. A comparison between the dual route theory's visual route and the visual-phonological route theory.



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

the development of sight word processing in children learning to read.

Investigations of the separateness of the two routes. The dual route theory has found limited empirical support. The independence of each route is questionable. As discussed below, studies involving nonwords, spelling-to-sound regularity effects in word processing, and acquired reading disorders have demonstrated that, in contrast to the postulates of dual route theory, the lexical and nonlexical routes are not separate, but work in concert.

Lexical processing was found to be implicated during diagraph pronunciations, and affected pronunciation latencies in non-words (Campbell & Besner 1981; Coltheart, Besner, Jonasson & Davelaar, 1979). Although lexical processing in nonwords was also implicated by Glushko (1979), he did not consider that the two routes of the dual route theory might not be parallel.

According to Humphreys and Evett (1985), in dual route theory nonlexical processing operates on the basis of spelling-to-sound rules of English. Venezky (1970) extensively described spelling-to-sound correspondences as invariant grapheme-phoneme correspondence rules (GPC). These rules lead to nonlexical phonological representations, resulting in pronunciations. However, Glushko (1979) found that phonological consistency of frequently matched regular words (e.g., hang, bang), primarily determined students naming times of regular words whose orthographic neighbors included exception words (e.g., base vs. vase). Additionally, Seidenberg, Waters, Barnes, and Tanenhaus (1984) found that orthographic neighborhoods exerted an influence on spelling-to-sound nonword processing, revealing a lexical influence and challenging the claim that only a

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

nonlexical route is operative.

Studies in acquired reading disorders were conducted because it was thought the dual route theory had neural networking implications. It was assumed that acquired reading disorders would manifest in either a lexical or a non-lexical reading impairment.

Lexical processing at a level less than the whole word was found among surface dyslexics, who were defined as having impaired lexical processing (Marcel, 1980; Shalice, Warrington, & McCarthy, 1983). More recently, Coltheart (1996) argued that phonological dyslexics also had deficits in orthographic processing related to sensitivity to graphemic complexity. Additionally, Harm and Seidenberg (2001) researched phonological dyslexia and its relationship to graphemic complexity and visual similarity, and concluded that because of the connections between orthography and phonology, orthographic manipulation had phonological consequences, especially when phonology was degraded. However, critics have questioned whether studies of acquired dyslexia should be used to support a theory of normal readers. Also, they have questioned whether case studies can be adequately generalized to a larger normal population.

Investigations of the development of sight word processing. Grapheme-phoneme correspondences are mapped to memory and facilitate word learning more effectively than visual cues alone. Ehri and Wilce (1985) found that reading words is facilitated more by grapheme-phoneme correspondences than by visual cues

alone. This counters the dual route theory's primary premise that both routes are equally viable. Ehri and Wilce (1985) study grouped students by their ability to read preprimer words into Pre-readers, Novices, and Veterans. Students were taught to read two kinds of

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

word spellings: (a) simplified phonetic spellings whose letters corresponded to sounds and (b) visual spellings whose letters bore no sound correspondence, but were more distinctive visually. Prereaders learned to read visual spellings more easily than phonetic spellings, indicating that they processed visual cues most easily. The novice readers learned to read phonetic spellings more easily than visual spellings, suggesting that children who have limited reading skills but know letter-sound associations can use this knowledge to learn and remember words. This suggests that for the novice beginning reader it is not the visual cue of the letter, but, the phonological influence afforded by grapheme-phoneme correspondence that is mapped to memory.

Grapheme-phoneme rules (nonlexical processing) by itself are inadequate in reading similarly spelled words. Ehri and Wilce (1987a) found that kindergarten students were able to read an entire set of fifteen similarly spelled words with greater consistency the more alphabetic and phonemic segmentation skill they had. This finding suggested that those better readers had greater knowledge of grapheme-phoneme correspondences. Furthermore, better readers' lexical retrieval is enhanced the more grapheme-phoneme correspondences are mapped to memory suggesting that there is a single visual-phonological route to sight word processing. The dual route theory does not adequately explain the posited developmental shift from the non-lexical to the lexical route as phonological recoding ability develops. Specifically, we are still left wondering how grapheme-phoneme correspondences enhance the ability to utilize visual or lexical cues. Also, it is unclear how much phonological recoding ability is needed before the developmental shift occurs.

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

Ehri (1991) emphasizes that phonological recoding is necessary to learn how to read. Beginners need to know how the alphabet system works to succeed in learning to read. According to Share, Jorm, Maclean, and Matthews (1984), phonological awareness along with letter knowledge are the strongest predictors of beginning reading achievement (r = .58 to .68), stronger even than intelligence (r = .39 to .41). Additionally, Gough and Tunmer (1986) conclude that children who cannot phonologically recode do not become good readers.

More recently, Vandervelden and Siegel (1995) studied kindergarten and second grade children's phonological recoding development and its relationship to word reading and spelling. A speech-print task, a pseudoword reading task, and a spelling task were used to measure phonological recoding. Kindergartners' facility with phonological recoding on a recognition task was measured using a speech-to-print matching task. After the word was read by an examiner, children had to select the target word (e. g., frog) from distinct choices with orthographic overlap (e. g., friend, frog, flop). Phonological recoding as a pseudoword reading task was measured based on the number of correct letter/phoneme matches and substitutes that were read as each printed psuedoword was presented. For instance, *sock* pronounced /sut/ indicated first letter decoding, and *sit* pronounced /sut/ indicated two-letter decoding. Phonological recoding as a spelling task required children to spell a set of words. The accuracy of phoneme-to-letter mapping was noted (i.e., spelling *cup* as *kup*). In kindergartners the results of the speech-to-print matching tasks and spelling task demonstrated that phonological recoding operates as a recognition mechanism. Phonological recoding of consonants on the speech-to-print matching task

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

occurred to the same extent as on the spelling task. Furthermore, phonological recoding on the pseudoword reading of the initial consonant explained at least 80 % of the variance on the word reading measures. According to Vandervelden and Siegel (1995), "These findings support the position that rudimentary levels of phonological recoding are involved from the outset in the acquisition of a reading vocabulary" (p. 863).

Ehri (1990) has suggested that when mature beginning readers see a word, they initially phonologically recode the word. This begins the process of setting up a visual-phonological route in memory for the word, leading from its spelling (orthography) directly to its pronunciation. Once such routes are established, readers can look at spellings and immediately retrieve their specific pronunciations without resorting to translation rules and recoding.

Phonological recoding offers a self- teaching mechanism. Share (1995) suggests that phonological recoding has a general benefit. Each successful decoding encounter with an unfamiliar word provides an opportunity to acquire the word-specific and general orthographic information that is the foundation of skilled word recognition. Phonological recoding, thus, facilitates the expansion of the lexicon. Each time a word is decoded, the reader learns more about letter-sound correspondences and lexical constraints, because certain letter-sound correspondences do not occur in English spellings (e.g., initial doublets). This suggests that as the lexicon expands, the reader becomes alerted to regularities beyond simple one-to-one letter-sound correspondences.

The course of orthographic development through Ehri's phases. In accordance with the Visual-Phonological Route Theory, Ehri (1980, 1984, 1987, 1991, 1992, 1995) has

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

stated that as a child reads, letters are processed as visual symbols for phonemes, and the sequence of letters are retained in memory as an alphabetic, phonological representation of the word. By phonologically recoding words, readers form access routes for those words in memory. Beginning readers go through four phases in developing these capacities (Ehri, 1995): *prealphabetic, partial alphabetic, full alphabetic* and *consolidated alphabetic*. The phases are defined by degree of knowledge of the alphabetic principle.

The prealphabetic phase is non-alphabetic. It involves remembering non-phonemic visual characteristics rather than letter-sound correspondences of words to read them. Sight words are read by remembering one or two distinctive visual cues in or around the word (e.g. remembering the tall posts in the middle of the word *balloon)* or associating a logo and its referent (e.g. remembering a red and yellow arch is read McDonald's). Additionally, sight words are easily forgotten. When text is read, it is because it is memorized.

The partial alphabetic phase is marked by the acquisition of letter name or letter sound knowledge. In this phase, reading is characterized by forming access routes out of partial letter-sound correspondences (i.e., initial or final letters). For example, students may read *kitten* by detecting and remembering the initial *k* is linked to the corresponding phoneme /k/ and the final *n* is linked to the corresponding phoneme /n/ in the pronunciation of "kitten" but ignoring other letter sound correspondences in the word. This results in confusion between similarly spelled words are confused (e.g. *kitten* and *kitchen*). In addition, context is used to read unfamiliar words because students lack much decoding skill. Familiar words are independently read, and nonwords are mistakenly read as real

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

words.

The full alphabetic phase is characterized by students being able to phonologically recode written words into pronunciations. Sight words are stored in memory by forming complete connections between graphemes in the spellings of words and phonemes in their pronunciations (e.g. the 4 letters in *went* are remembered as symbols for its 4 sounds). Similarly spelled words are not confused (e.g. *went* and *want).* Additionally, students are able to segment words into individual phonemes. Words that are practiced are read accurately and automatically. Decodable text is read independently.

The next phase is the consolidated alphabetic phase, in which readers consolidate recurring sequences of grapheme- phoneme correspondences into syllabic patterns to remember how to read words. As different words with the same orthographic patterns are repeatedly phonologically recoded and stored in memory, letter patterns become part of readers' generalized knowledge of the spelling system, and the phonological recoding of letter sequences becomes automatic. This facilitates the decoding of unfamiliar words (especially multisyllabic words), reduces the load of sight word storage in memory and speeds the process of accessing words (Juel, 1983; Venezky & Massaro, 1979) by allowing the reader to operate with multiletter units and to notice patterns that recur across words. For example, the word *string* is read by forming connections between 2 letter-chunks (*str* and *ing)* and then the chunks are blended. It is easier to read words because connections are multisyllabic rather than individual letter-sound correspondences. Additionally, analogies between known and unknown words are used to read words. Unfamiliar words and nonwords are rapidly decoded. According to Ehri's (1991, 1992,

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

1995) theory of the development of word reading, knowledge of orthographic patterns is considered a late development, not occurring until the consolidated alphabetic phase. However, there is evidence, discussed later, that contradicts Ehri's supposition that knowledge of multilettter patterns occurs only in the consolidated alphabetic phase.

More recently, Ehri (2000) has elaborated her theory to include the types of spellings produced at each phase:

1. Prealphabetic phase readers' invented spellings should evidence scribbles or random letters because of the absence of connections between letters and sounds.
2. Partial alphabetic phase readers' invented spellings should evidence partial spellings rather than complete phoneme representations due to insufficient knowledge of the alphabetic system.
3. Full alphabetic phase readers' invented spellings should evidence more complete spelling productions particularly for vowels, because it is easier for them to remember how to read and write words compared to partial alphabetic phase readers.
4. Consolidated alphabetic phase readers' invented spellings should be more conventional because the structures of larger units (sequences of letters that recur across various words) have been learned.

The modification of Ehri's theory to incorporate spelling development does not clearly state the point at which orthographic patterns begin to be mapped to memory. There is evidence (discussed below) that knowledge of orthographic patterns begins before the consolidated alphabetic phase.

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

Early Sensitivity to Orthographic Structure

Orthographic structure is increasingly remembered as readers' spellings and word reading become more advanced (Ehri, 2000). In the last twenty years, five methods have been used to study orthographic knowledge in beginning readers: (a) exposure to print; (b) using rime to decode unfamiliar words; (c) finding a target letter or word embedded in a context of letters and words; (d) invented spelling; and (e) identifying legal English spellings. Studies using each method will be reviewed in turn. Sensitivity to orthographic structure must begin before multiletter patterns are remembered. But, does this sensitivity begin during the final stage of word reading development, or before? If sensitivity to orthographic structure has its roots in preceding phases, what form does it assume? Is it limited to individual letters rather than multiple letter patterns? As readers move through the partial and full alphabetic phases and as their skill in reading and spelling words increases, they may become more astute at recognizing orthographic patterns and not simply individual letters. As such, the connections between multiple letter patterns and their phonemic correspondences may be formed in memory.

By the second grade, children are aware of multiletter patterns within a word. Barker, Torgesen and Wagner (1992) found that in third graders, the ability to choose correct spellings and the ability to choose the correct homophone predicted reading fluency more strongly than did phonological variables. Allington (1978) found that the ability to select the nonword item that was most word-like was a direct function of reading ability level for grade two and grade four readers. Henderson and Chard (1980) found that the ability of 6 and 7 year old second graders to make lexical decisions was based on the speed of

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

determining whether a six-letter display formed a real word. The second graders were able to utilize orthographic structure to detect which strings of letters could be words and which could not. Of interest in the present study is the suggestion that sensitivity to orthographic structure emerges prior to second grade.

Exposure to print. Children's exposure to print is the degree to which children have been introduced to and are familiar with a variety of print forms (e. g., book titles, functional signs, and environmental print). Cunningham and Stanovich (1990, 1998) used the Title Recognition Test of Children's Books (TRT) to assess whether exposure to print exerts specific effects on orthographic processing efficiency. The TRT contained actual book titles and foils; most books read in school were eliminated. Performance on the TRT accounted for significant variance in Stanford Word Reading scores, after phonological abilities were partialled out. This was true for children as young as late first grade. Still, while children's exposure to print predicts orthographic processing efficiency, it is not specifically linked to sensitivity to orthographic structure.

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

Using rime to decode unfamiliar words. Rimes are defined by Harris and Hodges (1995) in the Literacy Dictionary as "a vowel and any following consonants of a syllable, for example /ook/ in book" (p.221). Rime and orthographic rime are interchangeable terms. Beginning readers' use of orthographic rimes has been researched by Goswami (1986), who found that "orthographic rimes serve as functional units of word identification from the outset of reading, even before new readers have a vocabulary large enough to be readily measurable" (p.109). Goswami (1986,1988) studied the extent to which non-decoders (kindergartners), low decoders (first graders), and high decoders (second graders) identified unfamiliar test words using information gained from pronouncing the same orthographic rimes presented in clue words. For kindergartners, most of the scores were zero, but when analogies were made, it was due to similar end rime units, and the scores significantly differed from chance. For first and second graders, analogies between the ends of words were easier.

Peterson and Haines (1992) found that the use of orthographic rime to read unknown words was dependent on segmentation ability. The researchers grouped kindergarten children according to their ability to segment sentences into words and words into sounds. Prior to analogy training, low segmenters showed virtually no ability to use analogy to read unknown words. Training did not significantly improve their ability to use analogy to read words, but it did improve segmentation ability. Middle and high ability segmenters showed the greatest improvement to perform the word-reading-by-analogy task. Also, Ehri and Robbins (1992) found that the ability to use orthographic rime to read unfamiliar words was dependent on decoding skill. Bowey and Underwood (1996)

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

suggested that children derive rime correspondences through their experiences with words in print. This suggests that some kindergartners may be sensitive to orthographic structure in that they discern that rime units are similar, and use this knowledge to decode unfamiliar words, dependent on their phonemic segmentation ability. Still, phonemic segmentation ability may not be required for orthographic structure to be remembered.

Finding a target letter or word. In this method, words or strings of letters are displayed, and a target letter has to be found. Significant findings for kindergartners were dependent on the amount of time the target letter or word was displayed. Juola, Shadler, Chabot and McCaughey (1978) included 5.7-year-olds (kindergartners) and 8- year- olds (second graders) in a study of the development of visual information. The task involved three-, four-, or five- letter tachistoscope word display of nonwords that have legal and illegal English spellings and real words that have high frequency legal English spellings. Second graders response times were faster for nonwords with legal English spellings and high frequency real words than for nonwords that have illegal English spellings. But kindergartners had no significant differences in response times for any of the three types of word displays, suggesting that orthography did not influence kindergartners' responses. Kindergartners appeared to search the display letter by letter, as evidenced by their slow search rates (response times) and their subvocalizations of letters. The brief exposure inherent in a tachistoscope display contributed to kindergartners' inability to find a target letter in a word.

When the tachistoscope is removed from the experimental condition, kindergartners are able to demonstrate the ability to find a target letter in a word. Badian (1994b) gave

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

kindergartners a variety of pretests to predict early reading/spelling skills in Grade 1. A visual matching task was the orthographic measure. The response choices deviated from the target items mainly by sequencing or spatial orientation (e. g., drop: droq, drop, borq, brop). The Grade 1 reading measures were the Weschler Individual Achievement Test (Basic Reading and Spelling) and the Stanford Achievement Test (Reading Comprehension). The visual matching task had higher simple and partial correlations with basic reading and spelling than other subtests, including knowledge of shapes; letters colors, and syllable tapping. In fact, in a stepwise regression analysis, visual matching explained 32.1 % of the reading/spelling variance.

More recently, Badian (2001) administered an orthographic test for kindergartners, which predicted reading at grades 1, 3, and 7. A visual matching task was the orthographic measure (Badian, 1994b). The results indicated that the orthographic measure contributed significant variance to grade 1 word reading, reading vocabulary, and reading comprehension at grades 3, and 7. The study demonstrates that kindergartners have the ability to find a target letter in a word. This ability is an orthographic measure only because it involves letter identification, which is a basic requirement in any task involving orthography. But, finding a target letter in a word does not involve knowledge of orthographic structure.

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

Invented Spelling. Invented Spelling, according to Harris and Hodges (1995) in the Literacy Dictionary, is "the result of an attempt to spell a word which is not already known, based on a writer's knowledge of the spelling system and how it works"(p. 123). Children as young as kindergarten and first grade go through stages of development in learning how to spell (Beers & Henderson, 1977; Gentry, 1982; and Morris & Perney, 1984). Four developmental spelling stages have been defined: (a) *prephonetic*, characterized by being able to record one or both consonantal boundaries of a word; (b) *phonetic*, characterized by the appearance of vowels in spellings; (c) *transitional*, characterized by representing legitimate patterns of letters; and (d) *correct*. As a child progresses through each stage, word representation becomes closer to the standardized form. The nonstandard form of spelling has come to be called *invented spelling*. According to Gentry (1982), "A progressive differentiation of orthographic knowledge may be observed which over time enables the competent speller to rely on multiple strategies, including visual, phonological, lexical and morphological information accrued not from rote memory but from extensive experience with written language"(p. 193).

Invented spellings have been used to investigate whether first grade spelling is affected by the position of the phoneme in relation to stressed or unstressed syllables (Treiman, Berch & Weatherson, 1993). It has also been used to investigate letter omission in certain consonant clusters in first graders (Treiman, Zukowski & Richmond-Welty 1995). Additionally, invented spelling has been used to assess the relationship between first grade reading and spelling (Clarke, 1988). Treiman (1993) has stated, "Children's spellings provide a window on their representations of spoken words." Therefore, invented spelling

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

provides insight into the types of orthographic structures that are in memory.

The invented spelling phase demarcations have been generally identified as (a) /pre-communicative/pre-phonetic (use of a random string of letters, numbers or letter-like markings), (b) semi-phonetic (use of consonants to represent the sounds [e. g., hp or hlp for help]), (c) phonetic (representing the entire sound structure of a word [e. g., mal for mail]), and (d) transitional/near correct spellings utilizing orthographic or morphemic characteristics and (e) correct spellings. These demarcations are based on accuracy of using letters and letter patterns to represent sounds (Ehri, 1986; Gentry, 1982; and Morris & Perney, 1984). Invented spellings reveal memory for orthographic structure.

Distinguishing legal and illegal English spellings. Another way of assessing orthographic sensitivity is to measure distinctive responses to string of letters that are in accordance with English orthographic rules. The ability to distinguish legal from illegal English spellings emerges prior to second grade. McCaughey, Juola, Schadler and Ward (1980) found that pre-second grade children found target letters in tachistoscope word displays faster in words than in tachistoscope pseudowords and nonword displays. They concluded that pre-second graders processed familiar orthography faster.

Studies of the ability to distinguish legal from illegal spellings are not confined to detecting the legality of strings of letters, but have also included reading tasks. Reitsma (1983) found that first graders introduced to a word's orthographic structure were able to read the word even three days later. Real words familiar in spoken but unfamiliar in printed form were used to explore latencies to name words when the spelling was taught vs. not taught. Words were read two, four and six times by the students before naming

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

latencies were recorded. Each word was given a meaningful sentence. Training in reading unfamiliar words had a positive effect on reading the same word again a few days later. Conversely, familiarizing a child with a word's spoken form did not have the same result. Furthermore, when graphemes but not phonemes in words were altered (e.g., au/ou) creating illegal spellings after four previous readings, naming latencies were prolonged. This provides evidence for Ehri and Wilce's (1980) suggestion that specific word spellings are retained in memory.

Ehri and Robbins (1992) studied kindergartners' and first graders' ability to read unfamiliar words by analogy. They observed that when the spellings of double vowels were conventional (e.g., oo and ee), decoders were able to read more words correctly. This was in contrast to words with unconventional spellings of doubled vowels (e.g., aa, ii, and uu).

The ability to distinguish legal from illegal spellings can also include uncommon legal spellings, because there is less opportunity to know that the uncommon spelling is lėgal. Treiman, Goswami and Bruck, (1990) investigated first grade readers ability to pronounce nonwords. The grapheme-phonemic level was held constant, in that nonwords were grouped according to their grapheme-phoneme relations. Nevertheless, nonwords with common VC orthography (e.g., tain) were pronounced more accurately than non-words with less common VC orthography (e.g., goan). The difference was not explained at the grapho-phonemic level.

The ability to distinguish legal from illegal spellings is most often a word likeliness task. Foorman, Francis, Fletcher and Lynn (1996) used the orthographic processing tasks

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

administered by Stanovich and Siegel (1994). Orthographic processing was operationalized as a word likeliness choice task (e. g., filv or filk) taken from the Peabody Individual Achievement Test's (PIAT) Spelling Recognition Test. Also, the spelling recognition test created by Olson, Forsberg, and Wise (1994) (e.g., rain vs. rane) was used. Kindergartners, first graders and second graders were divided into three groups based on the WJ-R (Woodcock, 1989) Basic Reading Cluster; specifically on recognition of real and nonwords. The groups were (a) *non-disabled* , (b) *reading impaired* (reading achievement was consistent with age and IQ), (c) *reading- discrepant* (significant discrepancy between IQ and reading achievement), and (d) *low achievement* (poor readers without an IQ discrepancy). The results indicated that reading-discrepant children performed better on orthographic processing than their word recognition ability would predict. However, it was found that only when decoding was in the range of the nondisabled reader that orthographic processing could be predicted by decoding. But what level of decoding ability is necessary for orthographic processing to occur?

More recently, Cassar and Treiman (1996, 1997) found that even children in late kindergarten with a mean age of approximately 5 years and 7 months were sensitive to particular types of orthographic structure. Generally, the children's task was to choose the item that looked most word-like from pairs of nonwords. In the first experiment, nonword pairs having initial doublet nonwords (illegal English spelling) vs. final doublet (legal English spelling) nonwords (e.g., . bbaf vs.baff ; hhenis vs.heniss) were included. This experiment had two conditions, a visual and an audio-visual condition. In the visual condition, children were asked to identify the nonword that looks best. In the audio-visual

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

condition children listened to a taped pronunciation of each nonword pair. Kindergartners in the audio-visual condition were significantly more likely to choose legal English nonwords than children who only saw the nonword pairs.

In the second experiment, nonword pairs had legal and illegal English final consonant and vowel doublet spellings (e.g., jull vs. jukk; geed vs. gaad). There was no audio-visual condition. Additionally, students' doublet knowledge was examined in relation to their level of spelling development as measured by a spelling choice task (a phonetic vs. conventional spelling). First graders, but not kindergartners chose legal more often than illegal vowel doublets. Neither kindergartners nor first graders were able to discern legal from illegal final consonant doublets, but second graders were able to do so. Only the children classified as phonetic spellers were able to discern legal doublet spellings.

The purpose of the third experiment was to clarify kindergartners' discrepant performance. Combinations of the previous doublet types were included, and a time factor was introduced. Kindergartners were tested at the end of kindergarten and again at the end of their first semester of first grade. At time 1, final doublet spellings were chosen as legal spellings significantly more than initial doublet spellings. By time 2, students also chose the legal final consonant spelling instead of the illegal final consonant spelling. The majority of children at each test level were classified as semi-phonetic spellers, and correct performance increased with increasing spelling level. The semi-phonetic spellers at the end of the first semester of first grade chose the correct doublet spellings significantly more than chance. However, the Cassar and Treiman study failed to clarify a number of issues. The spelling stage that is associated with the ability to recognize legal doublet

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

spellings is unclear. In the second experiment it is the phonetic spellers, and in the third experiment it is the semi-phonetic spellers who gained this ability in the first grade. Because of this, it is also unclear whether there is a factor associated with first grade that increased first graders' performance, even though Cassar and Treiman state that teachers did not provide their students with legal doublet instruction. Also, the point during word reading acquisition that doublet spelling is remembered is unclear. The WRAT was the reading ability measure used. The WRAT does not provide information about pre-primer and primer reading items. Still, distinguishing legal from illegal double spellings is a method of assessment that provides information on sensitivity to orthographic structure, and this sensitivity can be seen even in kindergartners.

Assessing orthographic knowledge. There are three methodological issues in the assessment of orthographic knowledge. They are the choice of direct or indirect methods, the developmental distinctions made among participants, and the types of tasks used. Orthographic assessment is most sensitive when direct methods are used. It is most generalizable when developmental distinctions are made. Also, it mirrors natural acquisition processes when a word learning task is included.

According to the findings reviewed, orthographic knowledge is present before a child is in the second grade. However, the methods used to assess beginning readers' knowledge of orthography are sometimes indirect rather than direct. Indirect methods (e.g., children's exposure to print, using rime to decode unfamiliar words, or finding a target letter or word) do not reveal which types of orthographic patterns have been retained in memory. In contrast, direct methods (e.g., legal vs. illegal spellings and

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

invented spellings) assess the types of orthographic structure stored in memory. Orthographic knowledge should be assessed by measuring knowledge of legal vs. illegal English spellings and invented spellings because these methods have the potential for providing information on the knowledge and developmental processes involved in beginning memory for spellings.

Prior to the current study, Ehri's reader phase theory has not been used to classify participants according to word reading ability at the primer level. Grouping has been often based on age or grade (Badian, 1994b, 2001; Beers & Henderson, 1977; Bowey & Underwood, 1996; Cunningham & Stanovich, 1990, 1998; Henderson & Chard, 1980; Juola, et al., 1978) or grade and language awareness or facility (Morris & Perney, 1984). These groupings do not provide a window into which types of items are mapped to memory nor the processes used in word reading. When reading is assessed, it is often done to determine or confirm grade level rather than to identify specific abilities used in the reading process (Goswami, 1986, 1988; Reitsma, 1983: Treiman et. al., 1990; Treiman et al., 1995). When assessments are used to determine reading ability (Ehri & Robbins, 1992; Foorman et al., 1996), spelling and reading measures are not included or if they are, they are used to explore correlational relationships (Cassar & Treiman, 1997). None of the studies reviewed included assessments of both specific spelling and reading abilities, which would allow for their exploration as two compatible processes.

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

Word learning and spelling production. To date, orthographic sensitivity has not been measured using a word learning-spelling production task. A word learning task embodies the natural way students learn orthography, which is through reading words. A spelling production tasks requires students to attempt to produce the spellings that they have learned in some context. The combination of the two provides a more natural context for assessing the degree to which learned spellings have been mapped to memory. Therefore, this is a direct assessment method. Word learning tasks have been used for other purposes. For instance, Ehri and Wilce (1985) used a word learning-spelling production task to investigate the contribution phonology makes in supporting word learning. The use of a word learning-spelling production task was included in the current study to extend Cassar and Treiman (1997) findings on late kindergartners' ability to distinguish between legal and illegal English spellings for doublets. This task directly taps memory for doublet spellings that are read, by asking participants to recall, recognize and transfer spellings. It reveals whether sight words were remembered (i.e., with the doublet) or letter-sound connections stored (i.e., without the doublet). Furthermore, this marks the first time that such a task has been to investigate the contribution of orthography to the word learning process.

Summary. Knowledge of orthographic structure or spelling is crucial to the development of word reading. According to visual-phonological route theory, there is a single route to reading acquisition, such that connections formed between graphemes and phonemes leads to retention of specific words in memory. The visual-phonological route theory implicates phonology as the key to orthographic development.

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

The visual side of the visual-phonological route theory represents the orthographic aspect of reading acquisition. This theory originally postulated that only when graphemes and phonemes are consolidated is knowledge of orthographic structure acquired. According to the theory, orthographic features may be present before the consolidated alphabetic phase emerges and predominates, but this process has not been empirically quantified or thoroughly explored.

Ehri (1991, 1992, 1995) theorized that it is when the connection between the graphemes and corresponding phonemes are consolidated into larger syllabic units that decoding of multi-syllabic unfamiliar words is facilitated. According to Ehri, this occurs in the consolidated alphabetic phase. Within the context of the visual-phonological route theory, it is unclear how orthography develops. If the visual and phonological aspects are of equal importance, then knowledge of orthographic regularities and phonemes should develop simultaneously. This is especially true in the initial and final positions of a word, because very young readers use rudimentary letter-sound processing of a word's boundary letters to read words.

Of interest in the present study was the orthographic knowledge of readers in the partial and full alphabetic phases. Partial alphabetic phase readers are thought to use partial phonetic cues to read words, by forming and storing associations between some of the letters and their sounds in memory (Ehri & Wilce, 1987a). Full Alphabetic Phase readers have learned the *cipher principle*, which incorporates knowledge of the alphabet, phonemic segmentation skill, and application and internalization of the graphophonemic regularities of English (Ehri & Wilce, 1987b).

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

The literature review cites the five methods that have been used to document sensitivity to orthography before the second grade: exposure to print, use of rime to decode unfamiliar words, finding a target letter or word, invented spelling, and identifying legal English spellings. Studies using each of these research methods indicate early sensitivity to orthographic structure. Before children enter the second grade, they are able to distinguish legal from illegal English spellings (McCaughey et al., 1980). They are able to better pronounce words with common than uncommon VC orthography (Treiman et al., 1990). They can read and spell words with legal double vowels (Ehri & Robbins, 1992). Also, they are able to remember the specific orthographic structure of words (Reitsma, 1983) and use specific types of invented spelling (Beers & Henderson, 1977; Gentry, 1982; and Morris & Perney, 1984). Additionally, they demonstrate sensitivity to orthography in a visual matching task (Badian, 1994b, 2001), although kindergartners can not demonstrate this ability in a tachistoscopic word display. By first grade, exposure to print contributes to word reading scores (Cunningham & Stanovich, 1990; 1998). However, even kindergartners can use orthographic rime as functional units, facilitating kindergarten word identification (Goswami, 1986). This ability is dependent on segmentation ability (Peterson & Haines, 1992), decoding skill (Ehri & Robbins, 1992) and experiences with words in print (Bowey & Underwood, 1996), which influence the use of orthographic rime to read unfamiliar words.

Of the five methods cited in the literature review, only assessments of invented spelling and identification of legal English spellings are able to directly tap memory for orthography in the initial, medial, and final positions within words. This assessment

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

method provides a better understanding of how orthography develops, especially since partial phonetic cues have been implicated in the development of letter-sound knowledge (Ehri, 1991, 1992, 1995)

Studies by Cassar and Treiman (1996, 1997) contribute knowledge of beginning readers' memory for orthography. In these studies, the difference between a legal vs illegal doublet, a clear orthographic element, was understood before students were in the second grade. However, the studies do not reveal the reading or spelling processes involved in the acquisition of doublet knowledge. Perhaps if students were classified according to phase theory primer and pre-primer reading processes would illuminate the processes involved in doublet letter knowledge acquisition. Of course, if students were classified according to spelling level, the spelling processes involved in double letter acquisition would also be clearer. Additionally, if a word learning- spelling production task was done perhaps a window would open to reveal the extent doublet spellings were mapping to memory. Cassar and Treiman (1996, 1997) acknowledge this limitation in their own study," We need to compare children's spelling productions with their performance on various tasks tapping orthographic and phonological knowledge" (p. 643). The present study was designed to do just this, and also to compare reading acquisition with performance on tasks tapping orthographic and phonological knowledge.

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

Chapter 3

The Study

The study investigated the process of retaining orthographic images of words in memory by beginning readers (Ehri & Wilce, 1979) as postulated by the visual-phonological route theory (Ehri, 1992). The visual-phonological theory leaves unresolved the question of when orthographic knowledge about specific words begins to emerge. The current study was an effort to answer this question and to explore other assertions of visual-phonological route theory. Participants were classified into two groups according to developmental level, those at a semi-phonetic spelling and partial alphabetic reading phase and those at a phonetic spelling phase and a full alphabetic reading phase. Retention of orthography was determined by assessing participants' memory for various letters and letter patterns in words and nonwords, which they were taught to read (training words). The transfer of word spellings to words with similar pronunciations was also analyzed. Memory for the training words was assessed through a spelling recall test, a spelling recognition test, and a spelling assessment of words orthographically similar to the training words.

The study was a two-group design with between-subjects and within-subjects comparisons. Participants were pretested on their phonological and orthographic knowledge. Assignment to two developmental levels was determined by classification as a partial or full alphabetic phase reader and speller. Participants in each group were randomly assigned for training on one of two equivalent word sets with initial consonant doublets, final consonant doublets and CVC spellings. The design is outlined in Figure 2.

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

Figure 2. Design of study to examine beginning readers' memory for orthography

Steps	Tasks and Characteristics	Purpose/Features
1. Pretests		
(Sessions 1-3)	1. Letter names/sounds	Select participants
	2. Word reading	Select participants
	3. Invent spellings	Classify phase
	4. Nonword reading	Classify phase
	5. Double letter recognition	Assess participants
	6. Phonemic segmentation	Classify phase
2. Training		
(Session 4)	1. Learning to read 12 words	
	Set A or B	Random Assignment
	Word features:	Criterion: 2 perfect
	1. Final doublet (T/D)	successive trials
	2. Initial doublet (L/R)	
	3. Single consonants	
3.Posttests (Session 4-5)		
Immediate	1. Spelling recall	Trained Words
Delayed	2. Spelling recognition	Trained words
	3. Spelling Transfer	Transfer words

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

The two groups were compared on recognition and recall of single and double letters in the training words in the initial, medial, and final positions, generalization of letter patterns present in the training words to a transfer task, and number of trials to learn training words. The within-subjects comparisons involved the ability to recognize and recall letter patterns, generalize letter patterns, and recall letter patterns based on frequency of occurrence.

The use of doublets in varying positions in the word provided the test of memory for specific information about orthographic knowledge of English. Initial double letters were included, because in English initial double letters do not occur at the beginning of words. It was expected that its illegitimacy would cause participants to take a longer time to learn such words than words with doublets in legal positions. CVC spellings were included for control purposes. Both sets of words were spelled phonetically. The grade levels of the words were balanced across lists.

Two phonetically similar pairs of letters were selected for doubling, the alveolars *t* and *d* and the liquids *l* and *r*. Alveolars are sounds produced by raising the tongue tip to the alveolar ridge. The only difference between the two phonemes is that one is voiced /d/, and the other is voiceless /t/. Liquids entail some obstruction of the air stream in the mouth, but not enough to cause friction. The /l/ and /r/ differ in that /l/ is an alveolar and the /r/ is not. Their phonetic similarity can result in orthographic substitution (writing a *t* in the place of a *d* or writing *r* in the place of *l*) unless there is definite attention to orthography.

The independent variable was partial vs. full alphabetic phase word reading

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

classification. This was determined based on phonological recoding ability, invented spelling score, and confirmation of phonemic segmentation. The primary dependent variables were recall of training word spellings, recognition of training word spellings, and transfer of the orthographic doubling pattern of training words to new words. Other dependent variables included the number of trials to learn to read training words; recall of letters and letter patterns in the initial, medial, and final positions; recognition and recall of multiletter patterns with illegal vs. legal English spellings; and generalization of legal English spellings to a transfer task.

Classification of word reading phase was based on phonological recoding and invented spelling scores. The phonemic segmentation measure was used to confirm full alphabetic phase classification. A phonological recoding measure was included so as not to falsely classify partial phase readers as full phase readers. Prior to conducting the research, it was observed that teachers' instruction, in preparation for the annual assessment, included phonemic segmentation tasks. Students were taught to stretch out the pronunciations of words and count the phonemes they heard.

Measures of phonological and orthographic knowledge tested hypotheses derived from the visual-phonological route theory specifically that the visual and phonological routes are equally important and that knowledge of orthographic patterns and its corresponding phonemes develop simultaneously.

To assess phonological knowledge, it was necessary to assess phonemic awareness. Gough, Juel, and Griffith (1992) found that the ability to distinguish phonological elements smaller than syllables is necessary to make use of alphabetic orthography. Share

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

et al. (1984) found that preliterate measures of phonological awareness predict achievement in beginning reading. Stahl and Murray (1994) found that linguistic complexity across phonological awareness tasks was more predictive of beginning reading than the Yopp (1988) phonological awareness assessment, which also assesses phonological awareness, but not in the context of linguistic complexity. They found that the easiest linguistic level involved onsets and rimes, followed by vowel codas, cluster codas and cluster onsets. Each part of Stahl and Murray's phonological awareness tasks was subdivided based on that finding. Their instrument consisted of four parts, of which only one part, assessing phonemic segmentation, was included in the present study. The excluded portions of the Stahl and Murray instrument were the phoneme deletion, isolation of phonemes, and blending of phonemes tasks.

Phoneme deletion tasks require that an onset is taken away and the remainder of the word pronounced. During this process, a phoneme is mentally removed and a new pronunciation constructed. This task originally required consonants deleted in the initial, medial or final positions as well as syllabic deletions (Bruce ,1964; Calfee, Chapman and Venezky, 1972; and Rosner, 1975). This task was simplified and called the Strip Initial Consonant Task, which required that after practice, participants delete the initial consonant (Stanovich, Cunningham, and Cramer, 1984). This task was still found difficult for kindergartners to perform. According to Stanovich et. al " Clearly this task exceeds the cognitive and phonological analysis capabilities of many kindergarten children" (p. 182).

Isolation and blending of phonemes were excluded because pilot study findings

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

(Appendix P) indicated that segmentation ability and invented spelling were important in determining word reading phase.

In order to assess knowledge of orthographic patterns and regularities, letter name knowledge, letter sound knowledge, word identification, double letter patterns, illegal English spellings, and invented spelling were included in the assessment process.

Letter name knowledge was assessed because letters form the basis of orthographic processing. It is the benchmark indicating that readers have the capability to attend to visual alphabetic information in words. In correlational studies (Share et. al., 1984), it was found that letter name knowledge and phonemic awareness were the two best predictors of beginning reading achievement. In particular, tasks requiring children to name or identify letters were better predictors of reading achievement than simple letter matching tasks (Chall, 1967; Linehan, 1958). Letter name knowledge helps children to attach relevant sounds to letters; since many of the names of letters contain sounds that are commonly symbolized by the letters in word spellings (Ehri, 1983).

Not only accuracy, but also speed to name letters was assessed. Many researchers have suggested that slower alphanumeric naming speeds may be an identifying characteristic of dyslexics (Badian, 1994a; Ellis, 1985; Wolf, 1986). The ability to name letters or numbers is an autonomous system learned in early development and can be systematically probed to assess sub-processes common to both naming and reading before reading occurs (Wolf, 1991).

Letter-sound correspondence knowledge and phonological recoding ability were assessed. Knowledge of letter-sound correspondence is important because it facilitates

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

phonological recoding. Phonological recoding is also referred to as decoding. It involves transforming and assembling spellings into pronunciations via the application of grapheme - phoneme correspondences. It is the ability to sound out and blend words, as measured by a nonword reading task. Uhry (1992) found that the ability to predict kindergarten children's Grade 1 reading ability was predicted by the ability to sound out words. This task is not possible if one is not able to sound out phonemes. Monaghan's study (as cited in Ehri, 1991) identified three developmental phonological recoding benchmarks, the first of which was sounding out, but not blending individual phonemes. The more advanced phase reader should have phonological recoding ability and the earlier phase reader should at least have letter -sound correspondence knowledge.

A standardized word identification task, The Woodcock Mastery Test of Word Identification (Woodcock, 1989) was included in the current study.

Knowledge of legal English doublet spellings was assessed using the Double Letter Recognition Assessment developed by Cassar and Treiman (1996). Orthographic structure of the English language only allows for particular multi-letter patterns, especially particular double letter patterns. Cassar and Treiman found that even first graders were sensitive to doublet regularity.

Participants' ability to invent spellings of words was assessed because it provides insight into the orthographic patterns that are retained in memory. Furthermore, Morris and Perney (1984) suggest that the developmental aspects of invented spelling served as a predictor of first-grade reading ability.

Richgels (1995) found that among kindergartners who have received no formal

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

instruction in phonemic awareness or in spelling, those identified as good invented spellers were better word learners than those identified as poor invented spellers. There is a relationship between invented spelling development and reading ability. The present study did not explore this relationship, but it was used as one of the measures to determine reader phase.

After assessment of phonological and orthographic ability, participants were given a word learning task. Then, their recall, recognition and generalization of training words were measured.

Hypotheses and Rationale

The following were the relevant hypotheses and their rationale:

Ho 1:) Full alphabetic phase readers will reveal greater knowledge of capital and lower case letter names, letter-sound correspondences, legal English double letter knowledge, and word identification ability on the pretests than partial alphabetic phase readers.

It was expected that full alphabetic phase readers would have more advanced phonological and orthographic abilities than partial alphabetic phase readers. Additionally, it was expected that full alphabetic phase readers would have more advanced vowel knowledge.

Ho 2:) Full alphabetic phase readers will take fewer trials to learn training words to a criterion of 2 perfect criterion.

It was anticipated that because full phase readers' possess greater phonological and orthographic ability than partial phase readers, full alphabetic phase readers would take less time to learn the training words.

Ho 3) Full alphabetic phase readers when compared to partial alphabetic readers, will

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

recall significantly more initial letter(s), medial letter(s) and final letter(s) of learned words.

It was expected that participants in the partial alphabetical word reading phase would learn and remember partial letter cues in words, predominantly initial and final letters. Initial and final letters of words are the access routes to orthographic structure being committed to memory because, according to Bouma (1979), "initial and final letters of words benefit from the adjacent blank space left and right of fixation'' (p.125). But was it the initial or final letter that was attended to, or the initial or final phoneme in the word?

If full alphabetic phase readers recall letters in training words in the initial, medial, and final positions, this would support the claim that full alphabetic phase readers form complete connections between phonemes and graphemes. Would there be any differences between partial and full alphabetic phase readers' recall of orthography in the initial and final sub-lexical positions?

Ho 4) Both partial and full alphabetic phase readers will recall more single letter graphemes than doublets on the spelling recall task.

Given its greater environmental exposure, it is expected that participants will remember more singleton word type information (i.e., initial or final CVC spellings) than doublet word type (i.e., initial or final doublets). However, given their advanced development, full alphabetic phase readers should remember more singleton word type sub-lexical information than partial alphabetic phase readers.

Ho 5) On the spelling recall task, partial and full alphabetic phase readers will recall more legal English doublets (i.e., final double letters) than illegal English doublets (i.e., initial

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

double letters) in training words.

If partial alphabetic phase readers retain in memory only initial and final letters, then they would not be expected to remember whether letters were doubled. This would suggest that letter-to-sound connections are solely based on individual sounds mapping onto individual letters.

If partial alphabetic phase readers retain in memory extra visual information that was not signaled clearly by a phonological unit (i.e., final double letters), this would suggest that orthographic properties of words are mapped to memory early in the reading process.

If both partial and full alphabetic phase readers recall more final double letters than initial double letters, this would suggest that legal orthographic patterns are retained in memory better than illegal patterns.

Ho 6) Partial and full alphabetic phase readers will recall more final double letters that recur thrice among learned words than final double letters that occur only once.

If so, both partial and full alphabetic phase readers recall more final double letter patterns that recur thrice compared to double letter patterns that occur only once in each learning word trial, this would suggest that orthographic patterns may be retained based on frequency of occurrence. However, it was also anticipated that given the full alphabetic phase readers' advanced development, he/she would perform better than partial alphabetic phase readers.

Ho 7) In the spelling recognition task, full alphabetic phase readers will recognize significantly more initial letter(s) and final letter(s) of learned words than partial alphabetic phase readers.

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

. If full alphabetic phase readers recognize more initial and final letter(s) of learned words than partial alphabetic phase readers, this would suggest that full alphabetic phase readers have more knowledge about the connections between letters and sounds.

Ho 8) Partial and full alphabetic phase readers will recognize more legal English spellings (i.e., final double letters) than illegal English spellings (i.e., initial double letters).

If both partial and full alphabetic phase readers recognize up to three days after training more final double letters than initial double letters, this would suggest that legal orthographic patterns are retained in memory better than illegal patterns.

Ho 9) Full alphabetic phase readers, compared to partial alphabetic phase readers, will generalize significantly more initial and final letter(s) and represent more medial letters in a transfer task.

Also, if significantly more full alphabetic phase readers than partial alphabetic phase readers generalize word learning to a transfer task, this would suggest that it is not until the full alphabetic phase that word learning generalizes to words with similar orthographic patterns.

Ho 10) More final double letter knowledge than initial double letter knowledge will generalize to a transfer task for all participants.

If final double letter knowledge generalizes to a transfer task more than initial double letter knowledge, this would suggest that partial and/or full alphabetic phase readers are sensitive to legal orthography.

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

CHAPTER 4

Methods

Participants

Forty children from two New York City public schools in a 20 block area were included in this study although it was two different districts. There were 15 kindergarten children and 25 first-grade children. There were 22 females and 18 males. Ages ranged from 5 years and 5 months to 8 years and 4 months. The mean age of kindergartners was 5.99 months, and the mean age of first graders was 6.44. Kindergartners were first assessed for inclusion in the study using the battery described below. There were not enough kindergartners classified as full alphabetic phase readers. Therefore, first-grade children were included in the study.

The Division of Assessment and Accountability of the Board of Education of the City of New York approved the proposal to conduct this research (Appendix A). The principals and superintendents gave permission to conduct this research in their respective schools. In one school, three classes (2 kindergartens and 1 first grade) were assigned to the research study. In the other school, five classes (2 kindergartens and 3 first grades) were assigned. Each class had approximately 15 children. The researcher visited classes to explain the informed consent forms, children's assent forms, and the number of sessions required. Teachers rated students' language proficiency. Approximately 115 informed consent forms were distributed by teachers. Sixty-five children returned signed informed consent forms. Additionally, children had to agree to participate in the study by writing his/her name and circling the appropriate item on an assent form. No child was allowed to

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

participate even at the pretest level until the parent's informed consent was received. No child was allowed to participate in the study if he/she did not assent to it.

To be included, children had to be able to name at least 20 alphabet letters on the Letter Name Knowledge Test, 20 sounds on the Letter Sound Knowledge Test , have a reading level not higher than Grade 1 on the Woodcock Reading Mastery Test (1989) and score at a beginning spelling level on the Morris and Perney (1984) Invented Spelling Test. This test was used to exclude children who were too immature (score of 0) or too advanced (score of 4 or 5). Additionally, any child who was unable to follow directions on the pretests was excluded.

Twenty- five children were excluded from the study. Five kindergartners and one first grader were excluded because they named fewer than 20 letters. Five kindergartners and three first graders were excluded because they knew fewer than 20 sounds. One kindergartner was excluded because he was an immature invented speller. One kindergartner and six first graders were excluded because their invented spelling was too advanced. Only children classified as partial or full alphabetic phase readers were included in the study. This classification was based on performance on the phonemic segmentation test, invented spelling test, and phonological recoding task.

Of the 40 participants, 90% were African-American and 10% were Latin-American. In one school 87.7% of the school children were eligible for free school lunch. In the other school, 85.2% were eligible. Some classes focused on literacy and emphasized systematic phonics instruction, whereas literacy was not emphasized in other classes.

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

Materials

Pretests

The following pretests are described in the order in which they were administered.

1. *Letter Name Knowledge Test.* The materials used in this task were three 9 ``X 5 1/2" cards (one of which was a practice card). The practice card was the first card presented. It had six capital letters on it and like the other cards had an opaque covering with Xs, designed to prevent the child from prematurely seeing the letters. The next card had all 26 capital letters randomly arranged. The third card had all 26 lowercase letters, in a different random order. Letters cards were shown to all participants who were told to name the letters as quickly, but as accurately, as possible. A stopwatch was used to assess the time taken to name letters. The number of correctly named letters was recorded. The goal of this test was to assess the participants' accuracy and automaticity naming upper and lower case letters. Each raw score (26 maximum) was divided by the time it took the child to name the letters, yielding a letter-per-second measure.

2. *Letter-Sound Correspondence Knowledge Test.* The three cards used in the Letter Name Knowledge Test were also used in the Letter-Sound Correspondence Knowledge Test. The practice card was shown first. Each child was asked to produce the sound of the letter on each card. Children were shown all 26 uppercase and lowercase letters. The goal of this non-timed test was to assess participants' knowledge of the sounds of individual letters. Possible scores ranged from 0 to 26.

3. *Word Identification Test.* The words were printed on 9" X 5 1/2" index cards. Each index card had either five or six words written in two or three rows in capital letters. A

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

humorous picture appeared at the bottom of each index card. Children were asked to read the words and name the pictures out loud. The words were drawn from the Woodcock Mastery Test of Word Identification (Woodcock, 1989) which was used to determine if children could read pre-primer, primer, first grade and second grade words. Pictures were mixed in with the words to minimize the potential feeling of failure. Possible raw scores ranged from 0 to55, classified as pre-primer, primer, first grade, or second grade. To be included in this study no child could score higher than a raw score of 35 (1.9 grade equivalent).

4. *Invented Spelling Test.* There were 3 practice and 10 test items. During the practice phase, each sound in the word was isolated as the researcher read the word and wrote a letter on the board. In the test phase, each word was read aloud as a whole word by the researcher, without sound isolation, and then repeated in a sentence. Then, the word was repeated alone. Lastly, the children were asked to spell the word in writing as best they could, on the paper provided. This test was used to classify children into developmental phases. This test also revealed children's knowledge of phoneme-to-grapheme correspondences and phonemic segmentation. Additionally, it revealed children's knowledge of legitimate letter sequences in written language, thus assessing participants' orthographic sensitivity.

The Morris and Perney (1984) Developmental Scoring System was applied to each word. A score of 1 for an individual word indicated that only the beginning consonant was represented. A score of 2 for any word indicated that the beginning and ending consonants were represented appropriately. Children were classified as partial alphabetic

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

phase readers if they had the ability to use beginning consonants, or beginning and ending consonants to represent the phonemic structure on the majority of the test words. A score of 3 for any word indicated that the child was able to sound through a word, because the vowel was represented along with consonants. Children were classified as full alphabetic phase readers if they had the ability to sound through the majority of the words, indicating that connections were being formed between all of the phonemes and graphemes in the word. A score of 4 for any word indicated that there was an emerging awareness of orthography. Children were classified as consolidated alphabetic phase readers if they scored a 4 on the majority of test items. To be included in the study, participants had to have an average score between 1 and 3.8 on the invented spelling task.

5. *Phonological Recoding Nonword Test.* One practice item and five test items were sequentially presented on 9" X 5 1/2" cards with a nonsense word on each card. Children were told to look at the silly word and say the silly word. This test was used to classify children into developmental phases. Also, the goal of the Phonological Recoding Test was to determine the ability to blend phonemes. Children were classified as Partial alphabetic phase readers if they had a score between 0 and 2. Children were classified as Full Alphabetic readers if they had a score between 3 and 5. The words were: *zown* (practice) and *vip wub sog fen zak.*

6. *Double Letter Recognition Test.* The materials used in this test were 4 practice items and 30 test items. Sets of 10 test items were presented on 8" X11" oak tag. Two choices at a time were exposed. Both choices contained either a vowel doublet or a consonant doublet. One choice was an orthographically legal nonsense word (e.g., *heek*). The other

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

choice was an orthographically illegal nonsense word (e.g., *haak*). The 4 practice items were presented first. Children were told that some nonsense words look more like words than others. They were directed to choose the nonsense word that looked most like a word. The Double Letter Recognition Assessment was an abridged form of the test used by Cassar and Treiman, 1997. Its purpose was to assess participants' orthographic knowledge of consonantal doublets. The maximum score of 30 correct was based on selecting 10 legal consonant doublets from pairs of initial illegal vs. final legal doublets, 10 legal final doublets from pairs of legal vs. illegal final doublets, and 10 legal vowel doublets from pairs of legal vs. illegal vowel doublets.

7. *Phonemic Segmentation Test.* The goal of this test was to determine participants' awareness of sounds in spoken words. The test administrator pronounced 5 practice and 15 test words. Children were asked to repeat each word and then segment the word by raising a finger for each sound they said. This subtest was used to affirm full alphabetic phase readers' classification. Full alphabetic phase readers had to obtain phonemic segmentation scores of 5 or more. Possible scores ranged between 0 and 15.

Word Learning Task

On the Word Learning Task, children received either of two different lists of twelve training words, Set A or Set B. Each child learned to read the twelve words, each word presented on a 9" x 5-½" index card. The words were spelled with capital letters. Training on each word set continued until the child reached a criterion of two perfect trials in succession. The anticipation method was used to teach the participants the target words. During the first study trial, the experimenter read each word while sliding a finger under

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

the letters and then read a meaningful sentence, which contained the word and defined it. Each child was required to repeat the word as he/she pointed to the letters. During the following test trials, each child's ability to read the words was assessed. Each child had five seconds to read each word that was presented. Then, the experimenter read the word and its sentence. If a child read a word incorrectly, he or she had to repeat the word while sliding his or her fingers under the letters. This training procedure was followed until the child attained two perfect trials. The order of presentation of words was varied across trials. This training procedure allowed for the assessment of the number of trials needed before the training words were all read correctly.

Half of the participants learned to read Set A training words. This set included three words spelled with double *t* in the final position, one word with double *d* in the final position, three words with double *l* in the initial position, one word with double *r* in the initial position, and four items with CVC spellings. The Set A words are listed below with the spellings taught to children in capital letters and the conventional spellings in parentheses:

JETT	(jet)
FITT	(fit)
NUTT	(nut)
PADD	(pad)
LLES	(less)
LLIM	(limb)
LLUK	(luck)

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

RRAG (rag)

DEF (deaf)

WIP (whip)

TUB (tub)

FAN (fan)

The balance of the children learned to read Set B words. This set included three words spelled with double *d* in the final position, one word with double *t* in the final position, three words with double *r* in the initial position, one word with double *l* in the initial position and four different items with CVC spellings. The Set B words were:

DEDD (dead)

KIDD (kid)

MUDD (mud)

PATT (pat)

RREK (wreck)

RRIP (rip)

RRUG (rug)

LLAM (lamb)

WEB (web)

FIZ (fizz)

TUF (tough)

VAN (van)

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

Posttests

Three posttests were used. All of the posttests were administered individually. Only Post- Test I Spelling Recall Memory was administered immediately after the training procedure was completed. The other posttests were administered one to three days after the training session. The posttests were a Spelling Memory Test, a Spelling Recognition Test, and a Spelling Transfer Test.

1. *Posttest I: Spelling memory.* A spelling test, found in Appendix K, was administered. Each training word was presented orally by the researcher. The child was asked to repeat the word. The word was then repeated by the researcher in a sentence, and repeated again alone. Children were asked to write the spelling that was just learned. Also, children were asked to write all the letters that they remembered seeing in the word. Feedback was not given to children. One dependent variable, Spelling Memory, was a composite score incorporating memory for letters in the initial, medial, and final positions of all training words. The maximum score of 28 consisted of 4 initial doublets, 4 final doublets, 12 vowels, 4 initial singleton consonants, and 4 final singleton consonants. Recall of each letter type was scored as well.

2. *Posttest II: Spelling recognition.* A spelling recognition task was administered, wherein participants were presented each training word spelled three possible ways. Each three-choice item was presented on a separate 9" x 5 1/2" index card. The order of spellings was counterbalanced across cards to avoid any position bias. Children were asked to point to the word that was learned. Feedback was not given to children. Spelling Recognition scores represented a composite of correct responses for recognizing initial

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

doublets and final doublets yielding a maximum score of eight (4 initial doublets + 4 final doublets).

3. *Posttest III: Spelling transfer task.* An Invented Spelling test was administered. The words that were used had the same rime as the training words. Transfer was determined by assessing whether words with the same rime were assigned the same orthographic structure, for example, *dedd* (training word) *fedd* (transfer word). Posttest III was included to assess near transfer.

Each transfer word was presented orally. Children were asked to repeat the word. The word was included in a sentence and repeated again. Children were asked to write the spelling by recalling the letter patterns they just learned. Feedback was not given to children, but four practice items with CVC spellings were included. Spelling Transfer scores represented a composite of correct responses for transferring initial and final doublets and vowels of all learned words yielding a maximum composite score of sixteen, (4 initial doublets + 4 final doublets + 8 vowels).

Debriefing. Twelve 9" X 5 1/2" cards with the training words' conventional spellings were presented after all posttests were completed. Each child was told that he/she would practice reading the training words' correct spellings. Each word was read and the child was asked to repeat the word. Then, the child was asked to repeat the word as his/her finger moved beneath the word.

Procedures

All pretests, training, and posttests were done individually. The total number of

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

sessions per child was five. Each session took place on a different day. Each session lasted no longer than 30 minutes. The following is a list of the sessions and the order of the pre- and posttests and the word learning task:

Session 1- Letter Name Knowledge Test (Appendix D)

-Letter Sound Correspondence Knowledge Test (Appendix E)

-Word Identification Test Woodcock Mastery Test of

- Word Identification (Woodcock,1989) (Appendix F)

Session 2- Invented Spelling Test (Morris and Perney, 1984) (Appendix G)

- Phonological Recoding Test {Appendix H)

Session 3-Legal Spelling of Sight Words: Double Letter Patterns

-Assessment (abridged form of Cassar and Treiman, 1997) (Appendix I)

- Phonological Awareness Test: Phonemic Segmentation Subtest

(Stahl and Murray, 1994) (Appendix J)

Session 4- Word Learning Task (Appendix K)

-Posttest I: Spelling Memory (Appendix L)

Session 5-Posttest II: Spelling Recognition (Appendix M)

-Posttest III: Spelling Transfer Task (Appendix N)

-Debriefing by presenting conventional spellings (Appendix O)

Posttests II and III were conducted no more than three days after the Word Learning Task and Posttest I. The study was conducted in a separate classroom or at a learning center within the classroom at the public school during school hours.

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

Chapter 5

Results

The data collected was in the form of quantitative scores for each test. A two-group pretest posttest design was used. All data were analyzed using the SPSS statistical package.

Pretests

Seven pretests were given to all participants to assess phonological and orthographic ability. Phonological recoding, invented spelling and phonemic segmentation were used to classify participants as partial or full alphabetic phase readers. Upper and lower case letter knowledge, letter-sound knowledge, double letter knowledge and word identification ability were the other pretests administered.

Age, gender, and grade of the two phase groups are shown in Table 1. As evident from these values, grade was not a variable confounded with phase. There was only a slight imbalance between partial and full phase groups with one fewer kindergartner and one more first grader in the full phase group than in the partial group. Full alphabetic phase readers were only slightly older than partial alphabetic phase readers.

Participants were classified as partial or full alphabetic phase readers based on three pretests. *T*-tests were used to compare performance of the two groups on tasks of phonological recoding, invented spelling, and phonemic segmentation to verify that the two groups differed significantly. As reported in Table 1, results indicated significant differences favoring full over partial alphabetic phase readers on the measures of phonological recoding, invented spelling, and phonemic segmentation.

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

Table 1

Characteristics and Group Differences on Pretests for Partial and Full Alphabetic Phase Readers

Sources	Partial Alphabetic (N=20)		Full Alphabetic (N=20)			
	M	SD	M	SD	df	t
Participant Characteristics						
Gender (F; M)	9F; 11M		12F; 8M			
Number of Participants						
Kindergarten	8		7			
First Grade	12		13			
Age (Mo.)						
Kindergarten	71.88	3.23	72.00	2.16		
First Grade	75.33	4.25	79.23	7.82		
Reader Phase Classification						
Pretests						
Phonemic Segmentation (15 max)	4.75	3.57	7.35	2.81	38	-2.56*

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

Table 1 (continued)

Sources	Partial Alphabetic (N=20) M	SD	Full Alphabetic (N=20) M	SD	df	t
Invented Spelling (5 max.)	1.91	0.65	3.20	0.22	23	-8.40***
Phonological Recoding (5 max)	0.40	0.60	3.30	0.73	38	-13.71***
Other Pretests						
Capital Letters (letters per second)	1.13	0.36	1.35	0.35	38	-1.97
Lowercase (letters per second)	0.90	0.24	1.13	0.29	38	-2.80**
Letter Sounds (26 max.)	21.30	1.53	23.55	1.91	38	-4.12**
Woodcock Word Identification (55 max.)	9.65	7.62	20.30	10.85	38	-3.59**

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

Table 1 (continued)

Sources	Partial Alphabetic (N=20)		Full Alphabetic (N=20)			
	M	SD	M	SD	df	t
Double Letter Recognition Total (30 max.)	17.35	4.28	20.06	5.47	38	-1.74
Initial Doublets (10 max)	6.30	2.94	7.15[a]	2.41	38	-1.00
Final Doublets (10 max)	4.60	1.96	6.40[a]	1.47	38	-3.29**
Vowel Doublets (10 max)	6.05[a]	2.06	7.30[a]	1.49	38	-2.20*

*p<.05. **p<.01. ***p<.001.

[a] Mean value is beyond a chance level of performance at p <.05

Note: Test for Homogenity of Variance for invented spelling indicated $F(1,38) = 26.99$, p .001.

Equal variances not assumed for invented spelling reduced *df* from 38 to 23.

Initial Doublets = initial illegal vs. final legal doublets

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

The distributions of nonword decoding scores for the partial and full phase groups did not overlap. Among partial phase readers, 65% scored zero, 30% scored one, and 5% scored two with 0% scoring above two. Among full phase readers, 75% scored three, 15% scored four, and 10% scored 5 with 0% scoring below three on the phonological recoding task. The presence of a bimodal distribution of scores supports the qualitative distinction between the two phases.

There was some overlap in the distribution of scores on the invented spelling task. Among partial phase readers, 8% scored zero, 27.5% scored one, 34% scored two, 27.5% scored three, 2% scored four, and 1% scored five. Among full phase readers, 0% scored zero, 2.5% scored one, 13% scored two, 58.5% scored three, 18% scored four, and 6.5% scored five. However, the majority of the scores were different. Only 3% of partial phase readers scored above three whereas only 16% of full phase readers scored below three.

Several other pretests were administered to obtain more information on participants' phonological and orthographic ability: upper and lower case letter knowledge, letter-sound knowledge, double letter knowledge and word identification ability. *T*-tests reported in Table 1 indicated significant differences between the two phase groups on final doublet and vowel doublet knowledge, Woodcock test of word reading, letter sound knowledge, and lower case letter naming speed. However, the groups did not differ in their initial doublet knowledge and capital letter naming speed ability.

Performance on the double letter recognition pretest was subjected to further analysis to ascertain whether phase differences were indicative of beyond chance performance levels. The number of test items in each doublet knowledge subtest was ten with two

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

choices per test item. Therefore, chance level performance for each subtest was five. Examples of items testing knowledge of doublets were initial doublets (e.g., *luss* vs. *llus*), the task being to reject the illegitimate initial doublet and select the final legitimate doublet), final doublets (e.g., *viss* vs. *viww*), and vowel doublets (e.g., *haak* vs. *heek*). Each child's raw score on each subtest was compared to a raw score of 5 and a mean difference was calculated for each phase group to determine whether the mean difference was significantly greater than chance. A matched-paired *t*-test was conducted. Partial alphabetic phase readers detected legal doublets beyond a chance level for vowel doublet items, $t(19) = -2.28, p < .05$, and evidenced a trend that just missed significance for initial doublet items, $t(19) = -1.98, .05 < p < .10$ Partial alphabetic phase readers did not perform beyond a chance level for final consonant doublet items, $t(19) = .914, p > .05$. Full alphabetic phase readers demonstrated beyond chance performance for all types of doublet items: initial doublets, $t(19) = -3.99, p < .001$; final doublets, $t(19) = -4.27, p < .0001$ and vowel doublets $t(19) = -6.90, p < .0001$.

The proportion of phase readers scoring 6 or greater on the doublet letter pretest was examined to determine whether significant beyond chance level performance was due to high scores of a few participants. As reported in Table 2, the analysis indicated that for initial doublets at least 60% of partial and full phase readers had scores of 6 or greater suggesting that the majority of both phase groups had knowledge that initial doublets are illegal English spellings. However, a different pattern was evidenced for final doublet and vowel doublet responses. Full compared to partial alphabetic phase readers had more scores greater than five suggesting better knowledge of legal doublet patterns in the full

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

phase group. Interestingly, almost all of the full phase readers revealed knowledge of legitimate and illegitimate vowel doublets. This suggests the claim that full phase readers have strong vowel knowledge.

These findings support those of Cassar and Treiman (1997). They indicate that beginning readers in the partial and full alphabetic phases do possess knowledge about orthographic features of words that are not specified by their phonological properties. Partial phase readers indicated some awareness regarding which vowels in words are doubled; also, they recognized that words do not begin with double consonants. Full alphabetic phase readers revealed the same awareness as well as awareness about which consonants are doubled at the end of words.

To summarize the pretest outcomes, age was not a significant contributing factor in participants' classification as partial or full alphabetic phase readers. Differences between the two groups centered on reading and spelling skills. As expected, full alphabetic phase readers scored significantly higher on the three pre-tests used to classify reader phase which were invented spelling, phonological recoding and phonemic segmentation. Full alphabetic phase readers showed significantly higher mean scores on the tests of Woodcock word identification, letter sound knowledge, lower case knowledge, vowel double letter knowledge and final double letter knowledge. Significant differences between phase groups did not occur for initial doublet knowledge or for capital letter naming speed. To conclude, findings on pretests for the most part supported the hypothesis that full alphabetic phase readers would perform better than partial phase readers.

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

Table 2

Frequency and Proportion of Partial and Full Alphabetic Phase Readers Who Selected Six or More Correct Choices on the Doublet Letter Pretest

Sources	Initial Doublets	Final Doublets	Vowel Doublets
		Partial Alphabetic Phase (N=20)	
6	2	2	10
7	2	3	2
8	2	1	1
9	3	0	0
10	3	0	2
Total	12	6	15
%	60	30	75

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

Table 2 (continued)

Sources	Initial Doublets	Final Doublets	Vowel Doublets
		Full Alphabetic Phase (N= 20)	
6	5	4	4
7	0	6	9
8	2	2	1
9	0	2	3
10	7	0	2
Total	14	14	19
%	70	70	95

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

Word Learning Trials

Participants were classified as partial and full alphabetic phase readers. Then, each participant was randomly assigned to learn either Word Set A or B. Children practiced reading the words until the set had been read twice in a row without error. All participants reached criterion. Performance was subjected to analyses of variance. A one-way analysis of variance was done to determine whether full alphabetic phase readers took fewer trials to learn the words to criterion than partial alphabetic phase readers did. The independent variable was reader phase. The dependent variable was the number of word learning trials completed prior to reading words perfectly two times in a row. Test statistics indicated a significant main effect of reader phase $F(1,38) = 9.51, p < .01$. Full alphabetic phase readers had a lower mean score of 2.15 (SD = 2.68) compared to partial alphabetic phase readers mean score of 5.20 (SD = 3.52). These findings demonstrate that full alphabetic phase readers took fewer trials in learning to read new words than partial alphabetic phase readers.

A second analysis was done to examine performance during the first three word learning trials for the three types of words being learned (i.e., initial doublet, final doublet, or CVC spellings). The dependent variable was the number of words read correctly. A four way analysis of variance was conducted. The between-group variables were reader phase (i.e., full vs. partial) and word set (i.e., A vs. B). The within-group variables were trials (i.e., 1 vs. 2 vs. 3), and word type (i.e., initial consonant doublets vs, final consonant doublets and CVC spellings). Test statistics reported in Table 3 indicate significant main effects for reader phase, trials; and word type. The main effect for word set was not

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

significant. All interactions involving reader phase, word set, trials, and word type were not statistically significant (all p's > .05).

Mean performance, reported in Table 4, indicates that full alphabetic phase readers had significantly higher mean scores across all trials and types of training words than partial phase readers. Additionally, performance improved from Trials 1 to 3 on all three types of training words for both phase groups. Of the three word types, initial doublet words were not read as well as the other two types: M (initial doublet) = 2.52, M (final doublet) = 2.93, M (CVC) = 2.85. Post hoc Tukey tests showed that performance on initial doublet words was significantly worse than performance on the other two word types that did not differ. These findings indicate that words containing illegal initial doublets were harder for children to learn to read than words containing single consonants and legal final doublets

Word specific errors made during word learning trials. Word specific errors made during learning trials were explored to determine whether it took participants longer to learn particular training words and whether the pattern favoring full over partial phase readers held across words as well as across participants. The number of partial and full alphabetic phase readers who made at least one error learning training words during the word learning trials was tallied. Errors included misreadings and nonresponses.

Comparison of performance of the two reader groups on each word in Table 5 reveals that for 22 out of 24 words, full phase readers made fewer errors reading the words than partial phase readers. These findings are consistent with those above and indicate that the influence of reader group held across words as well as participants.

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

Table 3

Analysis of Variance of Words Read Correctly for Reader Phase, Word Set, Word Type and Trials

Sources	SS	MS	df	F
	Between Subjects			
Reader Phase	44.80	44.80	1	8.34**
Word Set	1.47	1.47	1	0.27
Reader Phase X Word Set	4.67	4.67	1	0.87
Residuals	193.37	193.37	36	
	Within Subjects			
Word Type	6.96	3.48	2	4.48*
Word Type X Reader Phase	0.62	0.31	2	0.40
Word Type X Word Set	4.42	2.21	2	2.85
Word Type X Reader Phase X Word Set	0.29	0.14	2	0.19

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

Table 3

Sources	SS	MS	df	F
Residuals (Word Type)	55.93	0.78	72	
Trials	15.54	7.77	2	12.99***
Trials X Reader Phase	0.87	0.44	2	0.73
Trials X Word Set	2.37	1.19	2	1.98
Residuals (Trials)	43.07	0.60	72	
Word Type X Trials	.44	0.11	4	0.26
Word Type X Trials X Reader Phase	2.58	0.64	4	1.48
Word Type X Trials X Word Set	1.51	0.38	4	0.87

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

Table 3 (continued)

Sources	SS	MS	df	F
Word Type X Trials X				
Reader Phase X Word Set	1.84	0.46	4	1.06
Residuals (Word Type X Trials)	62.73	0.44	144	

*p <.05. **p<.01. p <001.

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

Table 4

Means and Standard Deviations of Correct Responses for Partial and Full Alphabetic Phase Readers Across Trials (1-3) by Word Type

Sources	Partial Alphabetic (N=20)		Full Alphabetic(N=20)	
	M	SD	M	SD
Initial Doublet (max. = 4)				
Trial 1	2.30	1.30	2.95	1.05
Trial 2	2.45	1.23	3.55	0.76
Trial 3	2.80	1.15	3.50	0.89
Final Doublet (max. = 4)				
Trial 1	2.50	1.40	3.45	0.83
Trial 2	2.95	0.94	3.55	0.76

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

Table 4 (continued)

Sources	Partial Alphabetic (N=20)		Full Alphabetic (N=20)	
	M	SD	M	SD
Trial 3	3.35	0.93	3.65	0.75
CVC Spellings (max. = 4)				
Trial 1	2.60	1.47	3.35	1.09
Trial 2	2.85	1.18	3.45	0.89
Trial 3	3.10	1.17	3.80	0.52

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

Table 5

Frequency of Readers' Word Specific Errors[a] Made During Word Learning Trials for Word Set A and Word Set B

	Partial Alphabetic		Full Alphabetic	
Training Words	n	%	n	%
Word Set A				
jett	2	10	0	0
fitt	8	40	4	20
nutt	7	35	2	10
padd	7	35	5	25
lles	9	45	5	25
llim	7	35	2	10
lluk	5	25	4	20
rrag	8	40	2	10
wip	7	35	1	5
tub	5	25	2	10
fan	3	15	1	5
def	4	20	2	10

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

Table 5 (continued)

	Partial Alphabetic		Full Alphabetic	
Training Words	n	%	n	%
Word Set B				
dedd	1	5	2	10
kidd	4	20	2	10
mudd	5	25	3	15
patt	6	30	3	15
rrek	6	30	4	20
rrip	6	30	4	20
rrug	7	35	3	15
llam	5	25	3	15

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

Table 5 (continued)

	Partial Alphabetic		Full Alphabetic	
Training Words	n	%	n	%
web	3	15	1	5
fiz	5	25	3	15
van	2	10	2	10
tuf	6	30	5	25

Note:The number of participants reading words in each set in each phase group was 10.

a. The errors included misreadings and no response

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

Table 5 also reveals that the hardest words to read tended to be those that began with an initial consonant doublet. In Word Set A, the highest proportion of errors made by partial alphabetic phase readers occurred on the training word *lles* (45%). The highest proportion of errors made by full alphabetic phase readers occurred on the training words *lles* and *padd* (25% each). In Word Set B, the highest proportion of errors made by partial alphabetic phase readers occurred on the training word *rrug* (35%). The highest proportion for full alphabetic phase readers was on the training word *tuf* (25%). Thus, in three out of four cases, initial doublet words proved to be hardest to learn.

Furthermore, Table 5, reveals that the easiest words to read tended to be those that ended with a final doublet. In Word Set A, the smallest number of partial alphabetic phase readers made errors on the training word *jett* (10%). The smallest number of full alphabetic phase readers also made errors on the training word *jett* (0%). In Word Set B, partial alphabetic phase readers' made the fewest errors reading the training word *dedd* (5%). The full alphabetic phase readers made the fewest errors reading the training word *web* (5%).

Interestingly, in each word set the training word that participants made the fewest errors in learning tended to be the word that was introduced first on Trial 1 (i.e., Word Set A: *jett*; Word Set B: *dedd*). .

Posttests

After participants learned one of two word sets to two perfect consecutive trials, three posttests were administered to assess memory for the words that were learned. The posttests were Spelling Recall, Spelling Recognition and Spelling Transfer.

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

Spelling recall. The spelling recall task was a dictation task that required participants to write the spelling of each word that they learned to read. This task immediately followed the final word learning trial. Word type and sublexical position were hypothesized to affect spelling recall. A four-way analysis of variance was conducted. The between group variables were reader phase (i.e., full vs. partial) and word set (i.e., A vs. B). The within group variables were type of consonant recalled (i.e., singleton consonants in CVC spellings vs. doublet consonants in CCVC and CVCC spellings) and sublexical position of letters in training words (initial vs. final). The dependent variable was the correct recall of letters. Results of the analysis of variance are reported in Table 6. A main effect of reader phase was detected. Full alphabetic phase readers recalled more consonant letters with a higher mean score of 11.90 (SD = 1.94) compared to partial alphabetic phase readers' mean score of 10.25 (SD = 2.67). Main effects of letter type and position were detected as well as a significant interaction between type and position. No other main effects or interactions were statistically significant (all p's > .05).

From mean performance reported in Table 7 and Figure 5, the source of the interaction involving letter type and position can be seen. Among singleton consonants, final consonants were recalled almost as well as initial consonants, whereas among double consonants, final doublets were recalled much better than initial doublets. Because initial, but not final doublets were illegal and because at least some readers were aware of this as indicated by their pretest performance, this offers one explanation why readers were worse at remembering initial (illegal) than final (legal) doublets. Another possibility is that

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

Table 6

Analysis of Variance of Spelling Recall for Partial and Full Alphabetic Phase Readers on Word Set A and B for Type and Sublexical Position of Consonants

Source	SS	MS	df	F
		Spelling Recall		
		Between Subjects		
Reader Phase	6.81	6.81	1	5.06*
Word Set	.16	.16	1	.12
Reader Phase X Word Set	3.31	3.31	1	2.46
Residual	48.43	1.35	36	
		Within Subjects		
Type (Singleton vs. Doublet)	97.66	97.66	1	56.68***
Type X Reader Phase	.06	.06	1	.03
Type X Word Set	.77	.77	1	.44

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

Table 6 (continued)

Source	SS	MS	df	F
Type X Reader Phase X				
Word Set	.77	.77	1	.44
Residual (Type)	62.03	1.72	36	
Position (Initial vs. Final)	31.51	31.51	1	25.19***
Position X Reader Phase	.01	.01	1	.00
Position X Word Set	.31	.31	1	.25
Position X Reader Phase X				
Word Set	1.41	1.41	1	1.12
Residual (Position)	45.03	1.25	36	
Type X Position	43.06	43.06	1	41.42***
Type X Position X Reader Phase	.31	.31	1	.30
Type X Position X Word Set	.06	.06	1	.05

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

Table 6 (continued)

Source	SS	MS	df	F
Type X Position X				
Reader Phase X Word Set	1.41	1.41	1	1.35
Residual (Type X Position)	37.43	1.04	36	

*p<.05. **p<.01. ***p<.001.

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

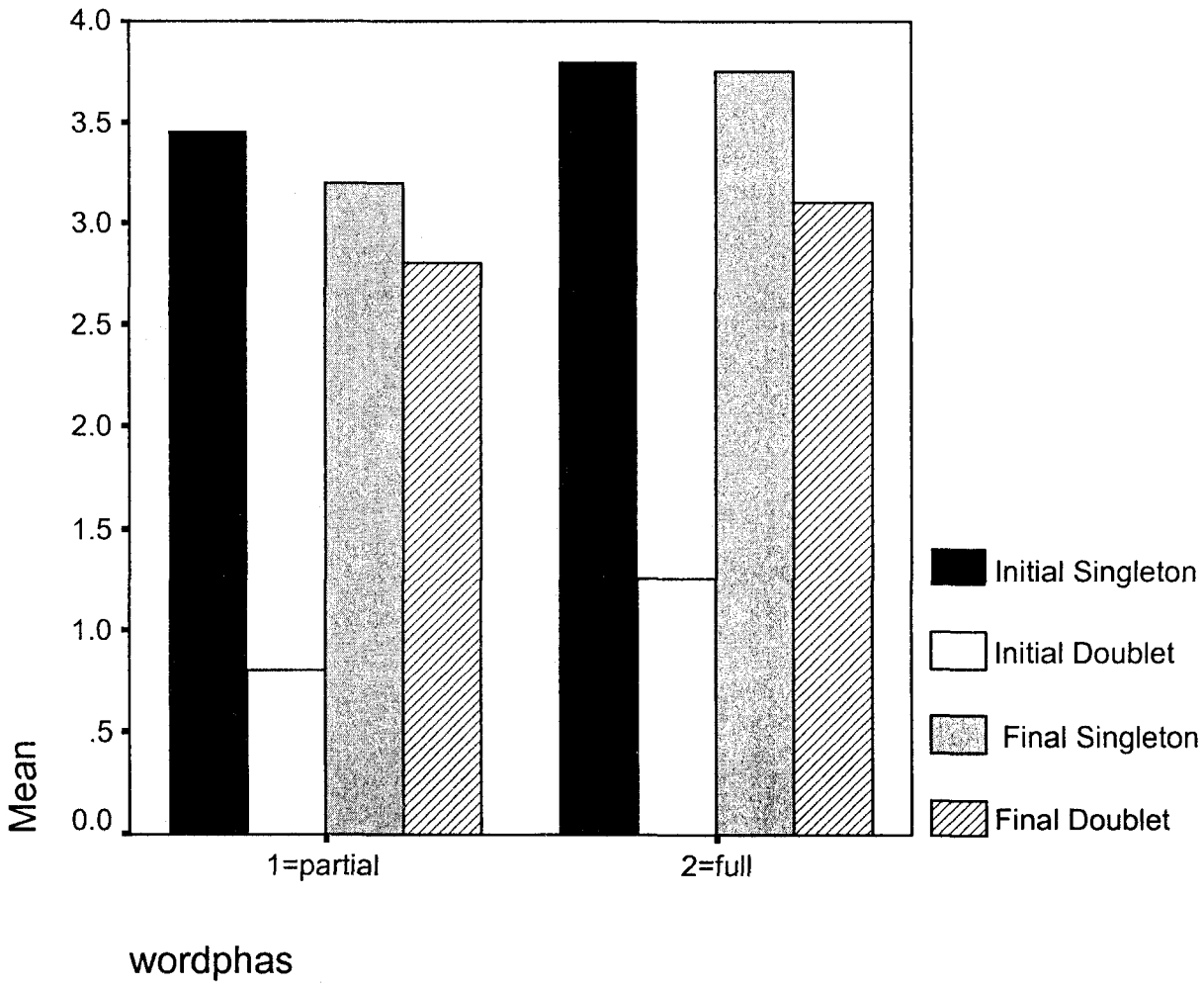
Table 7

Spelling Recall Mean Performance and Standard Deviation as a Function of Word Type and Sublexical Position

Source	Word Type			
	Singleton		Doublet	
Sublexical Position	M	SD	M	SD
Spelling Recall				
Initial (4 max.)	3.63	.84	1.03	1.29
Final (4 max.)	3.48	1.03	2.95	1.38

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

Figure 3. Partial and full alphabetic phase readers' consonant singleton and doublet spelling recall memory for the sublexical initial and final position.



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

because readers were less accurate reading words with initial doublets than final doublets, the former type was not secured as well in memory as the latter type.

Some additional measures of spelling recall were examined: number of vowels, number of final doublets that occurred once, and number of final doublets that recurred in three different words. It was expected that full alphabetic phase readers would recall significantly more vowels in training words than partial alphabetic phase readers. A one way analysis of variance was conducted. The independent variable was reader phase. The dependent variable was vowel letter recall. Mean performance demonstrated that full phase readers spelled vowels more accurately with a mean score of 7.60 (SD = 2.80) compared to partial alphabetic phase readers' mean score of 5.50 (SD = 2.86). The test statistic indicated that full alphabetic phase readers, as anticipated, had significantly better mean performance on vowel knowledge then partial readers, $F(1,38) = 5.52, p < .05$. This indicates that full phase readers formed complete connections between letters in words and their corresponding sounds during the word learning task.

Additionally, doublet frequency was postulated to affect spelling recall. This analysis was done only on final doublets because they are legal English spelling patterns. The hypothesis was that increased exposure to particular doublets would increase recall of those doublets. All recall items were assessed immediately after the training words were learned to a criterion of two perfect trials.

A two-way analysis of variance was conducted to compare the spelling recall for final doublets that occurred thrice vs. once for partial and full alphabetic phase readers to determine whether greater exposure to a particular doublet pattern would lead to greater

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

recall for that pattern. The between group variable was reader phase. The within group variable was doublet frequency (thrice vs. once). The dependent variable was the number of final doublets spelled correctly. Scores on the final doublet that occurred once were multiplied by 3 to render scores comparable to the doublets occurring 3 times. Test statistics indicated no main effect for reader phase $F(1,38) = 0.07, p > .05$. The unadjusted mean score for final doublets that occurred once was 0.68 (SD = 0.47). The adjusted mean score was 2.03 (SD = 1.42). The mean performance for final doublets with three instances of exposure per word learning trial was 2.28 (SD = 1.15). The F test comparing spelling recall for final doublets that occurred thrice vs. once was not statistically significant $F(1,38) = 1.04, p > .05$, indicating that seeing the same final letter doubled in three different words did not enhance participants' memory for that doubled letter over a doubled letter occurring in only one word.

Word Specific Analysis of Spelling Recall. Recall memory for training word consonant spellings for both word sets was explored to determine whether findings for participants were replicated across words and whether word specific lexical features influenced spelling recall. Table 8 shows the number of correctly spelled initial and final consonants produced by partial and full phase readers for each word in Sets A and B. Also it displays various kinds of errors that occurred, specifically the number of times that doublets were misspelled as single consonants, and the number of times that single consonants were misrecalled as doublets. Findings in the analysis revealed superior recall of consonants by full phase readers for about half of the words, and this was not dependent on consonant type. Full phase readers tended to produce more correct spellings than

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

partial phase readers for all training words (i.e., beginning initial consonant doublet, ending final consonant doublet and CVC spellings). There was not any one training word that was associated with a large amount of error, irrespective of word set or reader phase.

One possible reason why full phase readers' spelling performance was not uniformly superior across words is apparent in Table 8. Inspection of errors in Word Set B revealed that full phase readers were more apt to misrecall final doublets as single consonants than partial phase readers were (i.e., 11 errors vs. 4 errors, respectively).

Inspection of errors in which singletons were misrecalled as doublets or doublets misrecalled as singletons suggested that there were processes which interfered with full phase readers' correct spellings. There were 8 words that began with illegal doublets (i.e., *ll* or *rr*) and ended with single consonants across Word Set A or B. As is evident in Table 8, both reader phase groups showed the poorest recall of initial consonant doublets, 10% correct (partial) and 15% correct (full). Inspection of errors revealed that in most cases initial doublets were spelled as single consonants (see Table 8). However, inspection of readers' correct spellings of final singleton consonants in these words revealed a surprising phenomenon. For 7 out of the 8 words, full phase readers spelled fewer of these consonants correctly than partial phase readers (i.e., total of 36 singletons correct by full vs. 50 singletons correct by partial phase readers). Further error inspection revealed why. Full phase readers were more apt to double the final letters in these words than partial phase readers! In addition, full phase readers consistently converted the initial doublet to a singleton. There were no cases where the initial doublet was preserved and the final singleton was converted to a doublet. Full phase readers doubled final letters 27 times in

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

these words, whereas partial readers doubled these letters only 7 times. Doublet misspellings of individual words are reported in Table 9.

Full phase readers were not more apt to double final letters in all words. Final letters in CVC spellings were mistakenly doubled many fewer times than final letters in the training words that began with an initial doublet (i.e., 8 times vs. 27 times, respectively, see Table 8). Partial phase readers never doubled final letters in training words with CVC spellings.

One explanation for these findings is that full phase readers remembered that the training words that beginning with *l* or *r* contained a doublet, but they also recognized that initial consonant doublets are illegal English spellings, as shown by their performance on the doublet pretest. So, they responded by moving the doublet to a legal position at the end of the training words. Not all letter doublets that were produced were legal; however, a number of participants (7 out of 20) doubled the *k* at the end of words. Thus, although the position of doublets was shifted from illegal to legal, the particular letters doubled were not always legal.

One other phenomenon needing explanation is apparent in Table 8. Inspection of errors in Word Set B revealed that full phase readers were more apt to misrecall final doublets as single consonants than partial phase readers (i.e., 11 errors vs. 4 errors, respectively). It was not the case that full phase readers never doubled final consonants, for they did this sometimes in spelling training words that began with the initial doublet *ll* or *rr*. The reason underlying this misspelling pattern on Set B is not clear. The same pattern was not evident with training words in Set A where full phase readers were less apt to misspell final doublets as singletons than partial readers (i.e., 17 errors vs. 5 errors).

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

Table 8

Frequency of Partial and Full Phase Readers' Correct Responses Spelling the Initial and Final Consonants of the Training Words in Set A and Set B and Errors Recording Double Letters When Singles Were Correct and Single Letters When Doubles Were Correct

Word Set A

Training Responses	Correct				Errors		Initial Errors		Final Errors	
	Partial		Full		Partial	Full	Partial	Full	Partial	Full
	Initial	Final	Initial	Final	(D->S)[a]		(S. ->D)[b]		(S. ->D)[c]	
Jett	9	5	10	9	4	1	0	0	n/a	n/a
Fitt	9	6	10	8	4	2	1	0	n/a	n/a
Nutt	10	6	10	9	4	0	0	0	n/a	n/a
Padd	10	2	10	8	5	2	0	1	n/a	n/a
Lles	4	6	2	4	6	8	n/a	n/a	1	5
Llim	2	6	3	4	7	7	n/a	n/a	1	6
Lluk	2	6	3	3	6	6	n/a	n/a	1	5
Rrag	0	7	5	4	10	5	n/a	n/a	0	2

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

Table 8 (continued)

Training Responses	Correct				Errors		Initial Errors		Final Errors	
	Partial		Full		Partial	Full	Partial	Full	Partial	Full
	Initial	Final	Initial	Final	(D->S)[a]		(S. ->D)[b]		(S. -> D)[c]	
Word Set A										
Def	9	9	10	8	n/a	n/a	0	0	0	2
Wip	7	8	10	7	n/a	n/a	0	0	0	2
Tub	9	7	10	8	n/a	n/a	1	0	0	2
Fan	10	8	10	9	n/a	n/a	0	0	0	1
Total	81	76	93	81	46	31	2	1	3	25
Total Items	120	120	120	120	80	80	80	80	80	80
%	68	63	77.5	67.5	57.5	38.7	2.5	1.25	3.75	31.2
Word Set B										
Dedd	9	9	8	7	1	3	1	2	n/a	n/a
Kidd	10	7	10	8	2	2	0	0	n/a	n/a
Mudd	10	8	9	7	1	3	0	1	n/a	n/a
Patt	9	7	9	6	0	3	0	1	n/a	n/a

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

Table 8 (continued)

Training Responses	Correct				Errors		Initial Errors		Final Errors	
	Partial		Full		Partial	Full	Partial	Full	Partial	Full
	Initial	Final	Initial	Final	(D->S)[a]		(S. ->D)[b]		(S. -> D)[c]	
Rrek	0	4	3	5	9	7	n/a	n/a	1	2
Rrip	1	6	1	5	8	9	n/a	n/a	2	2
Rrug	2	7	3	5	6	7	n/a	n/a	1	3
Llam	5	8	4	6	5	6	n/a	n/a	0	2
Web	7	7	9	9	n/a	n/a	0	0	0	1
Fiz	7	8	8	9	n/a	n/a	0	1	0	0
Tuf	8	8	9	10	n/a	n/a	0	1	0	0
Van	8	8	8	8	n/a	n/a	0	0	0	0
Total	76	88	81	85	32	40	1	6	2	10
Total Items	120	120	120	120	80	80	80	80	80	80
%	63.3	73.3	67.5	71	40	50	1.25	7.5	2.5	12.5

D-> S[a] = falsely recalling a doublet as a singleton.

S->D [b]= falsely recalling a singleton as a doublet in the initial sublexical position.

S->D[c] = falsely recalling a singleton as a doublet in the final sublexical position.

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

Table 9

Partial and Full Alphabetic Phase Readers Initial Doublet Errors on Spelling Recall Memory Posttest

Training Word	Conventional Spelling	Spelling Responses	
		Partial Alphabetic	Full Alphabetic
Word Set A			
lles	less	lass (1)	lass (4)
			less (1)
llim	limb	lemm (1)	lamm(4)
			lemm (1)
			lumm (1)
lluc	luck	lakk (1)	lukk (2)
			lakk (2)
			kakk (1)
rrag	rag		ragg (2)

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

Table 9 (continued)

Training Word	Conventional Spelling	Spelling Responses	
		Partial Alphabetic	Full Alphabetic
Word Set B			
rrek	wreck	rikk (1)	rekk (2)
rrip	rip	rpp (1)	ripp (1)
		ripp (1)	repp (1)
rrug	rug	rgg (1)	rugg (2)
			rogg (1)
llam	lamb		lemm (1)
			lamm (1)

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

To conclude, in both word sets there did not appear to be any errors or correct responses associated uniquely with any particular training word. The most correct responses irrespective of word set or reader phase occurred for training words that had legal English spellings (i.e., ended with a final doublet or CVC spellings). The fewest correct responses were for training words with illegal English spellings (initial doublets). Full alphabetic phase readers made the most singleton to doublet errors by converting final singletons to doublets in words that began with an initial doublet.

Most of the training words consisted of spellings that differed from the conventional forms. For example, *mud* was taught as *mudd*. There were only 2 words out of 12 on each list that was spelled correctly. The number of participants producing correct spellings for words taught with unconventional forms was examined. Results are presented in Table 10. Relatively few were observed, a total of 11 by partial phase readers and 7 by full phase readers (maximum possible 200 per phase group). Ten of these conventional spellings were phonetic, containing one letter for each phoneme (e.g., *jet, rip*) whereas nine were more complex and included silent letters (e.g., *lamb, wipe, deaf*). More partial than full phase readers produced conventional spellings that were phonetic, 11 partial vs. 5 full. Very few complex conventional spellings were produced, only two (*less* and *dead*), both by full phase readers. Full phase readers, being more advanced, were more likely to know conventional spellings. The fact that they did not produce them indicates that they were engaged in recalling the spellings of words they learned rather than generating phonetic or conventional spellings. Additionally, conventional phonetic spellings were produced much more often when they were the forms taught (i.e., *tub, fan,*

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

web, van yielding 41 conventional spellings or 4.1 per word) than when they were not the forms taught (i.e., the 10 training words with phonetic conventional spellings altered to include double letters, yielding 16 conventional spellings or 1.6 per word). This is further evidence that participants were using their memory to spell words rather than inventing spellings.

Spelling Recognition. Partial and full alphabetic phase readers were asked to recognize correctly spelled training words with doubled letters in a multiple choice test administered up to three days after they learned to read the training words. A three-way analysis of variance was conducted to compare partial and full alphabetic phase readers' recognition of correct spellings. The between group variables were reader phase and word set. The within group variable was consonant doublet position (initial vs. final). The dependent variable was the number of words correctly recognized. Test statistics, shown in Table 11, indicated no significant main effects of reader phase or word set. The mean number of words recognized correctly by partial readers was M=4.85 (SD=1.87), and by full readers was M=4.35 (SD=1.84). The maximum score was 8.

Further analysis was conducted to determine whether the lack of influence of reader phase on performance occurred because both reader groups did not respond beyond a level of chance. A matched paired *t*-test was conducted. There were eight test items on the spelling recognition memory assessment and 3 choices per test item. Therefore, chance level performance was 2.67.

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

Table 10

Partial and Full Alphabetic Phase Readers' Production of Conventional Spellings on Spelling Recall Memory Posttest for Training Words

Spelling Taught	Conventional Spelling	Number of Conventional Spelling Responses	
		Partial Alphabetic	Full Alphabetic
Word Set A			
JETT	jet	1	0
FITT	fit	1	1
NUTT	nut	0	0
PADD	pad	1	0
LLES	less	0	1
LLIM	limb	0	0
LLUK	luck	0	0
RRAG	rag	3	1
DEF	deaf	0	0
WIP	whip	0	0
TUB	(same)	(2)	(3)
FAN	(same)	(6)	(8)

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

Table 10

Training Word	Conventional Spelling	Number of Conventional Spelling Responses	
		Partial Alphabetic	Full Alphabetic
Word Set B			
DEDD	dead	0	1
KIDD	kid	1	1
MUDD	mud	1	0
PATT	pat	0	2
RREK	wreck	0	0
RRIP	rip	2	0
RRUG	rug	1	0
LLAM	lamb	0	0
WEB	(same)	6	6
FIZ	fizz	0	0
TUF	tough	0	0
VAN	(same)	(5)	(5)

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

Table 11

Analysis of Variance of Spelling Recognition by Partial and Full Alphabetic Phase Readers on Word Set A and B for Sublexical Position of Doublet Letters

Source	SS	MS	df	F
		Between Subjects		
Reader Phase	1.25	1.25	1	.70
Word Set	.00	.00	1	.00
Reader Phase X Word Set	.45	.45	1	.25
Residual	64.10	1.78	36	

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

Table 11 (continued)

Source	SS	MS	df	F
		Within Subjects		
Position	5.00	5.00	1	3.85
Position X				
Reader phase	.05	.05	1	.04
Position X				
Word Set	7.20	7.20	1	5.55*
Position X				
Reader phase X				
Word Set	.05	.05	1	.04
Residual (Position)	46.70	1.30	36	

*p<.05. **p<.01. ***p<.001.

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

Each individual reader's raw score was compared to a raw score of 2.67 to determine whether mean raw scores were significantly greater than chance. Results for the matched paired t-test showed that both reader phase groups performed significantly higher than chance for recognizing initial and final doublets. For partial alphabetic phase readers, $t(19) = -5.21, p < .001$. For full alphabetic phase readers, $t(19) = -4.14, p < .001$.

An analysis of the proportion of phase readers who scored 5 or greater on the Spelling Recognition Posttest was done to determine whether beyond chance level performance was due to a few participants having large raw scores. Surprisingly, more partial alphabetic phase readers than full phase readers had scores that were 5 or greater: 65% of the partial readers vs. 40% of the full readers (see Table 12). However, the difference fell short of significance with $z = 1.58$, $p = .11$ (two-tailed). One explanation may be that partial phase readers' memory was boosted by their greater experience with words during the word learning trials.

In the spelling recognition test, it was predicted that more final doublets (legal English spellings) would be recognized than initial doublets (illegal English spellings). As evident in Table 11, the main effect of letter position was not significant. However, the interaction between letter position and word set was statistically significant. The cause of this interaction is evident in Table 13. In Set A, final doublet words were recognized much better than initial doublet words. However, in Set B, no such difference was evident and in fact the opposite pattern favoring initial doublets was slight but apparent.

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

Table 12

Proportion of Partial and Full Alphabetic Phase Readers Scoring Five or Greater on Spelling Recognition Posttest

Sources	Partial Alphabetic (N=20)	Full Alphabetic (N=20)
5	6	3
6	2	3
7	5	0
8	0	2
Total	13	8
%	65	40

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

Table 13

Mean Scores and Standard Deviations by Word Set for Correctly Recognizing Initial and Final Doublets

Source	Initial Doublet Recognition		Final Doublet Recognition	
	M	SD	M	SD
Word Set A	1.75	1.37	2.85	.93
Word Set B	2.35	1.35	2.25	1.16

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

Further analysis of the errors in the recognition task was conducted to determine whether more full compared to partial alphabetic phase readers chose final doublets when initial doublets should be chosen. This pattern was observed in the Spelling Recall Posttest, where, full alphabetic phase readers misspelled final single consonants as doublets when asked to spell words beginning with an initial doublet. Numbers of full and partial alphabetic phase readers performed equivalently in incorrectly choosing at least one final doublet when the initial doublet should have been recognized (i.e., 13 out of 20 in each group). However, full alphabetic phase readers made somewhat more errors of this type than partial alphabetic phase readers (i.e., total of 25 vs. 17 mistaken choices).

To conclude, it was predicted that full alphabetic phase readers would recognize more initial and final doublet letters in words they had learned to read than partial phase readers. However, this was not supported. Both partial and full alphabetic phase readers recognized doublets significantly beyond a level of chance. It was also anticipated that participants would recognize more final doublets (legal) than initial doublets (illegal), but this only occurred on one of the two word sets.

Spelling transfer. Partial and full alphabetic phase readers were assessed on their ability to transfer doublet spelling patterns from Word Sets A and B to similarly spelled new words. This spelling dictation test followed the Spelling Recognition Posttest, both given up to three days after training.

A one-way analysis of variance was conducted to compare partial and full alphabetic readers' generalization of initial and final doublets. The independent variable was reader phase. The dependent variable was the number of initial and final consonant doublets

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

included in spellings of the untaught words. Test statistics on initial and final consonant transfer indicated a nonsignificant main effect for reader phase $F(1, 38) = 0, p > .05$.

An analysis of partial and full alphabetic phase readers' correct transfer of doublets was conducted to examine the distribution of scores. As reported in Table 14, partial and full alphabetic phase readers' scores were low with most participants producing no doublets in their spellings.

Partial and full alphabetic phase readers' ability to spell the vowels in the transfer words was assessed. A one way analysis of variance was conducted to compare partial and full alphabetic phase readers' generalization of vowel knowledge to determine whether full alphabetic phase readers spelled vowels better than partial phase readers did. The independent variable was reader phase. The dependent variable was the number of correctly spelled vowels. Test statistics on vowel knowledge transfer for reader phase was significant favoring full phase readers, $F(1, 38) = 5.44, p < .05$.

To summarize, although it was predicted that full alphabetic phase readers would generalize more initial doublet and final doublet letters in their spellings of transfer words than partial phase readers, this was not supported. On average, participants transferred few if any doublet spellings to untaught words.

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

Table 14

Frequency of Partial and Full Alphabetic Phase Readers Correct Transfer of Doublets on Spelling Transfer Posttest

Sources	Partial Alphabetic	Full Alphabetic
Raw Scores (range 0-3)		
0	14	16
1	4	2
2	1	1
3	1	1
Total	20	20

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

The Spelling Transfer Posttest evidenced no substantial generalization of doublets present in training words. A more in depth inquiry was done to determine whether nonspecific doubling occurred. Results revealed that five partial alphabetic phase readers (25%), compared to seven full alphabetic phase readers (35%), doubled consonants in their spellings. Partial alphabetic phase readers' nonspecific doubling responses occurred in initial, medial, and final positions of the words, with the majority (70%) in final position. In contrast, all full alphabetic phase readers' nonspecific doubling responses occurred in the final sublexical position. These spellings are reported in Table 15. This is the same pattern demonstrated on the Spelling Recall and Recognition Posttests, in that full alphabetic phase readers tended to misrecall initial doublets (illegal English spellings) as final doublets (legal English spellings).

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

Table 15

Frequency of Nonspecific Doubling During Spelling Transfer Task by Partial and Full Alphabetic Phase Readers

Participants	Conventional Spelling	Expected Spelling	Spelling Response
Partial Alphabetic Phase Readers			
1.	lock	llok	llotaffpb
	lamb	llam	lamm
	loss	llos	lass
2.	bad	badd	ppot
3.	cud	cudd	tddn
4.	limb	llim	bidd
5.	cud	cudd	cutt

Table 15 (continued)

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

Participants	Conventional Spelling	Expected Spelling	Spelling Response
	rib	rrib	rubb
	ruff	rruf	ruff
	limb	llim	limm
Full Alphabetic Phase Readers			
1.	lock	llok	lokk
2.	rug	rrug	rogg
3.	rug	rrug	regg
4.	lamb	llam	lamm
5.	rib	rrib	redd
6.	lamb	llim	lamm
7.	limb	llim	lemm

Each cell represents participants' individual spelling generalization response(s).

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

CHAPTER 6

Discussion

The main aim of this study was to gain insight into the orthographic component of Ehri's visual-phonological route theory. Specific inquiry was made as to the point at which beginning word readers remember orthography. Ehri's phase theory was used to classify beginning readers. The recall, recognition and transfer of consonant double letters learned in training words by participants classified as partial and full alphabetic phase word readers was investigated. It was expected that full alphabetic phase readers would learn the training words faster and would score higher on all pre and posttest items than partial readers, because full alphabetic phase readers have more complete knowledge of the alphabet system and read words by sequentially sounding out each phoneme. Overall, this study's findings supported this hypothesis.

Full phase readers exhibited significantly higher mean performance on most pretest measures, except capital letter knowledge and initial doublet letter knowledge. Reader phase differences were also evident during word learning. Full alphabetic phase readers made fewer errors reading the words than partial phase readers did and as a result took fewer trials to learn to read training words.

On the spelling recall task, full alphabetic phase readers recalled more vowels and consonants than partial phase readers did. However exposure to a particular doublet in multiple words did not boost spelling recall for either reader group. Interestingly, during spelling recall of words with initial doublets, full phase readers were more apt to write the initial doublets as a singleton consonant and write the final singleton as a doublet

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

consonant. This tended to occur only for words that began with an initial doublet indicating that full phase readers transformed illegal doublet spellings into legal doublet spellings.

Readers in both phases recognized spellings of doublets beyond a chance level on the spelling recognition task, and the two groups did not differ indicating that both phase groups remembered doublet spellings. However, in one of the word sets, spellings of words with final doublets were recognized better than spellings with initial doublets, but the difference was not evident in the other word set!

On the spelling transfer task, little use of doublets was observed, indicating that doublet patterns learned in training words were not generalized to new words. Full alphabetic phase readers represented the vowel in spelling transfer words because they had greater knowledge of short vowels. Even though correct transfer of doublets for the most part did not occur, there were differences between the two phase groups in nonspecific doubling (i.e., using a different doublet than the doublet in the training word). Only full alphabetic phase readers' nonspecific doubling responses consistently occurred in the final sublexical position, the position for legal English doublets.

The other hypothesis that partial phase readers would remember initial and final doublets was supported. Partial phase readers remembered orthography in the initial and final positions because these are the partial cues they use to read words. Accordingly, partial phase readers did not on average represent vowels during the spelling recall posttest. However, partial phase readers had a beyond a chance level recognition of legal English vowel spellings. It is easier to recognize familiar spellings than it is to recall

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

them. It is concluded that as beginners learn to read, the grapheme-phoneme connections that they use to read words determines the orthography that is recalled.

Additionally, both groups showed evidence of knowledge of English orthography. Illegal initial doublets were harder for all participants to learn than legal final doublets and CVC spellings.

Both reader phases had higher-than-chance levels for recognizing initial and final doublets. However, neither of the reader phase group's evidenced transfer of initial or final doublets. These findings must be considered in more detail in order to explain results, introduce alternative explanations, and consider theoretical, developmental, diagnostic and instructional implications.

Why did full alphabetic phase readers not show greater capital letter knowledge than partial phase readers? Significant reader phase differences were not evident because partial and full alphabetic phase readers either reached ceiling or performed close to a ceiling level on the pretest of capital letter knowledge. To be included in the study, participants had to know at least twenty letters. So, those with lower scores were dropped. Furthermore, capital letters are generally learned before children enter school (Adams, 1998). In one study, English speaking Californian 5-year-olds was able to name 71% of uppercase letters correctly (Masonheimer, 1982 cited in Ehri, 1986). In the present study, participants were over five years old.

Why did full phase readers compared to partial phase readers make fewer errors and take fewer trials and recall vowels during training on the Spelling Recall Posttest? According to the findings in the present study, this occurred because full phase readers

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

had more letter-sound correspondences mapped to memory, and this facilitated learning training words faster and having fewer errors. Ehri (2000) has explained that, "at this level, children understand the basic system that accounts for many letters in conventional spellings, so they find it easier to remember how to read words than children at the partial level." Full alphabetic phase readers not only know more consonant grapheme-phoneme correspondences than partial phase readers, but more vowel grapheme-phoneme correspondences, as well. Accordingly, full phase readers recalled vowels and partial phase readers, for the most part, did not.

Why did doublet frequency not contribute to participants' recall of training word spellings? Although the memory recall posttest immediately followed the word learning trials, specific doublet categorical knowledge did not significantly develop. One possible explanation is that there were not enough items of each linguistic type (i.e., *dd tt* or *ll rr*) to ensure that specific categorical knowledge was formed. Still, Reitsma (1983) found that as few as four practice trials were needed to retain letter information about specific words in memory. Although participants remembered specific words, they did not recognize doublets as general spelling patterns. How many instances that are required to support generalization awaits study.

An alternative explanation may lie in the linguistic features of the letters that were chosen as doublets. Both /t/ and /d/ were used as doublets. Their only distinguishing linguistic feature is that /t/ is unvoiced whereas /d/ is voiced. Specific categorical knowledge may take longer to develop between phoneme-graphemes that are separated by minimal features. Moreover, *tt* and *dd* doublets are not always pronounced distinctively.

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

For instance, in *little* and *middle* both doublets are pronounced close to /d/.

Why did full alphabetic phase readers during spelling recall and recognition change initial doublet to a singleton and final singleton to a doublet in words that began with an initial doublet? Initial doublets, which are illegal English spellings, were changed into into final doublets, which are legal English spellings, because young children tend to overgeneralize the patterns they knew. Common patterns (such as final doublets) become mapped to memory. Through the mapping process, overregularization is applied for uncommon or irregular patterns (initial doublets) that occur in specific words and are remembered as a doubling feature of the words. During the application of this general principle, initial doublets are erroneously reduced to singletons while final singletons are erroneously doubled. This suggests that development progresses from a general doubling principle to memory for letters that double in specific words. A similar phenomenon occurs during language development, wherein a child understands that the suffix *ed* signals the past tense and erroneously applies this knowledge to an irregular verb (e.g., "I goed to the store").

Why did full alphabetic phase readers outperform partial phase readers in recalling spellings, but not in recognizing spellings? Most likely it is because it is easier to recognize a correct spelling than it is to remember how to produce it.

Recognition memory is more sensitive than recall memory. According to Long and Prat (2002), recognition only requires familiarity. Therefore, recognition tasks have a lower retrieval demand than recall tasks. In fact, children as young as kindergartners reveal this recognition-recall distinction, although young children may not fully

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

understand why recognition is easier (Spier and Flavell, 1979). Accordingly, age differences have not been found in recognition data (Myers and Perlmutter, 1978; Naus, Ornstein and Kreshtool, 1977 Perlmutter , 1984; Perlmutter & Myers , 1979 as cited in Schneider and Pressley, 1997). No phase differences were apparent for recognition memory because both partial and full alphabetic phase readers, having read the training words, were familiar with them.

The present study replicates Reitsma's (1983) finding that unfamiliar real words that were learned could be remembered three days later. Reitsma did not require students to remember spellings but only to read them. The present study only required participants to recognize spellings. The ability to read and recognize spellings involves memory. Partial and full phase readers recognized initial and final doublets beyond a chance level. Although it was assumed that the full phase reader, having more knowledge, should both recall and recognize more training word spellings than partial phase readers, full phase readers only differed from partial phase readers in recalling more spellings but nor in recognizing more spellings. Recall tasks require that information is retrieved. Recognition tasks considerably reduce retrieval demands and because they require only familiarity even novices can perform well on recognition tasks (Long and Prat, 2002). Although both phase readers had a memory for the spellings, phase differences were not apparent because even a novice reader could recognize spellings.

Recognition memory is generally superior to recall, but superiority is influenced by distractors and by time (Coon, 2001). Regarding the impact of distractors, full phase readers may have had more difficulty recognizing correct spellings because the distractors

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

were especially attractive, more so to them than to partial readers. The incorrect choices were spelled similarly to other words that appeared on the word learning task. For example the correct choice *jett* was paired with the incorrect choices, *jjet* and *jet.* Full phase readers may have been more aware of these competing spelling patterns than partial readers. Regarding the impact of exposure time, full phase readers did not have as many exposures to the words as partial phase readers. According to Reistma (1983), a minimum of four exposures to words is needed for beginners to retain spellings of specific words in memory. Inspection of the percentage of participants who were exposed to the set of words at least four times revealed 45% of the full phase readers and 80% of the partial phase readers. Partial phase readers had more exposures because they took a longer time to reach criterion. Most full phase readers were exposed to words fewer than four times, because they took less time to reach criterion, resulting in their being able to immediately recall spellings but not differentially recognize spellings three days later any better than partial readers.

On the Double Letter Recognition Pretest, why did partial phase readers recognize legal vowel doublets, yet not recall vowel spellings of training words? The answer to this question is related to aspects of the previous discussion. Partial alphabetic phase readers recognized vowel doublets because they experienced enough words to recognize legal and illegal vowel doublets, but they did not have enough knowledge of vowel grapheme-phonemes to recall training words' vowel spellings.

Why was vowel knowledge represented on the transfer task while consonant doublet knowledge was not? To succeed in the transfer task, participants had to notice that the

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

training word spellings and new spellings were analogous, due to their phonologically identical rime pattern. In the pilot study, transfer was not detected (refer to Appendix P). It was thought that the lack of transfer might be due to the fact that the administrative instructions did not explicitly state that the participants should generalize the orthographic information gathered during training to the transfer task. As Detterman and Sternberg (in press) note, "It is amazing the extent of similarity it is possible to have between two problems without subjects realizing that the two situations are identical and require the same solutions. Evidently, the only way to get subjects to see the similarity is to tell them or point it out in some not so subtle way" (p. 20). To correct for this potential problem, the final study's administrative directions explicitly asked children to write the spellings by recalling the letter patterns they had just learned. Yet, instances of transfer were rare. When they did occur, it was full alphabetic phase readers' generalization of vowel knowledge from learned words to the transfer task. Neither initial nor final doublet knowledge transferred.

According to Omrod (2002), transfer is facilitated when learning is meaningful, when the similarity between two instances increases, when a short amount of time has elapsed, when the material is perceived as context-free, when the instructional time increases and when there are varied examples and opportunities for practice. All of these precursors to transfer were evident in the training experience, except an increase in instructional time and varied examples.

All of the words were phonetically real words, although most of their spellings were not conventional. Sentences were used to give the words a meaningful semantic context.

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

Phonetically the rime patterns were the same. No more than three days elapsed between training and the transfer assessment. The words were context free; sentences were only given initially for training words to be meaningful. Furthermore, full alphabetic phase readers have phonological recoding ability. Ehri and Robbins (1992) suggested that phonological recoding facilitates reading analogous words. The question that arises is why didn't phonological recoding facilitate transfer to the spelling of analogous words? Full alphabetic phase readers demonstrated phonological recoding ability during the pretests. How much phonological recoding ability is necessary for transfer to the spellings of analogous words to take place? Even though nonspecific doublet transfer did occur equivalently among reader phase groups (approximately 25% of each reader phase group), correct transfer was minimal. The non-specific transfer that occurred indicated that most of these participants applied their knowledge of orthographic structure and demonstrated that consonant doublets should appear at the end of words and not at the beginning. The question remaining for future research is what facilitates transfer?

Why was it that both phase reader groups had greater difficulty learning illegal than legal English spellings? It is not surprising that full alphabetic phase readers had greater difficulty learning illegal than legal English spellings, and they differentially recalled legal better than illegal English spellings. However, even partial phase readers demonstrated orthographic sensitivity, in so far as retention of consonant spellings varied with the type of consonant (singleton or doublet) and its position (initial or final sublexical position) and this was more surprising. This further supports other evidence that young children do acquire orthographic knowledge before second grade, as shown by responding faster to

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

words than psuedowords (McCaughey et al., 1980), word likeliness tests (Badian, 1994b, 2001), and discriminating between legal and illegal consonant doublet spellings (Cassar and Treiman, 1996, 1997).

What were the strengths of the present study? The present study's strengths are related to assessment. In the present study, a direct method was used initially to assess orthographic knowledge and later to assess retention of training word spellings. This provided information as to which spelling patterns were mapped to memory. Furthermore, the participants were grouped based on phase theory, which provided an opportunity for references to the specific processes used to spell and read words. This was the case even for children who had pre-primer level word identification ability. Moreover, a word learning task was used to provide a more natural context to the way spellings are actually learned.

The direct methods that were used to initially assess orthographic knowledge were legal vs. illegal English spellings and invented spellings. These assessments gave indications of whether beginning readers are able to recognize legal English doublet spellings and the types of processes used to spell unfamiliar words. Through these assessments, it was concluded that there were developmental differences in recognizing legal English spellings and in inventing spellings. However, the use of a direct method to assess the recall of the spellings of training words was insightful. The direct method used was simply to produce training word spellings after the words were learned and read without errors two consecutive times. Through this assessment, a window was opened to reveal that particular types of spellings became mapped to memory as a result of phase

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

differences.

Grouping participants into partial and full alphabetic phase readers allowed for phase based conclusions to be drawn concerning all aspects of this study. This is important because demarcations of ability that involve grade or age do not provide precise information concerning pre-primer reading ability. For example, in the present study there were kindergartners who were classified as having a more advanced word reading ability than some first graders. Additionally, often the reading assessments that are administered are not linked to a developmental model (e.g., WRAT or Woodcock Word Identification). As such, these assessments can only provide information concerning whether grade level ability is evidenced or not. If a child has a pre-primer or primer level score, the test provides no information concerning a child's word reading processing or ability. Other demarcations of ability, such as language awareness or facility, may provide some information about phonemic awareness or English fluency but, as is the case with grade or age, they do not provide information concerning the processes used to read.

In the research literature, beginning readers' orthographic assessment rarely includes both word reading and spelling levels. This perpetuates the illusion that reading and writing are unrelated, although they are found to be related in a number of studies (Griffith, 1987; Juel, Griffith & Gough, 1986; Uhry & Shepherd, 1993) in which first grade students were asked to read a list of words or write dictated words or distinguish correct from incorrect spellings. In the present study, however, invented spelling and phonological recoding ability were used as reader phase classification measures. Ehri (2000) declared that reading and spelling are two sides of the same coin, in that reading

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

utilizes grapheme-phoneme relations and spelling utilizes phoneme-grapheme relations. Inclusion of word reading and spelling levels allow the further analysis of the relationship between early spelling and word reading. Using both a measure for word reading (in this case phonological recoding) and invented spelling ability in classifying children not only served to classify children by phase but can also demonstrate concurrence between two compatible theories of development. As was apparent in this study, the greater the phonological recoding ability; the closer the approximations of invented spellings to conventional forms. Full alphabetic phase readers read more nonwords than partial phase readers, and produced more accurate invented spellings than did partial alphabetic phase readers.

A word learning or reading task is the most appropriate context for assessing orthography. It is most analogous to the natural context in which spellings become mapped to memory. As children repeatedly read the same spellings, the spellings are eventually remembered. As the number of trials increased during training word trials, words were read more accurately. Assessing orthography should include processes reflective of how orthography is learned.

What are the limitations of the study? The primary limitations of the study are related to the validity of phase classification variables, instrumentation and generalization. Essential to the research design is the requirement that participants are divided into two groups, based on the three pretests, invented spelling, phonological recoding, and phonemic segmentation. Reader phase classification was the independent variable. Use of the three pretests to group participants yielded distinctive differences between partial and

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

full alphabetic phase readers. However, when the informed consent forms were distributed to the various teachers, this researcher observed explicit instruction in phonemic segmentation in two kindergarten and one first grade classroom. This was done in preparation for the ECLAS exam, an end-of-year primer level literacy assessment measure. To address this, the phonemic segmentation assessment was used to confirm rather than to establish phase classification. Although performances on the three pretests used to classify phase readers were significantly different between groups. The phonemic segmentation pretest was the least significant. Studies that use reader phase classification as an independent variable need to ensure validity by incorporating in to their procedures observation of instruction and inquiry into class preparation for, and types of test items in, primer level literacy assessments.

The Spelling Transfer Posttest as a measure of participants' ability to generalize training word spellings is of questionable validity. The spelling consonant transfer task did not reveal significant performance differences between reader phase groups because participants read training words repeatedly until they were able to read the words without error two consecutive times, but partial phase readers had greater exposure to the training words than full phase readers, thus perhaps explaining the lack of between group differences. Furthermore, the Spelling Transfer Posttest scores showed that even full phase readers had little capability to perform this task. Full phase readers' low mean scores on this measure may indicate that at this phase transfer ability is not yet developed. However, it is also possible that their low mean scores are a result of a study design flaw; perhaps they were not exposed to words enough times to overlearn the spelling patterns. .

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

Finally, generalization of this study's findings is limited to African-Americans and Latino-Americans from a lower SES level. Although a gifted school was included, students are not classified as gifted until 2nd or 3rd grade, beyond the grades tested here.

What are this study's theoretical implications? The present study affirms that the beginning reader remembers orthography. The visual-phonological route theory postulates that there is only a visual phonological route to sight word acquisition. When the beginning reader phonologically recodes sight words, both the words visual (orthographic) and phonological features are processed and retained in memory. Therefore, some types of orthographic patterns are known even by the beginning sight reader. During the partial alphabetic phase, children read words by using partial letter-sound connections. As the present study affirms, partial alphabetic phase readers' memory for orthography reflected the partial letter-sound connections they used to read words. Partial alphabetic phase readers were able to remember doublets in the final position. This signaling shows that letter-sound connections are not limited to individual letters mapping to individual sounds. Rather, it is the graphemic representation of a phoneme that maps to memory, even at the earliest phase of development of word reading. When letter-sound relations are used to initially recode words, the grapheme-phoneme correspondences become mapped to memory. Through this recoding process the reader teaches himself or herself orthographic patterns (Share, 1995). The current study indicated that even partial alphabetic phase readers were able to discern legal from illegal English spellings. Additionally, common patterns were remembered more than uncommon patterns. The finding that both phase reader groups recalled more single

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

consonants (a common pattern) than double consonants (an uncommon pattern) supports this. For, although the initial position is most salient for beginners, initial double letters (uncommon patterns) were not remembered. This shows the strength of background alphabetic knowledge for legal English spellings. This process facilitates lexical expansion. This is how sight words are acquired, irrespective of the instructional process used.

What are the study's developmental implication? This study confirms phase theory's basic premise that the more advanced phase reader has a greater understanding of the alphabet principle. The study confirms that developmental differences between partial and full alphabetic phase readers occur at the level of the vowels (Ehri, 1992). Full alphabetic phase readers scored significantly higher than partial alphabetic phase readers for vowel recall, and for vowel spellings on the transfer task. Thus, full alphabetic phase readers form more complete connections between phonemes and graphemes. In contrast, partial alphabetic phase readers form incomplete letter-sound connections (Ehri, 1992, 2000). The current study found that partial phase readers did not remarkably recall vowels on the spelling recall task nor did they represent them on the transfer task. Moreover, during the spelling recall task, partial phase readers primarily recalled initial and final graphemes. This may be due to the initial benefit from adjacent blank space to the left and right of fixation (Bouma, 1979).

What are the study's diagnostic implication? There is a greater need for direct assessment in the study of orthographic retention. This study used direct methods to study orthographic retention, and supports prior findings that late kindergartners and first

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

graders demonstrate orthographic knowledge. A direct assessment determines the types of lexical items that are mapped to memory. Direct methods are those orthographic assessments that are able to consistently identify not only which phoneme-grapheme correspondences have mapped to memory, but also developmental differences in memory for phoneme-grapheme correspondences.

Direct methods such as identifying English spellings (Cassar & Treiman 1996; 1997; Ehri & Robbins 1992; Foorman et al, 1996;McCaughey, M. et. al., 1980; Reitsma, 1983; and Treiman et. al., 1990), and using invented spellings for unfamiliar words (Beers & Henderson, 1977; Gentry, 1982; Morris & Perney, 1984; Treiman et.al., 1995; Treiman et. al., 1993; Treiman, 1993) reveal orthographic knowledge by opening a window to the types of information stored in the brain. The direct method used in this study was a word learning-spelling production task. Words were learned and participants were asked to spell the words. This process elucidated the connection between reading and spelling, while enabling an investigation of a variety of sublexical positions with or without multiletter features and noting learning latency effects. This type of orthographic assessment provides more information about orthographic development than do other direct methods of assessment.

What is the instructional implication of the study? It is necessary that the methods employed in initial reading instruction utilize the natural processes that co-occur during the acquisition of sight words. According to visual-phonological route theory, the chief operative cognitive process during sight word acquisition involves phonology and orthography. The present study affirms that the beginning reader remembers orthography

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

from the time that a child is able to read a word, whether partial or full cues are used.

This implies that once a child is able to read a word, he or she is able to understand instructional methods that involve grapheme- phoneme correspondences. Such an approach is labeled grapho-phonemic instruction. This type of instruction takes a variety of forms: (a) simply pairing phonemes with their graphemes (Marsh & Mineo, 1977), (b) categorization of sounds (Bradley & Bryant, 1983), (c) more complex activities such as word box or word sort instruction (Joseph, 2000), (d) or phonological awareness training coupled with letter sound correspondence training (Ball & Blachman, 1991; Schneider, Roth & Ennemoser, 2000) (e) or training in segmenting and spelling phonologically regular words (Uhry & Shepherd, 1993) and (f) invented spelling (Clarke, 1988). This approach is associated with synthetic phonics programs, which explicitly teaches students to convert letters into phonemes and blend them into recognizable words (Report of the National Reading Panel, 2000) Synthetic phonics programs do not have to be negated by drill the skill tactics. Letterland is an example of a synthetic phonics program that used picture mnemonics to teach letter sound correspondences by integrating a picture of the corresponding phoneme on to the shape of each alphabet letter. Study of Letterland concluded that the shape of letters included in pictures reminded learners of letter sound correspondences (Ehri, Deffner and Wilce, 1984).

Implications for Future Research

The present study investigated orthographic retention in beginning readers who were classified as either partial or full alphabetic phase readers. Results indicated that partial alphabetic phase readers, despite using partial cues to read words and semiphonetic cues

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

to spell words, retained orthographic information as they learn to read words. This suggests that the development of beginning readers would benefit from activities that support the phonological-orthographic connections. The unique combination and presentation of phonological-orthographic connections needs further exploration. Will utilizing both these modalities have a more profound affect on sight word retention? Will explicit instruction have to be given in order for students to attend to particular phonological-orthographic connections?

This study suggests that teachers should incorporate word learning-spelling production tasks into student assessment. In the present study, orthographic patterns were not introduced as part of meaningful text reading. Yet, this paper is not intended to implicate a drill-and-test instructional modality. The form that this should take in a classroom context needs to be qualified.

Another area for future research is the relationship between learning consonant orthographic patterns and their generalization to new words. In the present study, significant specific consonant doublet transfer did not occur for either partial or full alphabetic phase readers. Does transfer of doublet or multiletter patterns begin in the consolidated alphabetic phase? How many pattern exposures are required before it occurs? Of note, transfer of doublet patterns was not assessed using a recognition task, which might have demonstrated greater sensitivity to doublet patterns in new words.

The minimal frequency of presentation for a particular orthographic pattern is unclear. In the present study, patterns that were introduced thrice in word learning trials, as opposed to once, failed to contribute to significant spelling recall. The frequency with

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

which phonological-orthographic connections are presented needs further exploration. The current study facilitated theoretical, developmental, diagnostic, and educational considerations relevant to the field of literacy acquisition by investigating the orthographic component of the visual-phonological route theory.

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

Appendix A

Board of Education Approval to Conduct Research in School Districts

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

BOARD OF EDUCATION OF THE CITY OF NEW YORK
Harold O. Levy, *Chancellor*

DIVISION OF ASSESSMENT AND ACCOUNTABILITY
110 Livingston Street, Room 728, Brooklyn, NY 11201
Phone: (718) 935-3767 Fax: (718) 935-5268

ROBERT TOBIAS
EXECUTIVE DIRECTOR

APPROVAL TO CONDUCT RESEARCH IN SCHOOLS/DISTRICTS

To the Superintendent/Principal:
The research study described in the Proposal Summary has been approved by the Proposal Review Committee (PRC) of the Division of Assessment and Accountability. (See the Approval Letter signed by the Chair of the PRC.) This researcher is now seeking principals and superintendents willing to cooperate in the study. Please sign below if you agree to have your school participate in this study.

Before beginning the study, the researcher must submit this form to the Division of Assessment and Accountability with signatures of cooperating principals.

NOTE:

Researchers who need to be in schools must have fingerprints on file at the Board of Education prior to field work.

Where data collection includes information from records, school personnel must ensure that confidentiality is preserved.

Researcher/Principal Investigator: Donna-Marie Wright
Title of Project: Do Beginning Readers Remember Orthography

Research Will Involve:

Cooperating School	District #	Grade(s)	# of Classes	# of Staff Pupils	Signature of Principal
1 P.S.	14	K & 1st	3	48	Patricia Hayden-Singleton
2 P.S.	16	K & 1st	4	60	Dr Foxie-Baptiste
3					
4					
5					

Superintendent's Signature _____ District _____

Superintendent's Signature _____ District _____

Superintendent's Signature _____ District _____

10/98

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

Appendix B

Informational Letter and Parent Consent Form

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

Ph.D. Program in Educational Psychology

The Graduate School and University Center
The City University of New York
365 Fifth Avenue
New York, NY 10016-4309
TEL 212.817.8295 FAX 212.817.1516

My name is Donna Wright and I am a *student* in the Educational Psychology Ph.D. Program at the Graduate Center of The City University of New York (CUNY), and Principal Investigator of this project, entitled "Do Beginning Readers Remember Orthography." This is a research study of kindergarten and first grade children's memory of spelling patterns. The study is expected to provide us with more information about spelling and reading processes. I would like permission for your child to participate in this study.

I will meet with your child a maximum of six times. All children will participate once. Those reading no higher than a first grade level will participate for five additional sessions. Each time I meet with your child the meeting will last for 35 minutes. The study will take place in the school during school hours. The teacher will schedule the tasks to make sure that no important activities are missed. Typically, students enjoy these sessions and look forward to participating in them. With your permission, I would like to make an audiotape of these sessions, so I can record the details accurately. My advisors and I will only hear the tapes. All information gathered will be kept strictly confidential, and will be stored in a locked file cabinet, to which only my advisor and I will have access. At any time your child can refuse to answer any questions or end the session without penalty.

There are no known risks involved in this study. The benefits of your child's participation are that he/she will have interesting reading and spelling tasks that support classroom activities. There will be approximately 40 participants taking part in this study.

I may publish results of the study, but names of people, or any identifying characteristics, will not be used in any of the publications. If you would like a copy of the study, please provide me with your address and I will send you a copy in the future.

If you have any questions about this research, you can call me at (718) 599-5092 or my email address,dwright@ccny.cuny.edu or my advisor Dr. Linnea Ehri at (212) 817-7000 or lehri @gc.cuny.edu. If you have questions about your rights as a participant in this study, you can contact Hilry Fisher, Sponsored Research, The Graduate Center/City University of New York, (212) 817-7523, hfisher@gc.cuny.edu.

. I will give you a copy of this form to take with you.

I_____agree to have my child _____ participate in the study described above.
(Parent's Printed Name) (Child's Printed Name)

I agree to have this interview taped please [circle one]:
Yes No

Is English your child's first language? [circle one]
Yes No

What language do you and your family speak most often at home?
Yes No

Do you want information shared with your child's teacher [circle one]
Yes No

Graduate School & University Center / CUNY
IRB
Approved
6-21-04-02
Approved: 4/17/03 To Expired: 4/16/03

_____ _____
Parent's Signature Date Investigator's Signature Date

The Graduate School and University Center is The City University of New York's doctorate-granting institution, which operates in consortium with all the CUNY campuses : Bernard M. Baruch College : Borough of Manhattan Community College : Bronx Community College : Brooklyn College : The City College : The City University of New York Medical School : The City University of New York School of Law at Queens College : The College of Staten Island : Medgar Evers College : Eugenio Maria de Hostos Community College : Hunter College : John Jay College of Criminal Justice : Kingsborough Community College : Fiorello H. LaGuardia Community College : Herbert H. Lehman College : New York City Technical College : Queens College : Queensborough Community College : York College

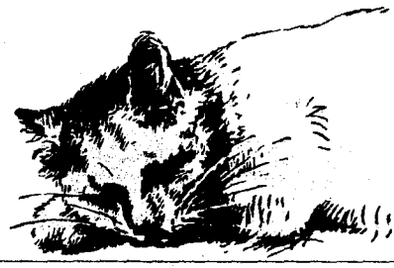
Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.

Appendix C

Children's Assent Form

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

Name _____



If you want to be a part of this study circle the smiling face. If you do not want to be part of the study, circle the cat.

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

Appendix D

Complete Administrative Instructions

Letter Name Knowledge

Materials. The materials used in this task were three 9 X 5 ½ cards (one of which is a practice card). The practice card was the first card presented. It had six capital letters on it and an opaque covering with X's, designed to prevent the child from prematurely seeing the letters. The other two cards had either twenty-six capitals or lower case letters randomly arranged. The score range for capital letters was 0-26. The score range for lower case letters was 0 – 26. Scores were recorded on a recording sheet. Stop watch recorded the time it took for participants to name all capital letters. Then, stop watch recorded the time it took for participants to name all lower case letters.

Administration instructions. The examiner states: "I want to know how many letters you know. " (Child is given a practice card). "Letters will appear where you see X's. You will start here and move across the line, naming each letter as fast as you can without making a mistake. Be sure to try and name all of the letters on the card. Remember to name the letters as fast as you can. Please begin." (Then, the opaque top sheet was flipped and the practice items were displayed).

The following routine was used if initial administrative instructions were not understood.

1) "Name each letter as fast as you can".

2) "Move from line to line."

Practice Items:

C F G H I B

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

The same directions were given for the remaining cards. No other practice items preceded the test items. No feedback was given nor any opportunity to redo the task.

Upon completion of the practice test, children were told, " Great job! Now I'm going to show you more letters. Letters will appear where you see the X's. Start here and move across the line naming each letter as fast as you can without making a mistake. Please begin." Press stop watch. Stop the watch and record the time immediately after the last letter is stated.

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

Appendix D - Material A

Naming Letters (Capital Letters on one card)

D F B G H J

L M O P R T

V X W Z Y C Q

A E K I N U S

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

Appendix D - Material A

Naming Letters (lower case letters on one card)

g k i h m x

y n p q r s

t v u w z a l

c b e f d j o

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

Appendix D - Material B

Naming Capital Letters Data Sheet

Name:_____Date_____

Capital Letter Name Knowledge

Circle indicates letter is not known.

D F B G H J

L M 0 P R T

V X W Z Y

A E K I N U S

C Q

Score Range 1 - 26_____

Time Recorded_____

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

Appendix D - Material B

Naming Lower Letters Data Sheet

Name _____Date_____

Lower Case Letters

g k l h m x

y n p q r s

t v u w z a i

c b e f d j o

Score Range 1 - 26 _____

Time Recorded _____

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

Appendix E

Complete Administrative Instructions

Letter Sound Correspondence Knowledge

Materials. The cards with 26 upper case letters used in the Letter Awareness Test were used in the Sound Knowledge Test, which was not timed. The score range was from 0 to 26, recorded on a recording sheet.

Administrative instructions

"Now, I want to know how many sounds you know. You already told me the name of the letters. Now, I want you to tell me the sounds of each letter. You can take your time on this task. Be sure to say all of the sounds of the letters on the card. You can guess. Please begin."

The following routine was used if initial administrative instructions were not understood.

"Take your time."

"Tell me the sound of each letter."

"Move from line to line."

"Good Job"

Practice Items:

C F G H I B

Note: if the child says the name of the letter during the practice test, the test administrator said, "C is the name of the letter. Tell me the sound the letter makes."

The Sound Knowledge Test followed the same sequential order of presentation as the

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

Letter Awareness Test. However, only capital letters were tested. See Appendix D-Material A. The number of correct responses was recorded.

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

Appendix E - Material B

Letter - Sound knowledge Data Sheet

Name _____Date_____

Letter Sound Knowledge

Circle indicates letter is not known.

D F B G H J

L M O P R T

V X W Z Y C Q

A E K I N U S

Score Range 1 - 26 _____

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

Appendix F

Complete Administrative Instruction

Word Identification Part A: Woodcock Mastery Test, 1989

Material. The same size 9 X 5 ½ index cards displayed five or six words written in two columns using capital letters. At the end of each column was a magazine picture. The grade level of the Woodcock mastery Test of Word Identification was recorded on a recording sheet.

Administration instructions. " I'm going to show you some cards. Each of the cards will have words and pictures. I want you to read the words and name the pictures out loud. Please begin.

The following routine was used if initial administrative instructions were not understood.

"Try to read the word."

"Name the picture."

Practice Items:

None

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

Appendix G

Complete Administrative Instructions

Invented Spelling, (Morris and Perney, 1984)

Materials. The materials that were used were one pasted colored sheet of paper and a pencil. For each word, a score between 1 – 5 was given and recorded on a separate recording sheet.

Administration instructions. An abridged version of Morris and Perney (1984) Invented Spelling Test, coding system analyzing Invented Spelling knowledge, and Administrative Instructions were used. The following is the summary of the administrative instructions for the practice items:

Present a word orally

Model a sound it out spelling procedure for the word

"I will write the sounds I hear in some words." (Say sounds and write the letters). This is done for all practice items.

Practice Items:

bat; map; fan

The following is a summary of the administrative instructions for each test item:

Present a word orally. (Each word is pronounced naturally, not sounded out.)

Administrator says, "Please repeat the word".

3) The word is given in a sentence.

4) The Administrator repeats the word again and says, "Be sure to write the sounds you

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

hear."

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

Appendix G - Material A

Invented Spelling Test, (Morris and Perney, 1984)

1) BACK – SOMETIMES MY BACK HURTS.

2) SINK – WASH THE DISHES IN THE SINK.

3) MAIL – PLEASE MAIL THE LETTER.

4) DRESS – DON'T PUT ON THAT DRESS!

5) PICKING – I AM PICKING UP YOUR DIRTY SOCKS FROM THE FLOOR.

6) LAKE – DUCKS SWIM IN THE LAKE.

7) RICE – I DON'T LIKE TO EAT RICE.

8) PEEKED – I PEEKED TO SEE WHERE MY MOTHER HID MY PRESENT.

9) STICK – DON'T TRY TO HIT ME WITH THAT STICK.

10) GATE – CLOSE THE GATE WHEN YOU COME IN THE FRONT YARD.

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

Appendix G - Material B

Invented Spelling Data Recording Sheet

Name_____Date_____

Two recording mechanisms:

a) Children record choices by writing on a pastel sheet of paper.

b) Answers are transferred on examiner recording sheet.

BACK_____

SINK_____

MAIL_____

DRESS_____

PICKING_____

LAKE_____

RICE_____

PICKED_____

STICK_____

GATE_____

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

Appendix H

Complete Administrative Instructions

Phonological Recoding

Materials. The materials used in this task were six 9 X 5 1/2 cards 9one of which was a practice card). The practice card was the first card presented. Each card had a CVC nonsense word, except the practice card (which had a CVCC nonsense word that included a diphthong). The score range was from 1-15. A point was recorded for each correct pronunciation in the initial, medial and final positions. Scores were recorded on a recording sheet.

Administrative instructions. The examiner states," I am going to show you some silly words. Silly words are words that look like words but do not mean anything. As I show you each silly word, I want you to say it."

The following routine was used if initial administrative instructions were not understood.

"Look at the word."

"Say the word."

Practice Item: zown

The same directions were given for the remaining cards. No other practice item preceded the test item. No feedback was given nor any opportunity to redo the task.

Upon completion of the practice test, children were told, "Great job! Now I'm going to show you more silly words."

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

Appendix H - Material A

Phonological Recoding

VIP

WUB

SOG

FEN

ZAK

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

APPENDIX H - Material B

Phonological Recoding

Name_____ Date _____

Circle indicates word is not known.

Above each circle should be a representation of what was stated.

Check indicates word was accurately pronounced.

VIP

WUB

SOG

FEN

ZAK

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

APPENDIX I

Complete Administrative Instructions

Legal Spelling of Sight Words: Double Letter Recognition (Cassar & Treiman, 1997)

Materials. The materials used in this test were 4 practice items and 30 test items, each on a 9 X 5 ½ size index card. Each card presented two choices to the child. One choice was an orthographically legal nonsense word. The other choice was an orthographically illegal nonsense word. The possible score range was from 0-to 20, which was recorded on a recording sheet.

Administration instructions. "I am going to show you some nonsense words. Nonsense words are words that can be spelled but are nonsense, because the words have no meanings. Some nonsense words look more like words than others. Look at each pair of nonsense words, and point to the one you think looks most like a word." The practice words were the only words in which feedback was given. Feedback consisted of the experimenter telling the participants the appropriate choice for the pair and instructing the participant to point to that item. This was repeated for each practice item. Questions about the procedure were answered. Otherwise, the feedback following each word choice was, "Good job." The same order of words was given to each child.

The following routine was used if initial administrative instructions were not understood.

"Look at each pair of nonsense words."

"Circle the one you think looks most like a word."

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

Practice Items:

HENISS	HHENIS
JUBEFF	JJUBEF
YYATUF	YATUFF
VINALL	VVINAL

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

Appendix I - Material A

Legal Spelling of Sight Words: Double Letter Recognition

LUSS	LLUS
TISS	TTIS
FFEM	FEMM
SIMM	SSIM
PPOM	POMM
NNEF	NEFF
MOTT	MMOT
LLAT	LATT
SSAF	SAFF
TUNN	TTUN

NOVV	NOSS
DETT	DEVV
VISS	VIWW
CEJJ	CEPP
JUKK	JULL
NAKK	NAFF
SOLL	SOHH
TEFF	TEHH
DAPP	DAJJ

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

GAWW	GATT
HAAK	HEEK
FEEP	FIIP
JAAT	JEET
BIID	BOOD
WOOR	WIIR
STEE	STAA
DRAA	DREE
BREE	BRII
SPOO	SPAA
PLOO	PLII

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

Appendix I - Material B

Legal Spelling of Sight Words: Double Letter Recognition Data Sheet

Name_____ Date_____

Children record choices by pointing to choices on cards.

Answers are circled on data sheet.

LUSS LLUS

TISS TTIS

FFEM FEMM

SIMM SSIM

PPOM POMM

NNEF NEFF

MOTT MMOT

LLAT LATT

SSAF SAFF

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

TUNN TTUN

NOVV NOSS

DETT DEVV

VISS VIWW

CEJJ CEPP

JUKK JULL

NAKK NAFF

SOLL SOHH

TEFF TEHH

DAPP DAJJ

GAWW GATT

HAAK HEEK

FEEP FIIP

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

JAAT JEET

BIID BOOD

WOOR WIIR

STEE STAA

DRAA DREE

BREE BRII

SPOO SPAA

PLOO PLII

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

Appendix J

Complete Administrative Instructions

Phonological Awareness: Phonological Segmentation (Stahl & Murray, 1994)

Material. There were no materials shared with the children. The test administrator had the practice and test items written on cards. The score range was from 0 to 15. It was recorded on a separate recording sheet.

Administrative instructions. The instructions were, "I want to know how many sounds you hear in each word. I will slowly say a word. Then, I want you to slowly say the word." Slowly does not suggest that the examiner will segment the word for the child. "For each sound you hear, raise a finger." Below is the routine that followed:

Examiner pronounces word.

Child repeats word.

Examiner says, "Raise a finger for each sound you say."

If wrong, examiner says, "Watch me do it." Examiner models the appropriate behavior.

Examiner says, "Now you do it." (child copies).

Modeling is only done during the practice items.

Practice Items:

ASH; ME; CAN; FISH; SAND

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

Appendix J - Material A

Phonological Awareness: Phonological Segmentation (Stahl & Murray, 1994)

Singleton Onset-Rime

move time sick done soup

Cluster Onset

float cream speed place stick

Cluster coda

send think ramp sold toast

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

Appendix J - Material B

Phonological Awareness: Phonological Segmentation Data Sheet

Name _____ Date _____

Circle each one that is incorrect. Write what was stated on blank line.

Singleton Onset – Rime

MOVE_____

TIME_____

SICK_____

DONE_____

SOUP_____

Cluster – Outset

Float_____

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

CREAM_____

SPEED_____

PLACE_____

STICK_____

Cluster – Coda

SEND_____

RAMP_____

TOAST_____

THINK_____

SOLD_____

Score Range 0 – 15_____

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

Appendix K

Complete Administrative Instructions

Word Learning Task

Materials. Each word was presented on a 9 X 5 1/2 index card. Children were trained on one of two sets of words. Sentences were included to reinforce each word's meaning.

Administrative instructions.

The card is presented.

The administrator says," This says...(reads the word)"

A sentence with the word is read.

The administrator states, "You read the word".

Test Trials

A word is presented.

The administrator states, "You read it."

If the word was read correctly, the Administrator stated, "Good". If the word was read incorrectly, the administrator began again from step two of the Study Trial. The order of words was mixed up on each trial. Training continued until there were two perfect trials for the complete set of words.

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

Appendix K- Material A

Word Learning Task

Set A:

JETT - A JETT IS A FAST AIRPLANE.

FITT - DO YOUR SHOES FITT OR ARE THEY TOO BIG?

NUTT - TO EAT THE NUTT YOU HAVE TO CRACK OPEN THE SHELL.

PADD - YOU CAN WRITE ON A PADD OF PAPER.

LLES - (LESS) TWO IS LLES THAN FIVE.

LLIM - (LIMB) A LLIM IS A TREE BRANCH.

LLUK - (LUCK) GOOD LLUK TO YOU.

RRAG - YOU CAN USE A RRAG TO CLEAN WINDOWS.

DEF - (DEAF) PEOPLE WHO CAN'T HEAR ARE DEF.

WIP - (WHIP) YOU WIP A HORSE TO MAKE IT RUN FAST.

TUB - YOU TAKE A BATH IN A TUB.

FAN - YOU CAN COOL YOURSELF WITH A FAN.

Set B:

DEDD - (DEAD) WOULD YOU RATHER BE DEDD OR ALIVE?

KIDD - A KIDD IS A LITTLE GIRL OR BOY.

MUDD - PLAYING IN MUDD GETS YOU DIRTY.

PATT - YOU CAN PATT A DOG'S HEAD WITH YOUR HAND.

RREK - (WRECK) THE CAR WAS IN A RRECK AND GOT SMASHED.

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

RRIP - BE CAREFUL NOT TO RRIP THE TISSUE PAPER.

RRUG - THE SOFT RRUG COVERS THE FLOOR.

LLAM - (LAMB) A LLAM IS A BABY SHEEP.

WEB - A SPIDER BUILDS A WEB.

FIZ - (FIZZ) YOU CAN HEAR THE FIZ WHEN YOU OPEN GINGER ALE.

TUF - (TOUGH) THIS MEAT IS TOO TUF TO CHEW.

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

Appendix K - Material B

Word Learning Task Data Sheet

Name_____ Date_____

Trials

Each trial is represented by a check

Set A:

JETT	PADD	LLIM	LLES
FITT	FITT	NUTT	RRAG
PADD	DEF	JETT	DEF
LLIM	LLES	LLUK	FITT
RRAG	JETT	LLES	LLIM
LLES	RRAG	FITT	NUTT
DEF	LLIM	PADD	LLUK
NUTT	LLUK	RRAG	TUB
WIP	NUTT	FAN	WIP
FAN	WIP	WIP	JETT
TUB	FAN	TUB	PADD
LLUK	TUB	DEF	FAN

Number of Trials to Reach Criterion_____

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

Set B:

DEDD	PADD	LLIM	LLES
FITT	FITT	NUTT	RRAG
PADD	DEF	JETT	DEF
LLIM	LLES	LLUK	FITT
RRAG	JETT	LLES	LLIM
LLES	RRAG	FITT	NUTT
DEF	LLIM	PADD	LLUK
NUTT	LLUK	RRAG	TUB
WIP	NUTT	FAN	WIP
FAN	WIP	WIP	JETT
TUB	FAN	TUB	PADD
LLUK	TUB	DEF	FAN

Number of Trials to Reach Criterion_____

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

Appendix L

Complete Administrative Instructions

Post Test I: Spelling Recall Memory

Materials. The materials that were used were "9 X 5 1/2 pastel paper. These papers were distributed to the children before each word was written. For each word a score between 1 – 5 was given and recorded on a separate recording sheet.

Administrative instructions. Children were told, "Now I want you to write the spelling that you just learned. Be sure to write all the letters that you remember seeing in the word." Present a word orally. (Each word is pronounced naturally, not sounded out.)

1)The Administrator says, "Please repeat the word".

2) The word is given in a sentence. See Appendix K - Material A

3) The Administrator repeats the word again and says, "Be sure to spell the words the very best you can. Write all of the letters you remember seeing in the words."

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

Appendix L - Material B

Post Test I: Spelling Recall Memory

Name _____ Date_____

a) Children record choices by writing on pastel paper.

b)Answers are transferred on data sheet.

Set A

:

JETT - A JETT IS A FAST AIRPLANE._____

FITT - DO YOUR SHOES FITT OR ARE THEY TOO

BIG?_____

NUTT - TO EAT THE NUTT YOU HAVE TO CRACK OPEN THE

SHELL._____

PADD - YOU CAN WRITE ON A PADD OF PAPER.

_____

LLES - (LESS) TWO IS LLES THAN

FIVE._____

LLIM - (LIMB) A LLIM IS A TREE

BRANCH._____

LLUK - (LUCK) GOOD LLUK TO

YOU._____

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

RRAG - YOU CAN USE A RRAG TO CLEAN

WINDOWS._____

DEF - (DEAF) PEOPLE WHO CAN'T HEAR ARE

DEF._____

WIP - (WHIP) YOU WIP A HORSE TO MAKE IT RUN

FAST._____

TUB - YOU TAKE A BATH IN A TUB._____

FAN - YOU CAN COOL YOURSELF WITH A

FAN._____

Set B:

DEDD - (DEAD) WOULD YOU RATHER BE DEDD OR

ALIVE?_____

KIDD - A KIDD IS A LITTLE GIRL OR

BOY._____

MUDD - PLAYING IN MUDD GETS YOU

DIRTY._____

PATT - YOU CAN PATT A DOG'S HEAD WITH YOUR

HAND._____

RREK - (WRECK) THE CAR WAS IN A RRECK AND GOT

SMASHED._____

RRIP - BE CAREFUL NOT TO RRIP THE TISSUE

PAPER._____

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

RRUG - THE SOFT RRUG COVERS THE

FLOOR._____

LLAM - (LAMB) A LLAM IS A BABY

SHEEP._____

WEB - A SPIDER BUILDS A WEB._____

FIZ - (FIZZ) YOU CAN HEAR THE FIZ WHEN YOU OPEN GINGER

ALE._____

TUF - (TOUGH) THIS MEAT IS TOO TUF TO

CHEW._____

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

Appendix M

Complete Administrative Instructions

Posttest II: Spelling Recognition Memory

Materials. The materials used in this task were possible spellings for each word set. Three possible spellings were placed on a "9 X 5 ½" index card.

Administrative instructions. The administrative instructions were, " I am going to show you several words. Only one will look like the word you learned to read. Your job will be to point to the word you learned to read." The choices were presented and the participants were asked, "Please point to the word that you learned to read." The possible score range was between 0 – 12. The scores were recorded on a separate recording sheet

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

Appendix M - Material A

Posttest II: Spelling Recognition Memory

Set A:

FITT	FIT	FFIT
JJET	JETT	JET
PAD	PADD	PPAD
NUTT	NNUT	NUT
LLES	LES	LESS
LIMM	LLIM	LIM
LUKK	LLUK	LUK
RAG	RAGG	RRAG

Set B:

DEDD	DED	DDED
KKID	KIDD	KID
MUD	MUDD	MMUD
PATT	PPAT	PAT
RREK	REKK	REK
RIPP	RRIP	RIP
RUGG	RRUG	RUG
LAM	LAMM	LLAM

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

Appendix M - Material B

Posttest II: Spelling Recognition Memory

Name_____Date_____

Set A:

FITT	FIT	FFIT
JJET	JETT	JET
PAD	PADD	PPAD
NUTT	NNUT	NUT
LLES	LES	LESS
LIMM	LLIM	LIM
LUKK	LLUK	LUK
RAG	RAGG	RRAG

Set B:

DEDD	DED	DDED
KKID	KIDD	KID
MUD	MUDD	MMUD
PATT	PPAT	PAT
RREK	REKK	REK
RIPP	RRIP	RIP
RUGG	RRUG	RUG
LAM	LAMM	LLAM

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

Appendix N

Complete Administrative Instructions

Post Test III: Spelling Transfer Task

Materials. The materials that were used were same size strips of paper. These papers were distributed to the children one at a time before each word was written.

Administrative instructions. 1) Children were told," Now I will ask you to write some new words. The words I taught you may help you spell the new words". The score range was between 0 – 5 for each word. The scores were recorded on a separate recording sheet. Present a word orally. (Each word is pronounced naturally, not sounded out.)

The Administrator says, "Please repeat the word".

2) The word is given in a sentence.

3) The Administrator repeats the word again and says, "Be sure to spell the words the very best you can."

Set A:

Practice Items:

JEF - JEF IS AT THE DOOR.

DEB - TELL DEB, PASS ME THE PAPER.

SIP - SIP YOUR JUICE.

Set B:

Practice Items:

WIZ - YOU ARE A WIZ KID.

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

PAN - YOU COOK FOOD IN A PAN.

PUF - I HOPE THERE IS NOT A FIRE. I SEE A PUF OF SMOKE.

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

Appendix N - Material A

Post Test III: Spelling Transfer Task

Set A:

PETT - DO YOU HAVE A PETT ANIMAL?

SITT - SITT IN THE CHAIR.

BADD - THERE IS NO SUCH THING AS A BADD BABY!

LLAM - A LLAM IS A BABY SHEEP.

RRUG - A RRUG COVERS A FLOOR.

LLOS - I LLOS SOMETHING. DID YOU FIND IT?

MUTT - A MUTT IS A TYPE OF DOG.

LLOC - DON'T LLOC YOURSELF OUT OF THE HOUSE.

Set B:

FEDD – I FEDD YOU ALREADY.

HIDD - I HIDD IT.

CUDD – COWS CHEW THEIR CUDD.

NATT – TELL NATT TO COME HERE.

RRIB – POINT TO YOUR RIBB.

LLIM (LLIMB) – DON'T CLIMB ON THE TREE LLIM; IT WILL BREAK.

RROC-THERE IS A RROC ON THE GROUND.

RRUF-A DOG GOES RRUF, RRUF WHEN IT IS HUNGRY.

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

Appendix N - Material B

Post Test III: Spelling Transfer Task

Name_____ Date_____

Two recording mechanisms:

a) Children record choices by writing on pastel paper.

b) Answers are transferred on examiner recording sheet.

Set A

Practice Words:

JEF_____

SIP_____

DEB_____

Test Items:

BADD_____

PETT_____

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

SITT_____

LLAM_____

RRUG_____

LLOS_____

MUTT_____

LLOCK_____

Score Range 0 –8_____

Set B:

Practice Items:

PUF_____

PAN_____

WIZ_____

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

Test Items:

FEDD_____

HIDD_____

CUDD_____

NATT_____

RRIB_____

RRUF_____

RROCK_____

LLIM_____

Score Range 0 –8_____

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

Appendix O

Debriefing

Administrative Instructions

Each child was shown each word's conventional spelling. The word was read and the child was asked to repeat the word. Then, the child was asked to repeat the word as his/her finger ran across the word.

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

Appendix O - Material A

Debriefing

Set A:

JET

FIT

PAD

LIMB

LUCK

LESS

RUG

DEAF

NUT

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

WHIP

FAN

TUB

Set B:

DEAD

KID

MUD

PAT

WRECK

RUG

RIP

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

LAMB

FIZZ

WEB

TOUGH

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

Appendix P

Pilot Study Findings on Two Separate Variables

Variable 1: Phonological Awareness Pretest

Descriptive analysis. Participants who were classified as full alphabetic phase readers had the highest segmentation skill. During the task, their behavior did not appear frustrated. Their errors involved incomplete segmentation; for instance, a word may be segmented into three phonemes instead of four (sp-ee-d).

The partial phase readers made the most errors. Instead of segmenting words, one participant , A6MDD, rhymed words (i.e., best = vest). Another participant, D4MDD, made semantic associations, (i.e., sick = doctor; soup = cook). Another participant, W4MTT, segmented the words into onset and rime. This participant's errors were similar to those of the full alphabetic phase readers who incompletely segmented. The major difference between the similar segmentation skills is that the full alphabetic phase readers would segment a word into three phonemes instead of four; whereas, the partial alphabetic phase reader was unable to break up the rime unit into its individual phonemes. Three participants, N4FDD, M4FTT, and S4MTT, instead of segmenting, isolated only the initial sound. The behavior and response patterns suggest that this test may be too difficult for partial alphabetical phase readers.

Statistical analysis. The mean performance level of partial alphabetic phase readers on the segmentation portion of the Phonological Awareness Pretest was .005 (SD= .007.) The mean performance level of full alphabetic phase readers was .675 (SD = .106).

A t-test was conducted to determine if there was a significant difference in the mean

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

performance of the partial and full alphabetic readers. The obtained $t(8) = -10.398$, $p < .05$.

Correlation between phonemic segmentation and invented spelling were explored. Both factors were significantly correlated $r = .78$, $p < .01$

Variable 2: Transfer of Orthography

Spelling Transfer results were included because there were not any significant instances of transferring training word orthography to new words with the same rime pattern. There was only one incidence of transfer, which occurred in the oldest participant. When he was asked to spell nine words, the orthography of one of the training words transferred to a new word with the same orthographic pattern in the rime unit. He was asked to spell fad. He spelled it fadd. In this one instance, the participant demonstrated that he transferred the orthographic pattern that he was introduced to during the training task.

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

REFERENCES

Adams, M. J. (1998). *Beginning to read: Thinking and learning about print*. Cambridge, Mass: M.I.T.

Allington, R. (1978). Sensitivity to orthographic structure as a function of grade and reading ability. *Journal of Reading Behavior, 10*, 437-439.

Badian, N. (1994a). Do dyslexics and other poor readers differ in reading related cognitive skills? *Reading and Writing: An Interdisciplinary Journal, 6*, 45-63.

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

Badian, N. (2001). Phonological and orthographic processing: their roles in reading prediction. *Annals of Dyslexia, 51*, 179-202.

Ball, E. and Blachman, B. (1991). Does phoneme awareness training in kindergarten make a difference in early word recognition and developmental spelling? *Reading Research Quarterly, 26* (1), 49-66.

Barker, T. A., Torgesen, J.K.,& Wagner, R.K. (1992). The role of orthographic processing skills on five different reading tasks. *Reading Research Quarterly, 27*, 335 -345.

Baron, R. (1986). Word recognition in early reading. *Cognition, 24*, 93-119.

Beers, J. W. and Henderson, E. H. (1977). A study of developing orthographic concepts among first graders. *Research in the Teaching of English, 2*, 133-148.

Bouma, H. (1979). Eye movements and functional visual fields: a tutorial review. In P. A. Kolers, Wrolstad, M.E., & H. Bouma (Eds.), *Processing Visible Language*, Vol. 1. (pp.115- 147). N.Y: Plenum.

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

Bowey, J. & Underwood, N. (1996). Further evidence that orthographic rime usage in nonword reading increases with word – level reading. *Journal of Experimental Child Psychology, 63,* 526 - 562.

Bradley, L. & Bryant, P.E. (1983). Categorizing sounds and learning to read: A causal connection. *Nature, 301*, 419-421.

Bruce, D. (1964). The analysis of word sounds by young children. *British Journal of Educational Psychology, 34*, 158-170.

Calfee, R., Chapman, R., & Venezky R. (1972). How a child needs to think to learn to read. In L. Gregg (Ed.), *Cognition in Learning and Memory*, (pp 130-182). New York: Wiley.

Campbell, R. & Besner, D. (1981). This and thap: Constraints on the pronunciation of new written words. *Quarterly Journal of Experimental Psychology, 33A*, 375-396.

Cassar, M. & Treiman, R. (1996). Is early spelling only phonetic? Young children's knowledge about letter patterns. Poster presented at the third annual meeting of the Society for the Scientific Study of Reading, New York, N.Y.

Cassar, M. & Treiman, R. (1997). The beginnings of orthographic knowledge: Children's knowledge of double letters in words. *Journal of Educational Psychology, 89*, 631-644.

Chall, J.S. (1967). *Learning to read: The great debate.* New York: McGraw-Hill.

Clarke, L. (1988). Invented versus traditional spelling in first graders writings: Effects on learning to spell and read. *Research in the Teaching of English, 22*, 281-309.

Coltheart, M. (1996). Phonological dyslexia: Past and future issues. *Cognitive*

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

Neuropsychology, 13, 749-762.

Coltheart, M., Besner, D., Jonasson, J. T. & Davelaar, E. (1979) Phonological encoding in the lexical decision task. *Journal of Experimental Psychology, 31,* 489-507.

(2001). *Introduction to psychology*. United States: Wadsworth.

Cunningham, A. & Stanovich, K. (1990). Assessing print exposure and orthographic processing skill in children: A quick measure of reading experience. *Journal of Educational Psychology, 82,* 733- 740.

Cunningham, A. & Stanovich, K, (1998). The impact of print exposure on word recognition. In Metsala, J. L. & Ehri, L.C. (Ed.). *Word recognition in beginning literacy* (pp.235-262). N. J.: Erlbaum

Detterman, D.K. & Sternberg, R. J. (in press). *Transfer on trial: Intelligence, cognition, and instruction,* Norwood, N.J: Ablex

Ehri, L. (1980). The development of orthographic images. In U. Frith (Ed.), *Cognitive processes in sSpelling* (pp. 311-338). London, England: Academic.

Ehri, L. (1983). Critique of five studies related to letter name knowledge and learning to read. In L. Gentile, M. Kamil & J. Blanchard (Eds.), *Reading Research Revisited* (pp.131-153). Ohio: Merrill.

Ehri, L. (1984). How orthographies alter spoken language competencies in children learning to read and spell. In J. Downing & R. Valtin (Eds.), *Language awareness and learning to read* (pp. 119-147). New York: Springer Verlag.

Ehri, L. (1986). Sources of difficulty in learning to spell and read. In M. Wolraich & D. Roth (Eds.), *Advances in developmental and behavioral pediatrics*(pp.121-195).

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

Greenwich, CT: JAI

Ehri, L. (1987). Learning to read and spell words. *Journal of Reading Behavior, 19*, 5-13.

Ehri, L. (1991). Development of the ability to read words: update. In R.Barr, M. Kamil,P. Mosenthal, & P.D. Pearson (Eds.), *Handbook of reading research*, (Vol. II), (pp. 383-417). New York: Longman.

Ehri, L. (1992). Reconceptualizing the development of sight word reading and its relationship to reading. In P.B. Gough, L. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp.107-140), Hillsdale, N.J.:Erlbaum.

Ehri, L. (1995). Phases of Development in learning to read words by sight. *Journal of Research in Reading, 18,* 116-125.

Ehri, L. (2000). Learning to read and learning to spell: Two sides of a coin.*Disorder, 20* (3), 19- 36.

Ehri, L., Deffner, N. and Wilce, L. 1984). Pictorial mnemonics for phonics. *Journal of Educational Psychology, 76*(5), 880-893.

Ehri, L. and McCormick, S. (1998). Phases of word learning: Implications for instruction with delayed and disabled readers. *Reading & Writing Quarterly, 14*(2), 135-155.

Ehri, L. & Robbins, C. (1992). Beginners need some decoding skill to read words by analogy. *Reading Research Quarterly, 27*, 12-26.

Ehri, L. and Soffer, A.G. (1999). Graphophonemic awareness: Development in elementary schools. *Scientific Studies of Reading, 1,* 1-30.

Ehri, L. & Wilce, L. (1979). The mnemonic value of orthography among beginning

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

readers. *Journal of Educational Psychology, 71*, 26-40.

Ehri, L.& Wilce, L. (1980). The influence on orthography on readers' conceptualization of the phonemic structure of words. *Applied Psycholinguistics, 1*, 371-385.

Ehri, L. & Wilce, L. (1985). Movement into reading: Is the first stage of printed word learning visual or phonetic? *Reading Research Quarterly, 20*, 163-179.

Ehri L. & Wilce, L. (1987a). Does learning to spell help beginners learn to read words? *Reading Research Quarterly, 22,* 47-65.

Ehri, L. & Wilce, L. (1987b). Cipher vs. cue reading. *Journal of Educational Psychology, 79,* 3-13.

Ellis, N. (1985). The cognitive neuropsychology of developmental and acquired dyslexia: A critical survey. *Cognitive Neuropsychology*, 169-205.

Foorman, B.R., Francis, D.J., Fletcher, J.M., & Lynn, A. (1996). Relation of phonological and orthographic processing to early reading: Comparing two approaches to regression-based reading level match designs. *Journal of Educational Psychology, 88*, 639-652.

Gentry, J.R. (1982). An analysis of developmental spelling in GNYS AT WRK. *The Reading Teacher, Nov.*, 192-200.

Glushko, R. (1979). The organization and activation of orthographic knowledge in reading aloud. *Journal of Experimental Psychology: Human Perception and Performance, 5,* 674-691.

Goswami, U. (1986). Children's use of analogy in learning to read: A developmental study. *Journal of Experimental Psychology, 42,* 73-83.

Goswami, U. (1988). Orthographic analogies and reading development. *Quarterly*

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

Journal of Experimental Psychology, 40, 239-268.

Gough, P.B., Juel, C. & Griffith, P.L. (1992). Reading, spelling and the orthographic cipher. In P.B. Gough, L. Ehri, . & R. Treiman, . (Eds). *Reading Acquisition.* Hillsdale, N.J: Erlbaum.

Gough, P.B. & Tunmer, W. E. (1986). Decoding, reading and reading disability. *Remedial and Special Education*, 7, 6- 10.

Griffith, P. (1987). *The role of phonological and lexical information in word recognition and spelling.* Unpublished doctoral dissertation, University of Texas, Austin.

Harm, M. and Seidenberg, M. (2001). Are there orthographic impairment in phonological dyslexia? *Cognitive Neuropsychology, 18* (1), 71-92.

Harris, T. and Hodges, R.E. (1995). *The literacy dictionary*. Delaware: International Reading Association.

Henderson, L. & Chard, J. (1980). The development of orthographic images. In U. Frith (Ed.), *Cognitive processes in spelling* (pp.85-116). London: Academic Press.

Humphreys, G. & Evett, L. (1985). Are there independent lexical and non-lexical routes in word processing? An evaluation of the dual-route theory of reading. *Behavioral and Brain Sciences, 8,* 689-740.

Joseph, L. (2000). Developing first graders' phonemic awareness, word identification and spelling: A comparison of two contemporary phonic instructional approaches, *Reading Research and Instruction, 39* (2),160-169.

Juel, C. (1983). The development and use of mediated word identification. *Reading Research Quarterly, 18,* 306 – 327.

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

Juel, C., Griffith, P., & Gough, P (1986). Acquisition of literacy: A longitudinal study of children in first and second grade. *Journal of Educational Psychology, 78*, 243-255.

Juola, J. F., Shadler, M., Chabot, R. J., and McCaughey, M. (1978). The development of visual information processing skills related to reading. *Journal of Experimental Child Psychology, 25*, 459- 476.

Linehan, E.B. (1958). Early instruction in letter names and sounds as related to success in beginning reading. *Journal of Education, 140*, 44-88.

Long, D. and Prat, C.S. (2002). Memory for StarTrek: The role of prior knowledge. *Journal of Experimental Psychology: Learning and Memory, 28*(6), 1073-1082.

Marcel, A.J. (1980). Surface dyslexia and beginning reading: A revised hypothesis of the pronunciation of print and impairments. In M. Coltheart, K.E. Patterson, & J.C. Marshall (Eds.), *Deep Dyslexia* (pp.227-258). London: Routledge and Kegan Paul.

Marsh, G. & Mineo, R.J. (1977). Training preschool children to recognize phonemes in words. *Journal of Educational Psychology, 69*, 748-753.

McCaughey, M., Juola, J. Schadler, M., and Ward, N. (1980). Whole word units are used before orthographic knowledge in perceptual development. *Journal of Experimental Child Psychology, 30,* 411-421.

Morris, D. & Perney, J. (1984). Developmental spelling as a predictor of first grade reading achievement. *The Elementary School Journal, 84*, 441-457.

Myers, N.A., & Perlmutter, M. (1978). Memory in the years two-five. In P.A. Ornstein (Ed.), *Memory development in children*(pp. 191-218). Hillsdale, N.J: Lawrence Erlbaum Associates.

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

Naus, M.J. , Ornstein, P. A., & Kreshtool, K. (1977). Developmental age differences in recall and recognition: The relationship between rehearsal and memory as test expectation changes. *Journal of Experimental Child Psychology, 23*, 252-265.

Olson, R.K. Forsberg, H., & Wise, B. (1994). Genes, environment and the development of orthographic skills. In V.W. Berninger (Ed), *The varieties of orthographic knowledge: Vol.1 Theoretical & Developmental*(pp. 27-71). Dordrecht, The Netherlands: Kluwer Academic.

Ormrod, J.E. (2000). *Educational psychology: Developing learners* (3rd ed.). New Jersey: Merril.

Perfetti, C. (1985). *Reading ability*. New York: Oxford University.

Peterson, M.E. & Haines, L.P. (1992). Orthographic analogy training with kindergarten children: Effects on analogy use, phonemic segmentation, and letter sound knowledge. *Journal of Reading Behavior, 24*, 109-126.

Reitsma, P. (1983). Printed word reading in beginning readers. *Journal of Experimental Child Psychology, 36,* 321 – 339.

Rey, A. & Jacobs, M. (2000). Graphemes are perceptual reading units. *Cognition, 75* (1), B1- B12.

Richgels, D. (1995). Invented spelling ability and printed word learning in Kindergarten. *Reading Research Quarterly, 30*, 96-109.

Rosner, J. (1975). *Helping children overcome learning difficulties*. New York: Walker.

Schneider, W. & Pressley, M. (1997) *Memory development between two and twenty*. Hillsdale, N. J: Lawrence Erlbaum.

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

Schneider, W., Roth, E., & Ennemoser, M. (2000). Training phonological skills and letter knowledge in children at risk for dyslexia: A comparison of three Kindergarten intervention programs. *Journal of Educational Psychology, 92* (2), 284-295.

Seidenberg, M.S. Waters, Barnes, G. S., & Tanenhaus,M.K., (1984). When does spelling or pronunciation influence word recognition. *Journal of Verbal Learning & Verbal Behavior, 23,* 383-404.

Shalice, T., Warrington, E.K., & McCarthy, R. (1983). Reading without semantics. *Quarterly Journal of Experimental Psychology, 35A*, 111- 138.

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

Share, D., Jorm, A., Maclean, R., & Matthews, R. (1984). Sources of individual differences in reading acquisition. *Journal of Educational Psychology, 76*, 1309-1324.

Spier, J.R., & Flavell, J.H. (1979). Young children's knowledge of the relative difficulty of recognition and recall memory tasks. *Developmental Psychology, 15*, 214-217.

Stahl, S. & Murray, B. (1994). Defining phonological awareness and its relationship to early reading. *Journal of Educational Psychology, 86*, 221-234.

Stanovich, K.E. (1980). Toward an interactive compensatory model of individual differences in the development of reading fluency. *Reading Research Quarterly,16*, 32-71.

Stanovich, K., Cunningham, A., & Cramer, B. (1984). Assessing phonological awareness in Kindergarten children: Issues of task compatibility. *Journal of Experimental Child Psychology, 38*, 175-190.

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

Stanovich, K. E., & Siegel, L. S. (1994). The phenotypic performance profile of reading disabled children: A regression based test of the phonological core variable-difference model. *Journal of Educational Psychology, 86*, 24 – 53.

Treiman, R. (1993*). Beginning to spell.* New York: Oxford Press.

Treiman, R., Berch, D. ,& Weatherson, S. (1993). Children's use of phoneme-grapheme correspondences in spelling: Roles of position and stress. *Journal of Educational Psychology, 85,* 466-477.

Treiman, R., Goswami, U., & Bruck, M. (1990). Not all non-words are alike: Implications for reading development and theory. *Memory & Cognition, 18*, 559-567.

Treiman, R., Zukowski, A. & Richmond-Welty, E.D. (1995). What happened to the 'n' of sink? Children's spelling of final consonant clusters. *Cognition, 55*, 1-38.

Uhry, J. (1992). *Predicting reading from print awareness and phonological awareness skills: An early reading screening*. San Francisco: American Educational Research Association.

Uhry, J. and Shepherd, M. (1993). Segmentation/spelling instruction as part of a first-grade reading program: Effects on several measures of reading. *Reading Research Quarterly, 28* (3), 219-233.

U.S. Department of Health and Human Services, National Institutes of Health and National Institute of Child Health and Development. (2000*). Report of the national reading panel* (NH Pub. No. 00-4769).

Vandervelden, M., & Siegel, L. (1995). Phonological recoding and phoneme awareness in early literacy: A developmental approach. *Reading Research Quarterly, 30*, 854 – 875.

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

Venezky, R.L. (1970). *The structure of English orthography.* The Hague: Morton.

Venezky, R.L. & Massaro, D.W. (1979). The role of orthographic regularity in word recognition. In L. Resnick & P. Weaver (Eds.), *Theory and Practice in Early Reading*(pp. 85-107). N.J: Lawrence Erlbaum

Wolf, M. (1986). Rapid alternating stimulus naming in the developmental dyslexics. *Brain and Language, 27* ,360-379.

Wolf, M. (1991) Naming speed and reading: The contribution of the cognitive neurosciences. *Reading Research Quarterly, 26*, 123-141.

Woodcock, R.W. (1989). *Woodcock Reading Mastery Tests-Revised.* Circle Pines, MN: American Guidance Service.

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

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