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Letter training and its effect on the development of beginning reading skills

Fugate, Mark Hanna, Ph.D.

Lehigh University, 1993

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Letter Training and its Effect on the Development of Beginning Reading Skills

by

Mark H. Fugate

Presented to the Graduate and Research Committee

of Lehigh University

in Candidacy for the Degree of

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Abstract

Throughout the past decade several researchers have noted a strong positive relationship between the letter-naming speed of young readers and the development of beginning reading skills. Walsh, Price, and Gillingham (1988) determined that the importance of letter-naming speed to the development of beginning reading skills may be critical but short lived, as the strength of this relationship is greatly diminished by second grade. Likewise, Ehri and her colleagues (Ehri & Wilce, 1985; Scott & Ehri, 1991) have demonstrated the importance of letter-naming in the development of alphabetic access to word learning, a beginning reading skill.

However, what has not been demonstrated is if training to improve letter-naming speed at an early phase of reading skill development, results in significantly improved beginning skills. The purpose of the present study was to determine if training to increase students letter-naming speed would result in increases in beginning reading skills.

The effect of training to improve letter-naming speed on beginning reading skill was evaluated with 39 first-grade students. Subjects were randomly assigned to trained and untrained groups and were administered curriculum-based measures of reading at pre-training, post-training, and follow-up. Trained students demonstrated significantly

faster letter-naming speed (t = 2.05; df = 37; p <.024; one tailed t-test) at post-training assessment as compared to untrained peers. However, the difference in letter-naming speed did not lead to a significant difference in measured reading skill (F = 2.26; df = 4, 34; p <.083) as evaluated by a repeated measures multivariate analysis of variance. Similarly, the ability of both groups of students to use alphabetic cues to word learning was nearly equivalent at post test.

In three of the four measures of beginning reading skill, differences between the mean scores of trained and untrained students were greatest at points where the assessment of skills most closely matched the content of classroom instruction. Although these differences are not statistically significant, these patterns in the data point to the value of future research to determine if a more causal relationship between letter-naming speed and the successful development of beginning reading skills might exist.

Chapter I

Introduction

Letter-Naming and Reading Development

Reading is a complex process which involves both local, low-level, decoding processes, and high-level, strategic, meaning driven processes. Recently, it has been suggested that the relative emphasis of these factors depends upon an individual's stage of reading development (Perfetti, 1985, p. 170-172). Low-level functions such as basic letter knowledge and phonemic awareness appear to be more important in the beginning stages of reading whereas strategic reading and comprehension skills guide more advanced reading processes.

This bi-level view is supported by a recent study exploring the developmental relationship of low-level processes. Walsh, Price, and Gillingham (1988) concluded that an individual's facility in the underlying processes (specifically letter naming) is a major determinant of subsequent progress in the initial stages of reading. The focus of the present study was to explore the role of letter naming in the development of beginning reading skills.

The Role of Letter-Naming in Beginning Reading

Several different, but somewhat interrelated, hypotheses have been proposed to explain the role of letter naming in the reading process. One theory emphasizes the role of letter knowledge in the development of phonetic reading skills. Another model highlights letter naming speed and its role in aiding efficient information processing.

<u>Letter-naming and Phonetic Cue Development</u>

One explanation of the role of letter naming in the development beginning reading skill, suggests that letter naming ability is an index of the thoroughness and confidence with which pre-schoolers have learned individual letter identities. It then follows that children who can confidently name letters will have an easier time learning about letter sounds and word spellings. This hypothesis is based on the fact that, in general, letter names are quite closely related to their sounds. Facility with letter names leads to better understanding of individual letter sounds, and mediates successful reading (Adams 1990). For example, if a student knows that a particular symbol is called "b" then she/he can use that fact to help remember that its sound is /b/.

Further support for the phonetic role of letter naming in the development of beginning reading skill is offered by Ehri and her colleagues (Ehri & Wilce, 1985; Scott & Ehri, 1990) who suggest that to facilitate reading, a reader needs to understand that word spellings are not arbitrary. The beginning reader must be able to distinguish individual letters within words, to distinguish individual sounds within pronunciations, and to process letters as symbols for those sounds. When children have facility with letter names they possess the terminology needed to conceptualize, describe, and talk about the visual constituents of a word's spelling.

According to these authors (Ehri & Wilce, 1985) Children learn to decode words in two different ways. Initially, beginning readers will use logographic, or visual cues, to decode words. When relying on logographic cues readers are taking some visually distinctive aspect of the word and associating it with the pronunciation of the word. An example of a logographic cue would be the recognition of a "McDonald's" by the characteristic "golden arches".

As beginning readers learn the alphabet, develop an awareness of the phonemic segmentation of words, and acquire an association between letters and their sounds, word recognition becomes less determined by logographic cues and more dependent upon phonetic or alphabetic cues. Phonetic cues are based upon a beginning readers understanding of letter names, sounds, or both (Ehri & Wilce, 1987). The development of beginning reading skills, as well initial understanding of the spelling system, are facilitated when beginning readers first learn to read words with phonetically sensible spellings (Durrell, 1958). Obviously, there is more to learn about the phonetic, alphabetic system than what can be provided by letter name knowledge, but names may be a necessary beginning.

In order to examine the importance of phonetic cue reading Ehri and Wilce (1985) conducted a study to determine the point at which beginning readers use phonetic cues. In this study kindergarten students were divided into pre-reader, novice, and veteran reading groups. Subjects were taught to read two different word spellings for common nouns. Phonetic words were those whose letters corresponded to the word sounds (e.g., JRF for giraffe), and visual spellings, words whose spellings had no sound correspondence (e.g., YmP for turtle). It was assumed that children would learn phonetic words based on an understanding of alphabetic cues. Visual words were designed to enhance learning based on logographic cues.

Pre-readers were found to learn visual spellings more easily than phonetic spellings, and it was suggested that they were better at developing logographic access routes. On the other hand, novices and veterans learned to read the phonetic spellings more easily. A comparison of the three groups' letter knowledge demonstrated that veterans and novices had mastered letter names, whereas pre-readers had not. Ehri and Wilce (1985) concluded that phonetic cue reading develops later than visual cue reading, and that the shift to phonetic reading may accompany the mastery of letters.

A more recent study in this series (Scott & Ehri, 1990) examined whether mastery of letter names might be a key factor enabling beginning readers to read words using phonetic cues. Subjects in this study were preschool and kindergarten children who demonstrated adequate facility with letters, but could read less than two words from a basic word list.

Results revealed that the students in phonetic cue word groups learned a significantly greater number of words than students in the visual cue word group. Scott and Ehri (1990) concluded that phonetic spellings were easier to learn than visual spellings, and that letter knowledge alone was sufficient for phonetic cue reading which ultimately lead to the development of alphabetic access routes. These authors also suggest that beginning reading skills will be enhanced if young readers first learn to read words whose spelling contains familiar letter sound cues.

It is theorized that the advantage of letter routes over visual routes is that word learning proceeds more rapidly, and that words are read more accurately and consistently. Collectively, these two studies suggest that good beginning readers differ from poor beginning readers in their ability to form alphabetic word access routes, and that facility with letter names, in the absence of word reading ability, may be sufficient for the development of these access routes.

Letter-Naming and Information Processing Efficiency

Another theory of the role of letter naming in the development of beginning reading skills, considers the speed of letter naming to be an index of the automaticity or facility with which letter recognition occurs. This explanation suggests that children who can automatically recognize letter shapes and patterns will have increased facility in recognizing the letter patterns in words. It follows that to whatever degree the student is required to expend effort identifying unrecognized letters, that student will have less attention and capacity remaining for processing and remembering words. To the extent that unknown letters are not processed, the growth of sight word vocabularies, and possibly determination of the correct meaning of the text, could be impeded (Adams, 1990).

Perfetti (1985) continued this line of thought when he suggested that the time it takes to attend to, perceive, and name a visual symbol (a lower level process) had a direct influence on the time which can be given to higher level reading processes. A critical element in Perfetti's model is the relative allocation of limited resources in the various information processes associated with reading. According to the theory of verbal efficiency (Perfetti, 1985), the efficiency of processing verbal symbols can be impeded by limits which may be placed on a person's capacity for attention and working memory.

Working memory is a limited capacity system which is limited by the number of memory elements which can be simultaneously activated. Relative to reading, working memory stores the results of partially processed sentences and groups new words into tentative structures as they are encountered.

Attention affects the efficiency of processing in two ways. First, to the extent that a process requires attention, that process is not "fixed" within the processing environment. Processes become fixed, within limits, by the amount of overlearning (practice) given to the process. Thus, it is suggested that the amount of attention can be reduced (and efficiency gained) by repeated exposure (practice) to specific verbal symbols. Second, it is assumed that attention involves a limited amount of resource allocation. Thus, the increased demands upon the attention system by any one process, will place constraints upon the amount of attention that can be given to other elements.

Thus, if there is facility with low-level processes, more memory and attention can be allocated to high-level processes. Alternatively, inefficient processing increases interference and can produce low quality processing. A key to improving beginning reading skills might be to increase the efficiency of low-level processing through repeated practice with letter naming.

Recent expansion of the verbal efficiency model of reading development regards speed in processing as a secondary consequence of reading development (Wolf, 1991). A key factor within this re-conceptualization of the efficiency model is the quality of the representation of verbal symbols within memory. The quality of representation directly affects how quickly information can be accessed and understood. Thus, speed is an outcome of access speed and information encapsulation. Consequently, practice with verbal symbols might strengthen lexical representation, which in turn will increase speed and subsequent achievement.

Walsh, et al. (1988) have provided important data on the role of letter naming speed in the development of beginning reading skills. These authors argued that letter naming speed was most likely an indicator of the general speed of low-level processes that, if slow and awkward, could inhibit early reading achievement. Thus, letter naming is a general indicator of "automaticity" of the low-level processes related to verbal efficiency. A study conducted by Walsh, et al. (1988) compared the relationship between a number of naming speed tasks and reading achievement among students in kindergarten through the third grade.

The initial finding of this study was a strong positive correlation between letter naming speed and subsequent reading development ($r = .89$, & $.80$) among kindergarten students. When the regression slope was calculated for the relationship between kindergarten letter naming speed and subsequent first-grade reading achievement, a steeply positive regression was demonstrated. Thus, Walsh, et al. suggested that for children in the early stages of reading, lack of facility in the processes of letter naming was an obstruction to progress in reading.

On the other hand, the correlation between letter naming speed in second-grade and third-grade reading achievement was not significantly greater than zero in either school (r = -.13 & -.06). Demonstrated within these results was an age-wise interaction which may represent a threshold effect within letter naming speed.

The results obtained by Walsh, et al. support a diminishing returns relationship between letter naming speed and reading development. According to this data, with letter naming speeds below a specified cut-off point, increases in letter naming speed are associated with substantial increases in later reading achievement. Above that threshold increases in letter naming speed are associated with minimal increases in subsequent reading ability. Thus, it is concluded that slowness appears to be a disadvantage, but increased speediness beyond the threshold is not necessarily an advantage. What seems to be important then, in terms of increasing verbal efficiency, is the transition from uncertainty to confident familiarity, rather than the transition from familiarity to effortlessness.

However, what remains open to question is whether training to speed up slow letter namers will produce a substantial improvement in later reading development (Walsh, et al., 1988). According to verbal efficiency theory (Perfetti, 1985), practice in naming verbal symbols, in this case letters, might result in increases in efficiency, as measured by naming speed, which will ultimately lead to improvement of reading skill.

To whatever degree deficits underlying the lack of facility with letter naming affect reading ability, the question remains as to whether the relationship is causal or associative (Wolf, 1991). If the relationship is associative, then to whatever extent both reading and naming systems share sub-processes that cannot be quickly activated or integrated, both will be impaired. If the relationship is causal slower naming speeds might directly interfere with decoding and word recognition processes. Slower word recognition would then interfere with higher level processes such as reading comprehension.

The Present Study

Although letter naming is not the only fundamental element in fostering success among beginning readers, it may be a significant prerequisite skill in the development of beginning reading skills. Several theories have been developed to explain the relationship between letter naming speed and reading achievement. Two of these theories highlight the role of facility with letter naming speed as an indicator of verbal efficiency and the role of letter naming in developing phonetic access routes to word reading.

Letter-Naming Facility

Initially, a limited resource model was proposed to explain the role of facility with letter naming in the development of reading skills. If fewer resources were required to process letters, then more resources should be available for the higher level processes of reading. Conversely, lack of facility with letter naming should create a drain on resources that would otherwise be allocated for high level processes.

More recent expansion of this theory, concerning the role of letter naming, has suggested that levels of processing occur in modules which are more independent of each other than previously hypothesized. According to this theory, the strength of facility with letters lies in the quality of their lexical representation within the memory system. Faster letter namers have better lexical representation whereas slower letter namers have poorer representation. Weak representation results in slow access which ultimately impedes comprehension.

Whether facility in letter naming leads to better reading through improved resource allocation or better access through better representation is difficult to prove in either case. What may be more important to demonstrate is a functional relationship between letter naming and reading ability. Research to date has clearly demonstrated that good beginning readers also name letters quickly, and poor beginning readers name letters slowly. However, it has not been shown whether improving the letter naming speed of poor beginning readers will result in improved reading achievement.

One purpose of the study was to assess the functional relationship between letter naming speed and reading achievement. Both allocation and representation theories lead to the conclusion that facility with letter naming can be improved with practice. Therefore, it follows that poor beginning readers should become better beginning readers if they are provided with direct training to increase their facility in letter naming.

Hypothesis #1: **It is hypothesized that first-grade students who are given direct training to increase their facility in letter-naming will demonstrate significantly better reading skills than their untrained peers.**

Letter-Naming and Alphabetic Processes

Another prominent theory on the role of letter naming in beginning reading achievement suggests that letter naming skill results in improved knowledge of letter sounds. Improved knowledge of letter sounds then leads to the development of phonetic access routes to word learning, which ultimately leads to better beginning reading skills. Research has demonstrated that good beginning readers are good letter namers and seem to make better use of alphabetic processes in learning new words. Alternatively, poor readers are poor letter namers and seem to make better use of logographic cues when attempting to learn words (Ehri & Wilce, 1985). It has also been shown that children with good letter skills, but with undeveloped word reading skills, make better use of alphabetic cues in learning new words (Scott & Ehri, 1990).

One conclusion of these studies is that good letter naming skills are sufficient for the development of the appropriate use of phonetic routes for learning new words. Thus, if the theoretical outcome of this statement is pursued good letter skills would lead to better phonetic learning of words, which would ultimately lead to improved beginning reading skills. Conversely, it is assumed that poor letter naming skills, to whatever extent they are lacking, will prolong the development of good beginning reading ability. Again, what has not been demonstrated, to this point, is if the simple training of poor letter namers, to help them become good letter namers, will improve their letter sound knowledge, alphabetic access to word learning, and ultimately improve their beginning reading achievement.

The second purpose of the present study was to determine whether training in letter naming facility for poor letter namers will improve their knowledge of letter sounds and use of alphabetic access routes, and, thereby, improve their beginning reading achievement, as compared to untrained cohorts.

Hypothesis #2: **It is hypothesized that students who have received training to increase letter-naming ability will be significantly more able to learn**

alphabetic access routes to word learning than their untrained peers.

The focus of this study was to explore the role of letter naming in the development of beginning reading skills. If letter naming skill is a primary pre-requisite to the development of subsequent reading skills then it was expected that letter training would result in significant gains in beginning reading skills. However, if letter naming skills have a less causative, and more associative, role in the overall development of reading skills, less than significant results would be obtained.

Chapter II

Literature Review

A strong positive correlation between letter naming ability and later reading achievement has been a persistent finding since the 1940's (Walsh, et al., 1988). Although much of the early research used letter naming accuracy as an index of letter identification skill, letter naming speed has been the focus of most recent research. The purpose of this review will be to outline recent research which identifies the relationship between letter naming speed and reading achievement and attempts to explain the role of this relationship in the development of beginning reading skills.

The Relationship Between Letter-Naming and Beginning Reading

The developmental relationship of letter naming to reading achievement has been explored using two different statistical modeling approaches. In an effort to determine the location of various pre-reading skills to reading achievement Heibert, Cioffi, and Antonak (1984) conducted an order analysis. In this analysis the relationship of measures of letter naming (LN), visual discrimination (VD), auditory discrimination (AD), reading purposes (PU), and reading processes (PR) were compared across 3, 4, and 5 year-olds.

Results of this analysis demonstrated a general, but at times not clearly determined, hierarchical relationship between the three pre-reading skills (VD, AD, LN) and two reading skills (PR, PU). Among the 3 and 4 year-old children pre-reading skills were shown to have a prerequisite relationship to the reading skills but no clear differentiation or structure among the skills was observed. However, among 5 year-olds a clear hierarchical relationship among the skills developed. With this age group visual discrimination and auditory discrimination became requirements for adequate letter naming. Letter naming, in turn, was observed to be a prerequisite skill for reading processes, which preceded the development of reading purposes.

In a second line of research, Jackson and her colleagues (Jackson & Myers, 1982; Jackson, Donaldson, & Cleland, 1988) suggested that a more adequate measure of the impact of letter naming on reading ability could be obtained if precocious readers were assessed before receiving formal reading instruction. Jackson and Meyers (1982) confirmed the relationship of letter naming speed to basic reading ability when they found a significant correlation in these skills within a group of gifted pre-school age children who were precocious readers.

Jackson et al. (1988) measured the performance of 87 students with precocious reading ability on eleven different measures of reading ability. The factor structure of obtained scores were analyzed and a LISREL analysis of the resulting model was developed to determine goodness of fit. The analysis suggested that all eleven reading measures were inter-correlated in a single factor titled general reading ability. This general reading ability was in turn influenced by the three separate, but interrelated, factors of speed, decoding rule use, and graphic precision.

Two of these factors, speed and graphic precision, have a strong relationship to naming speed. Emergence of a speed factor may support the position that there is a general temporal factor which bears a substantial influence on the reading process. The graphic precision factor, which negatively correlates with the speed factor, is a measure of the accuracy with which individual items and words are read. The role of accuracy, its relationship to speed, and their joint influence upon general reading ability is also an important component of hypotheses which have been developed to explain the role of letter naming in the reading process.

Continuous List Measures of Letter-Naming Speed and Reading Achievement

It has been noted that as early as the nineteenth century reading research by Cattell, a relationship between the oral reading rate for random letters, random words, and words in context had been demonstrated among adults (Biemiller, 1977-78). The correlation between oral reading rates and reading achievement has also been demonstrated. Biemiller suggested that individual differences in reading speed could occur at three levels; (a) the level of identifying individual letter features quickly, (b) at the level of using the structure within words to facilitate rapid word identification, or (c) at the level of using contextual structure to facilitate the identification of words in text, and that there may be differences in the importance of each skill within the development of reading skills.

Biemiller (1977-78) studied the relationship between three variables (random letter identification speed, random word reading speed, and reading words in text) and reading achievement across differing ages. Subjects in Biemiller's project included 118 students in grades two through six, and 20 college educated adults. The independent measures included; (a) 50 letter lists of randomly selected letters, (b) word lists compiled from basal readers, and (c) grade appropriate passages either borrowed from the classroom basal reader or developed by the author to reflect an appropriate reading level. The time required to read a group of letters, words, or passage was timed with a stopwatch, tape recordings of the sessions were analyzed and total time was corrected for time lost to errors. In this way only the time required for reading correctly was included. The dependent measure of achievement was the Metropolitan Achievement Test (MAT). Data were analyzed using analysis of variance to compare age, sex, and achievement on differences in reading times; product-moment correlation coefficients were used to determine the relationships between variables; and multiple regression analysis was used to examine the contributions of letter, word and text time variance to achievement.

Biemiller demonstrated that (a) the time required to identify letters, random words, and words in text is reduced as children grow older ($p. < .01$), (b) Younger children took longer to read simple words out of context than letters, whereas older children took about the same time to identify words and letters ($p. < .01$), and (c) there was a non-significant difference in reading time for boys and girls across all variables ($p. < .10$). When reading times were compared to achievement, children with better achievement demonstrated better reading speed, across all three measures, compared with low achievers. Multiple regression analysis demonstrated that letter naming time variance alone contributed the larger share of total text reading time in all but one grade (23% to 75%), and letter time variance was associated with around 30 to 70 percent of time variance in most age, class, and achievement groups.

Generally, these results suggested that younger readers are slower than older readers and poorer readers are slower than more able readers, both at the level of reading letters and words. Children who read letters slowly also read words proportionately more slowly. There also seemed to be a diminishing returns effect with the relationship between letter naming and word naming speeds - i.e. older, more able readers demonstrated similar random word and letter reading times, while there was a substantial difference between these two reading times among younger, less able readers. Younger, less able readers identified letters much more quickly than words.

While Biemiller was able to confirm the existence of a relationship between letter naming speed and reading achievement, critics suggested that additional issues needed to be addressed. One concern was that there was a general naming speed or temporal factor which was related to reading achievement, but not unique to letter naming speed. A second concern was the relationship of language analysis skills to the development of reading skills. As a result much of the letter naming research of the past decade has included one or both of these components.

For example, Blachman (1984) conducted a longitudinal study of the relationship of letter naming speed, general naming speed, and language analysis skill among a population of 34 inner-city children. In this project students were assessed in the spring of kindergarten and again in first-grade. Naming speed measures included the naming of colors, objects, and letters, whereas language analysis tasks included rhyming, syllable segmentation, and phoneme segmentation. Measures of reading achievement were the reading subtest of the Wide Range Achievement Test and the pre-reading skills composite of the Metropolitan Readiness

Test, reading subtest of the Wide Range Achievement Test, and the Gallistel-Ellis Test of Coding Skills.

Correlations between letter naming and kindergarten achievement were not calculated, however the correlation between letter naming and first-grade achievement ranged from -.55 to -.67. Correlations among objects and color naming, and first-grade achievement, were non-significant and ranged from -.18 to .04. Phoneme segmentation was the only language analysis measure which correlated significantly with first-grade reading achievement (.45 to .52). Within the first-grade scores object, letter, and color naming were significantly inter-correlated (.52 to .68) as were rhyming and syllable segmentation (.42 to .58). Phoneme segmentation was non-significantly correlated with all of these measures (-.02 to -.30).

In the kindergarten sample letter naming scores were treated as a dependent measure of reading skill, rather than as an independent variable. Given this treatment as a dependent measure little could be said of the relationship of letter naming to kindergarten achievement. It is important to note that color naming speed is significantly related to five or the six measures of kindergarten reading achievement (-.25 to -.61). Thus, it was the strongest indicator of achievement in kindergarten but is not significantly correlated with reading achievement in first-grade.

Generally, these results demonstrated a strong relationship between both letter naming speed and phonemic segmentation tasks and first grade reading achievement. However, it is important to note that in both kindergarten and first-grade the language analysis and naming speed tasks were substantially unrelated. This finding might suggest that these measures are tapping somewhat different, but significant, components of linguistic processing, and may weaken the argument for a single language deficit among poor beginning readers.

Blachman (1984) also found that children who had facility with color names in the spring of their kindergarten year were also more likely to name a greater percentage of their letters. Those who had the facility with letter names at the end of kindergarten, could name a greater percentage of words at the end of first-grade. Thus, these data supported the existence of a general naming ability where children with the ability to learn new verbal labels in kindergarten (colors) are more likely to learn a new set of labels in first-grade (letters and words). These results confirm the strong relationship between letter naming speed and beginning reading achievement. However, the results do not necessarily support the idea that letter naming speed is the only naming speed indicator related to later reading achievement.

A study by Good and Kaminski (1991) compared the relationship between the three variables of letter naming speed, picture naming fluency, and phonemic segmentation fluency with measures of reading achievement and measures of risk for reading failure. Criterion measures included the Metropolitan Readiness Test (MRT), Stanford Diagnostic Reading Test (SDRT), oral reading rate (CBM), teacher ratings of risk (TRR), the Rhode Island Pupil Identification Scale (RIPIS), and the General Cognitive Index of the McCarthy Scales of Children's Abilities (GCI). The letter naming, and picture naming measures were the number of units per minute correctly identified from pages of randomized letters and pictures respectively. Phonemic segmentation fluency was measured by calculating the number of word segments correctly identified per minute. Subjects were 20 students in a public school who were measured in the spring of their kindergarten and first-grade years.

All three pre-reading measures were significantly correlated with all criterion measures (MRT, RIPIS, TRR, GCI) in kindergarten (-.57 to -.89 and .58 to .88). Letter naming was the only pre-reading measure correlated with criterion measures (CBM, SDRT, TRR) of reading achievement in first-grade (.75, .77 and -.59 respectively). Both letter naming fluency and picture naming fluency were significantly correlated with the RIPIS at the end of first-grade (-.49 and -.49 respectively). When indicators of risk for reading failure (poor performance on criterion measures) were compared to performance on the letter naming and phonemic analysis tasks, there was generally good discrimination between students with and without risk across both variables.

Again these data confirm the strong relationship between letter naming speed and beginning reading achievement. However, the relationship between phonemic analysis and reading achievement measures, reflected in these studies, is less clear. There is some evidence to support the use of both measures as indicators of children who are at risk for early reading difficulty.

The Move to Discrete Trial Measures of Letter-Naming Speed

All of the letter naming speed research discussed in this chapter employed a continuous naming task in which the subject was asked to name a limited number of serially presented stimuli as quickly as possible. This method may over estimate the contribution of letter naming speed to the reading process, and therefore, it is not a pure measure of letter naming speed. In response to this criticism some researchers have used a discrete trial method of presentation for determining letter naming speed. Proponents of discrete-trial methods consider it a more precise measure of letter naming speed because it eliminates extra sources of variance such as scanning, sequencing or motoric strategies. With the discrete trial method, letters are usually presented by a tachistiscope and responses are timed by a computer using a voice activated switch. The unit of measure is the average time required to name the letters presented.

Stanovich and his colleagues (Stanovich, 1981; Stanovich et al., 1983; Stanovich et al., 1986) conducted a series of studies employing a discrete trial letter naming task. In the initial project (Stanovich, 1981), groups of skilled and less skilled readers were compared in their ability to quickly identify numbers, pictures, letters, colors, and words. Skilled and less skilled readers were differentiated by teacher ratings and their scores on the reading subtest of the Wide Range Achievement Test (WRAT), Stanford Achievement Test, and time required to orally read a short paragraph. Subjects were 22 students assessed in June of their first-grade year.

Stanovich (1981) found that less-skilled readers could not be differentiated from skilled readers based on their number, letter, and color naming speeds. However, significant differences were found between groups for word reading times ($p.<.05$) and word reading errors ($p.<.001$). Intercorrelations among measures demonstrated a pattern of results reflective of the ANOVA results. The reading achievement measures were strongly correlated with each other (.44 to .79) and with the word reaction time measures (.46 to .78), but were not significantly correlated with the color, number, and letter naming tasks (.04 to .18). Multiple regression analyses revealed that the only significant source of variance in reading achievement scores was word reading reaction time.

The results of this study fail to demonstrate a significant relationship between letter naming speed and reading achievement among the late first-grade population of this study. It is possible that the late first-grade age of these students placed them at a developmental level of reading achievement beyond the point at which letter naming speed is most important to the development of reading skills.

In a related study, Stanovich, et al. (1983) assessed the letter naming speed of two different groups of skilled and less-skilled readers. All subjects were in the first grade. Group A was assessed in both the fall and spring and Group B students were assessed only in the spring. Measures of reading achievement included the MAT and the Gates-MacGinite Reading Test. Groups of third and fifth graders were also assessed in the spring. The reading achievement measure for these groups was the Reading Survey of the MAT.

Analysis of this data (Stanovich, et al., 1983) found moderate to low, but significant, correlations between letter naming speed and reading achievement scores for all groups. The correlation between letter naming speed and MAT scores for Group A was -.38 ($p. < .01$) in the fall and -.28 ($p. < .05$) in the spring. Fall and spring correlations with the Gates-MacGinite were quite similar (-.37 and -.18 respectively). The correlations between the MAT and letter naming speed from the spring assessment of first-grade Group B, and fifth-grade were significant (-.29 and -.54 respectively; $p. < .05$), even though the correlation for third-grade students (-.22) was non-significant.

The correlations between letter naming speed and reading achievement among the first-grade groups in this study were larger than those observed previously (Stanovich, 1981). However, these correlations were substantially smaller than correlations in studies which employ continuous list measures. This finding may support the idea that continuous list procedures overestimate the relationship between facility with letters and beginning reading achievement.

To further examine the relationship between letter naming speed and reading achievement, Stanovich, et al., (1986) compared the scores of third and fifth grade students across 14 measures. Other than the previously used measures (MAT, letter naming speed, word naming) this project included the Peabody Picture Vocabulary Test (PPVT), picture naming, measures of language analysis skill (pseudo word-naming, rhyme production, oddity identification), and contextual facilitation.

In Stanovich et al. (1986) MAT scores for third-grade students were significantly correlated with the PPVT (.76), word naming speed (-.72), and word naming in neutral contexts (-.53). Performance on the MAT also correlated significantly with rhyming and oddity errors, but not with the corresponding time measures. Neither the picture naming nor letter naming times were significantly correlated with MAT scores (-.18 and -.07 respectively). Correlations among the various measures and the PPVT followed a similar pattern for the third-grade students.

The relationships in the data for the fifth-grade students contained some similarities to the third-grade results, but, there were also some interesting differences. Among fifth-grade subjects, scores of the MAT correlated significantly with every other variable in the study. In another interesting note, all variables in this data set obtained their highest correlation with pseudo word-naming time. The PPVT correlated most highly with the MAT (.64), as did word naming time (-.57) and neutral contexts (-.71). Correlations between letter naming time and the MAT, and PPVT, were -.30 and -.42 respectively. Similar to the pattern of results in Stanovich, et al. (1983), letter naming was significantly related to reading achievement measures in fifth-grade but not in third-grade.

These results (Stanovich, 1983; Stanovich, et al., 1986) do not support theories which suggest an important relationship between naming speed and the acquisition stages of reading development. To a certain degree the lack of correlation between letter naming speed and reading achievement in both third and fifth grades might be expected, or even a correlation in third but not fifth grade. However, a higher correlation in what is presumably a later developmental reading stage could be difficult to explain.

To this point discrete-trial letter naming data has failed to support the developmental reading theories which stress the importance of facility with letters. Two criticisms have been launched at the discrete-trial method. One is that discrete-trial methods generally fail to differentiate skilled and less-skilled readers because the need for the fast integration of a variety of cognitive and linguistic subprocesses, which are required in a serially presented continuous naming task, have been removed from the discrete-trial format (Wolf, 1991). It would follow that removal of key sources of variance would weaken the strength of the letter naming measure.

Another difficulty with the Stanovich (1981) et al. (1983;1986) method was in their calculation of the time scores. In the calculation of time scores, times longer than three seconds were discarded and scores which were more than 2.5 or 3.0 standard deviations from the mean were removed. This trimming of the slowest times introduces a source of bias into the data analysis and creates a restriction in the range of scores which would serve to weaken the resulting correlations. This problem has been addressed in a recent discrete-trial study of the importance of letter naming speed.

Walsh, et al. (1988) addressed the unit of measurement issue by averaging the reciprocals of each child's reaction time to obtain the measure of naming speed. These authors stated that the advantage of using reciprocals are; (a) they are scaled in a direction which will lead to positive rather than negative correlations and as a result are intuitively more easily interpreted, (b) reciprocal reaction times usually have a more normal distribution around the mean, whereas untransformed reaction times usually have a highly skewed distribution, and (c) reciprocal reaction times permit the meaningful inclusion of occasional long reaction times in an average.

Subjects in this study (Walsh, et al., 1988) were 52 kindergarten and 64 second grade students from two different schools. Letter naming speed was assessed in the middle of subjects kindergarten and second-grade years, and reading achievement data were collected 16 months later at the end of their first and third-grade years respectively. In addition to letter naming speed, the time required to name pictures of common objects (object naming) was measured. The measure of reading achievement was each child's end of year reading level as assessed by the Initial Placement Inventory. Advantages of this measure were that levels were assessed periodically throughout the year so that the final level determination was based on multiple assessments of each child, and it also placed both grade levels of children on a common scale of reading achievement.

The correlation between the mean letter naming speeds for kindergarten and second grade students was .85. The authors stated that this finding suggests that both groups of children employ the same processes for recognizing and naming letters. The resulting implication is that the speed advantage among second-graders comes not from the use of superior recognition strategies, but from their superior efficiency at the same strategies.

Walsh, et al. (1988) also found a strong positive correlation between letter naming speed and subsequent reading development (r = .89, & .80) among kindergarten students. The results were from two different schools with two kindergartens in each school. When the regression slope was calculated for the relationship of kindergarten letter naming speed and subsequent first-grade reading achievement, a steeply positive regression is demonstrated. For children in these stages of reading, lack of facility in the processes of letter naming proved to be an obstruction to progress in reading.

In contrast, the correlation between letter naming speed in second-grade and third-grade reading achievement was not significantly greater than zero in either school (r = -.13 and -.06). Demonstrated within these results was an age-related interaction which may suggest a threshold effect within letter naming speed.

Apparently, there are diminishing returns in the relationship between letter naming speed and reading development. According to this data, with letter naming speeds between 1.1, increases in speed are associated with substantial increases in later reading achievement. Above that threshold, increases in letter naming speed are associated with minimal increases in subsequent reading ability. Thus, it is concluded that slowness appears to be a disadvantage, but increased speediness beyond the threshold is not necessarily an advantage. The authors argued that the "transition from faltering unfamiliarity to effortless routinization may be more important than the transition from slow effortless to fast effortless routinization." However, what remains open to question is whether training to speed up slower letter namers will produce a substantial improvement in later reading development (Walsh, et al., 1988).

Another purpose of the Walsh et al. (1988) study was to measure the relative effect that naming speed has on the relationship between letter naming speed and reading achievement. Among the subjects in this study correlations between object naming speed and reading achievement were .34, .47 for kindergarten classes, and -.25, -.19 for second grade classes. The authors then regressed reading level on letter naming and object naming simultaneously. If a substantial part of the letter naming speed is due to a general temporal ability, then the multiple regression coefficient would not differ significantly from zero.

The resulting multiple regression coefficients for the kindergarten schools were .89, .75 for letter naming speed and .05, .11 for object naming speed. In each school the letter naming coefficients were significant ($p < .0001$, $p < .001$ respectively) while object naming coefficients were non-significant. For beginning readers, then, facility in the processes that underlie letter naming functionally affects progress in initial reading.

These results may provide additional evidence for a cognitive/developmental framework for reading processes described by Stanovich (1986). In this paper discussing the various causes of reading failure, Stanovich discusses the possible role of reciprocal causation effects. He suggests that there are changing relationships between developing reading ability and associated cognitive tasks. It is hypothesized that the development of various cognitive abilities influence the development of reading skills, which influence the further development of subsequent cognitive processes. This process may be reflected in the diminishing returns effect of letter naming speed noted by Walsh, et al. (1988). According to this formulation, individuals who possess needed prerequisite skills continue to build new skills. Alternatively, those who have failed to reach basic competence in low-level skills (ie, perhaps those students who failed to reach the letter naming threshold described by Walsh, et al.) are impeded in their subsequent development.

Direct Comparison of Continuous List and Discrete Trial Measurement

Issues related to the comparative differences in continuous list and discrete-trial methods of measurement were addressed in a recent study by Bowers and Swanson (1991). In this project both continuous list and discrete-trial methods were used to assess the letter and digit naming speeds of second-grade students. A variety of other measures were also employed. Reading achievement was assessed with; the Word Identification (WI) and Word Attack (WA) subtests of the Woodcock-Johnson Reading Mastery Test, Canadian Test of Basic Skills (CTBS), and time required to identify easy second grade words presented using a discrete-trial format. The Auditory Awareness Test, and an Odd Word Out task were employed to measure phonological awareness, and memory was assessed using the Digit Span subtest from the Wechsler Intelligence Scale for Children-Revised. Another addition to this study was the use of two differing inter-stimulus (ISI) presentation speeds in the discrete-trial letter and number identification tasks, and conditions of multiple item and single item presentation formats were included. Subjects were 46 second grade students who were divided into groups of average and poor readers based on teacher ratings and scores on the Woodcock-Johnson Word Attack subtest.

Scores on all of the measures differentiated average from poor readers, with the exception of Digit Span. A MANCOVA was performed on the discrete-trial scores for naming letters and numbers. Significant main effects were found for reading group (p.<.01), condition (p.<.001), and ISI (p.<.05). There was also a significant interaction between reading skill and ISI (p.<.05). Post hoc t-tests indicated that slower ISI times improve the scores of poor readers but did not affect the reaction time of average readers. The significant main effects suggested that average readers had faster naming speeds than poor readers across all conditions. Both groups of readers had slower identification times when items were presented in groups, rather than one at a time (Bowers & Swanson, 1991).

Both continuous list and discrete-trial naming speeds were significantly related to CTBS comprehension and word identification speed. However continuous list measures were related to accuracy measures of Word Attack and Word Identification, while discrete-trial reaction times were not significantly related. The phonological awareness tasks were significantly correlated with each other (.43) and with several reading tasks (WI, .36, .51; WA .49, .43; word reading speed, .35, .27). Neither phonological awareness measure was significantly related to discrete-trial naming speed measures, although the Auditory Analysis Test was significantly related to continuous list letter naming (.31) and digit naming (.30) tasks.

Bowers and Swanson (1991) have confirmed that both continuous list and discrete-trial letter naming tasks, under various conditions, discriminate poor and average second-grade readers. Their data also suggested that the conditions of presentation of the naming task can influence the relationship between discrete-trial ISI and reading group may lend support to the suggestion that letter naming tasks are more sensitive to differences between average readers, or in the terms of Walsh et al. (1988) the difference between unfamiliarity and slow efficiency, as opposed to the difference between degrees of effortlessness.

Although the relationship between letter naming speed and reading achievement has been demonstrated using a variety of methods, the functional relationship between training in facility with letters and subsequent reading achievement has yet to be established. However, if this relationship can be demonstrated another question would develop regarding the functional role letter naming speed plays in the development of reading skills.

Letter-Naming and Pre-reading Phonetic Skill

Ehri and her colleagues (Ehri & Wilce, 1985; Scott & Ehri, 1990) suggested that facility with letters leads to increased ability to understand the relationship of letters within words, which leads to the development of alphabetic access routes to word encoding, which ultimately leads to the development of beginning reading skills.

Early evidence of this alphabetic principle was discussed by Read (1971). It was noted that pre-school age children with letter knowledge are able to figure out their scribal significance. Thus, these children can spontaneously produce words such as Ppl (people), Jriv (drive), and Bot (boat). Although the spellings are often odd, an understanding of basic phonological knowledge is demonstrated.

In order to determine the relative importance of alphabetic and logographic access routes in developing reading skills Ehri and Wilce (1985) conducted a study to determine at what point beginning readers develop phonetic access routes. Alphabetic readers are individuals who use letter sounds to decode words while logographic readers use visual cues to decode words. An example of a logographic reader is the three year-old who can read the McDonald's sign because she/he recognizes the "golden arches."

In this study kindergarten students were divided into three reading level groups. Pre-readers were those students who read zero words from a list of 40 words, novices were those who read 1 to 11 words, and veterans read more than 11 words. Subjects were taught to read two different word spellings for common nouns. Phonetic words were those whose letters corresponded to the word sounds (e.g., JRF for giraffe), and visual spellings, words whose spellings had no letter sound but some form of visual correspondence (e.g., YmP for turtle).

An ANOVA determined that all main effects were significant for group ($p.<.01$) and trials ($p.<.01$), but there was a significant interaction for group x spellings ($p. < .01$) and trials x spellings ($p. < .01$). Tukey's post hoc pairwise comparison test determined that novices and veterans scored equivalently and significantly higher than pre-readers on measures of letter name and letter sound knowledge.

In this study Ehri and Wilce (1985) found that pre-readers learn visual spellings more easily than phonetic spellings, and novices and veterans learned to read the phonetic spellings more easily. Comparison of the three groups' letter knowledge demonstrated that veterans and novices had mastered letter names, while pre-readers had not. It was concluded that phonetic cue reading develops later than visual cue reading, and that the shift to phonetic reading may accompany the mastery of letters.

The purpose of a more recent study (Scott & Ehri, 1990) was to determine whether mastery of letters names might be a key factor enabling beginning readers to read words using phonetic cues. Subjects in this study were preschool and kindergarten children who demonstrated adequate facility with letters, but could read less than two words from a basic word list. Subjects were then divided into two phonetic word cue, and one visual word cue, groups. The phonetic count group gave attention to letters by counting the number of letters in a word while the phonetic name group recited the letter names. Groups of readers were then taught words from each list and trials to mastery and number of words learned was used as a measure.

Results of an ANOVA determined main effects for condition ($p. < .05$) and trials ($p. < .01$). Tukey's post hoc pairwise comparison tests were used to determine that subjects within the phonetic name group significantly outperformed subjects in the visual cue group. Inspection of the words learned per group suggested that the number of words learned by the phonetic groups were quite similar and both were higher than the number of words learned by the visual group. When comparing the number of group members who were able to reach criterion, 47% and 41% of the members of the phonetic name and count groups reached criterion, compared to 12% for the visual group.

Results revealed that the students in phonetic cue word groups learned a significantly greater number of words than students in the visual cue word group. One conclusion was that phonetic spellings were easier to learn than visual spellings for children who had facility with letters. It was further suggested that letter knowledge was sufficient for phonetic cue reading, and ultimately the development of alphabetic access routes.

The advantage of letter routes over visual routes is that word learning proceeds more rapidly, and that words will be read more accurately and consistently. Collectively, then, these two studies suggest that good beginning readers differ from poor beginning readers in their ability to form alphabetic word access routes, and that facility with letter names, in the absence of word reading ability, may be sufficient for the development of these access routes. Facility with letter naming may be an indicator of other important pre-reading variables like exposure to print (Biemiller, 1977-78). Thus, better phonetic access routes to word learning may be the product of variables other than simple letter knowledge. What has not been demonstrated is whether students with previously low letter knowledge, who have received training to improve their facility in letter naming will have increased ability to use alphabetic access routes in learning new words, and ultimately improved reading achievement as compared to a group of untrained peers.

Summary

In summary, it has been shown that letter naming speed is moderately to strongly correlated with reading achievement across a variety of studies. Although letter naming is not the only foundational element in fostering success among beginning readers, it may be a significant prerequisite skill in the development of beginning reading skills. Several theories have been developed to explain the relationship between letter naming speed and reading achievement, and two of these theories highlight the role of facility with letter naming speed as an indicator of verbal efficiency and the role of letter naming in developing phonetic access routes to word reading.

Chapter III

Method

Subjects

Subjects were 41 first-grade students from a rural southwestern New York school district for whom parental permission had been obtained. The county in which the school district is located is considered one of the more economically disadvantaged counties in the state and students within the school primarily represent lower to middle income families. The 41 subjects comprised approximately 56% of the entire first-grade class.

Students represented three individual classrooms and were randomly assigned so that there was equal representation from each class in the training and non-training groups. Thus, if there were 10 students from classroom "A" involved in the study, five students were randomly assigned to each group. However, two students (one from each group, both from the same classroom) were withdrawn during the training phase, due to prolonged illness and rescinded parental consent, leaving 20 trained and 19 untrained students.

While previous studies examining letter-naming speed have chosen end of year kindergarten students for subjects, this study chose to employ first-grade students solely for pragmatic reasons. It was believed that the letter-naming skill of early first-grade students would not vary substantially from the skill of end of the year kindergarten students. Difficulties at the initial research site resulted in a relocation of the study and a two month delay. With an early November start date, the first-grade subjects had opportunities to receive substantial reading instruction and as a result their letter-naming and beginning reading skills may differ substantially from students at the end of kindergarten.

Measures of Letter-Naming and Reading Ability

Letter-Naming Speed. A continuous list measure of letter-naming speed was used in this study. Three pages of 52 upper and lower case letters in random order were constructed (see Appendix A). Each list of letters was administered and timed with a stopwatch for 1 minute and the number of letters named correctly per minute was calculated. The median score of the three trials was used as the measure of letter-naming speed. Students who did not know specific letters were prompted with the letter name after 5 seconds.

This continuous list measure of letter-naming speed was previously employed by Good and Kaminsky (1991). Although the reliability and validity of this measure were not reported, similar measures of word recognition speed have been demonstrated to possess more adequate psychometric properties (see discussion in the Reading Measures section).

Reading Measures. The first-grade reading curriculum of the project school is divided into two sections. Reading readiness skills are taught until December and Houghton-

Mifflin basal reading series are used for the remainder of the year. In the Fall, during the reading readiness curriculum, students are taught the 9 letters that are not taught in kindergarten, receive instruction in letter sounds, are taught sight-words from a pre-determined list, and begin to read short-stories.

Measures of Word-Naming Speed and Accuracy. The Fall reading readiness curriculum contains a list of 41 sight words. All of these words were randomly ordered on three lists. For the measure of word-naming speed, the three lists were presented to the students and the unit of measure was the total number of words read correctly in one minute, as timed by a stopwatch. The median score of the three trials was used as the measure of word identification speed. Unknown words were verbally prompted if not identified within 5 seconds. The first of the three lists was read in its entirety by all students, regardless of speed, and the number of words read correctly out of 41 was used as the measure of word reading accuracy.

The validity and reliability of curriculum-based, word-list, measures of reading rate has been extensively reviewed by Marston (1989). Correlations among curriculum-based word identification measures and a variety of reading achievement measures range from .36 to .90, with a majority of coefficients exceeding .70 (p. 34-38). Test-retest and parallel forms measures of reliability yielded coefficients

Table 3-1

Timeline and outline of procedures

Curriculum	Procedure	Dates	Analysis
	Phase 1: Pre-Training Measurement of:	4 Days Nov. 3-6	
	Letter-Naming Speed (LNS)		t-test
	Word-Naming Accuracy (WNA) Word-Naming Speed (WNS) Fall Passage - Oral Reading Rate (FOR) Winter Passage - Oral Reading Rate (WOR)		
Fall: Pre-Reading Curriculum	Phase 2: Letter-Naming Training	12 Days Nov. 10-13, 17-20, 24-25, Dec. 1-2	
	Phase 3: Post-Training Measurement of:		
	LNS, WNA, WNS, FOR, WOR	2 Days Dec. 3-4	
	Assessment of Phonetic Reading Ability	2 Days Dec. 8-9	Oneway ANOVAs; Repeated Measures ANOVA
	Phase 4: Follow-up Measurement of:		
Winter: Basal Reader Curriculum	LNS, WNA, WNS, FOR, WOR	3 Days Feb. 18, 22-23	Repeated Measures MANOVA

ranging from .85 to .96 (p. 41).

Measures of Oral Reading Rate. Due to the delayed start of this project, measurement overlapped both phases of the first-grade reading curriculum (see Table 3-1). As a result, two sets of passage oral reading rate probes were developed; one set representing passages from each phase of the reading curriculum. For each set, passages randomly selected from the curriculum material, were read for one minute, as timed by a stopwatch. The number of words read correctly per minute was the unit of measure. The median score of each set of passages was used as the oral reading rate score and individual words which were unknown were prompted after an interval of 5 seconds. Copies of individual probes for all of the reading measures can be found in Appendix B.

The Fall reading readiness curriculum employs short stories with lengths ranging from 20 to 60 words. Fall reading passages were complete stories randomly selected from this group. When reviewing the stories which had been used by the three first grade teachers, it was determined that two teachers had overlapping story sets while the third teacher had chosen different stories from the available pool. As a result, two sets of Fall reading passages were developed and the student's median score from the set corresponding with their classroom was used as the measure of Fall oral reading rate.

In December the first-grade reading curriculum shifts to use of a basal reading curriculum. Winter oral reading passages were chosen from the book that first grade teachers anticipated would be the instructional book at the time of follow-up in February. Passages of approximately 120 to 140 words in length were randomly chosen from the beginning, middle, and end of the book used in each classroom. Oral reading passages for two classrooms were selected from the Moonbeams book of the Houghton-Mifflin Reading Series (Houghton-Mifflin, 1983), while passages for the third class were taken from the With a Crash and a Bang book of the Literature Experience Reading Series (Houghton-Mifflin, 1991). The median score from the set of passages corresponding with a given student's classroom was used as the Winter passage score.

Correlations between curriculum-based passage oral reading rate measures and a variety of reading achievement measures range from .68 to .91 (Marston, 1989, p.34-38). Test-retest and parallel forms measures of reliability yielded coefficients ranging from .82 to .99 (p.41).

Measure of Phonetic Reading ability. The phonetic word training task used by Scott and Ehri (1990) was used to assess the development of alphabetic word learning. The 12 nouns along with their simplified spellings were borrowed from the published article. Pictures accompanying the words were selected from the Primary Phonics Picture Dictionary (Makar, 1985). Simplified spellings for the 12 words include: BH (Beach), ORNG (Orange), JRF (Giraffe), KND (Candy), ANGL (Angel), RM (Arm), ER (Ear), JL (Jail), KML (Camel), LMN (Lemon), NDN (Indian), and PNO (Piano).

The training procedure consisted of one study and seven training trials. During the study trial, subjects were shown pictures of the target objects paired with the simple spelling (see Appendix C). The experimenter pronounced the word while moving a finger below its spelling. The subjects repeated the word, pointed to and named each letter. During the seven training trials the subjects were shown the spellings without pictures and asked to remember the word which had been paired with each. First responses were scored as correct or incorrect. Whether or not the response was correct, the correct picture was shown and the subjects named the letters. The order of the 12 words for each trial was randomly selected. Word and picture cards were 4 1/4 x 5 1/2 inch cards, bound together in separate books for each trial by 1 1/2 inch metal rings.

The measures of phonetic reading ability were the mean number of trials it took each student to learn each word to criterion, the total number of words learned by each student, and the number of words read correctly on each trial. Criterion for each word was reached when a subject performed two successive perfect trials. In determining mean trials to criterion each trial was assigned a score from 6 to 0 in descending order. Thus, if criterion was reached in trial 2 a score of 6 was assigned, trial 3 a score of 5,..., trial 7 a score of 1, and if a word was not learned to criterion a score of 0. The mean score of the 12 words for each student was then calculated. With this scoring format students who learn words more quickly obtain higher scores.

Total number of words learned was scored according to a three point scale: 3 points for obtaining two perfect successive trials, 2 points for two nonsuccessive perfect trials, 1 point for one perfect trial and 0 points for no perfect trials. Although these procedures have been employed previously (Ehri & Wilce, 1985; Scott & Ehri, 1990) no reliability or validity data have been reported.

Procedures

Experimenters. The experimenters were eight graduate assistants from a local university. Students met for ten weekly sessions of approximately one hour to learn administration and scoring of measures and tasks, discuss general experimental procedures, assess progress, and re-emphasize procedures as needed. Training sessions involved a presentation of specific procedures followed by guided practice.

Pre-Training Measurement. After students were selected and randomly assigned to letter training and non-training groups, the letter-naming speed, word reading accuracy, word-naming speed, and oral reading rate for both Fall and Winter passages for all subjects was assessed. All measures were individually administered in one session of approximately 20 minutes in length. An outline depicting the flow of the various phases of this project can be found in Table 3-1.

Training Phase. Students in the letter training group were individually taught pairs of uppercase and lowercase letters using the Gickling Folding-in technique (Shapiro, 1992). This card drill is designed to build sight vocabulary and provides a review of known words while assuring an appropriate mix of unknown words. The procedure was especially appropriate because it was simple and provided a large number of stimulus presentations which has been theorized to be necessary to promote verbal efficiency or strong lexical representation.

Stimulus materials for letter training were a series of 3 x 5 cards containing letters using the same print format as the continuous list letter identification tasks. Specifically, the letter training, "folding-in" technique consisted of a flashcard drill where 2 identified unknown letters were intermixed in a prescribed order with 8 known letters (see Table 3-2).

During each training session a page of randomly ordered upper and lower case letters was read. Known and unknown letters were identified, and two unknown letters (e.g., A,B) were selected for drill. Eight known letters (e.g., C,D,E,F,G,H,I,J) were selected and the drill proceeded as follows:

1. Present the first unknown letter and ask the student to pronounce the letter (A).
2. Present the first known letter (C).

3. Present the initial unknown letter again (A).
4. Present the first known letter again (C).
5. Present the second known letter (D).

6. Present the unknown letter again (A).
7. Present the first known letter again (C).
8. Present the second known letter again (D).
9. Present the third known letter (E).

Drill continued in this way until all 8 unknown letters had been folded-in with the one unknown letter (A,C,D,E,F,G,H,I,J). Then the drill proceeded as follows:

1. Present the second unknown letter and ask the student to pronounce the letter (B).
2. Present the first unknown letter (A).

3. Present the second unknown letter again (B).
4. Present the first unknown letter again (A).
5. Present the first known letter (C).

6. Present the second unknown letter again (B).
7. Present the first unknown letter again (A).
8. Present the first known letter again (C).
9. Present the second known letter (D).

This procedure then continued until both unknown letters were folded-in among the 8 known letters. The session was then completed with the re-reading of the letter page.

Table 3-2

Outline of letter-training procedures

Session 1: Students read the letter probe; 2 unknown (U1,U2) and 8 known (K1,K2,K3,K4,K5,K6,K7,K8) letters are identified; flashcards are presented in the following order:

Fold-in 1:		*Fold-in 2:*	
	U1,K1		U2,U1
	U1,K1,K2		U2,U1,K1
	U1,K1,K2,K3		U2,U1,K1,K2
	U1,K1,K2,K3,K4		U2,U1,K1,K2,K3
	U1,K1,K2,K3,K4,K5		U2,U1,K1,K2,K3,K4
	U1,K1,K2,K3,K4,K5,K6		U2,U1,K1,K2,K3,K4,K5
	U1,K1,K2,K3,K4,K5,K6,K7		U2,U1,K1,K2,K3,K4,K5,K6
	U1,K1,K2,K3,K4,K5,K6,K7,K8		U2,U1,K1,K2,K3,K4,K5,K6,K7
			U2,U1,K1,K2,K3,K4,K5,K6,K7,K8

Re-read letter probe after Fold-in 2 is complete

Session 2: Student reads letter probe; 2 unknown (U3,U4) letters are identified; 2 known (K7,K8) letters from Session 1 are removed leaving 8 known letters (U2,U1,K1,K2,K3,K4,K5,K6); flashcards are presented as follows:

Fold-in 1:		*Fold-in 2:*	
	U3,U2		U4,U3
	U3,U2,U1		U4,U3,U2
	U3,U2,U1,K1		U4,U3,U2,U1
	U3,U2,U1,K1,K2		U4,U3,U2,U1,K1
	U3,U2,U1,K1,K2,K3		U4,U3,U2,U1,K1,K2
	U3,U2,U1,K1,K2,K3,K4		U4,U3,U2,U1,K1,K2,K3
	U3,U2,U1,K1,K2,K3,K4,K5		U4,U3,U2,U1,K1,K2,K3,K4
	U3,U2,U1,K1,K2,K3,K4,K5,K6		U4,U3,U2,U1,K1,K2,K3,K4,K5
			U4,U3,U2,U1,K1,K2,K3,K4,K5,K6

Re-read letter probe after Fold-in 2 is complete

Session X: Subsequent sessions follow the same pattern as Session 2; Student reads letter probe; 2 unknown letters are identified; 2 known (K next to end, K end) letters are removed leaving 8 known letters; flash cards are presented as previously noted; re-read letter probe after Fold-in 2 is complete.

At the end of the session a packet of 10 letters had been compiled with the 2 unknown letters on top followed by the 8 known letters (B,A,C,D,E,F,G,H,I,J). On subsequent days known letters 7 and 8 (I and J) were removed from the packet leaving 8 letters (B,A,C,D,E,F,G,H) for drill when 2 new unknown letters (K and L) were identified for that days session. In this way the 2 unknown letters from one day became known letters 1 and 2 (B,A,C,D,E,F,G,H) for the next day, known letters 3 and 4 (K,L,B,A,C,D,E,F) the next day, etc.. Eventually, the unknown letters were removed from the packet as cards 7 and 8 on their sixth day after introduction.

Sessions took approximately 10 to 15 minutes and were conducted over a period of 12 consecutive school days. Twelve sessions permitted the most deficient letter namers opportunity to demonstrate mastery of all letters. Mastery was assumed when a student recognized, without hesitation, a previously unknown letter for two consecutive days. For students who gained mastery of all letters in fewer sessions, letters for training were randomly selected for each daily drill.

Students in the non-training group did not receive letter training, but were involved in individual sessions of 10 to 15 minutes per day. During these sessions non-training students worked on a daily journal assignment in the presence of the experimenters. Experimenters also engaged in verbal interactions with subjects a minimum of five times per session in an effort to simulate the amount of verbal interaction which occurred between experimenters and students in the training group. During each session the experimenter reviewed the assignment with the student, provided verbal assistance a minimum of five times during the session, and finished the session with a review of the assignment.

Post-Training Measurement. At the completion of the letter training phase the letter-naming speed, word-naming accuracy, word-naming speed, and oral reading rate for Fall and Winter passages of all students was measured. Procedures were the same as during pre-training assessment. Again, all four reading measures and the letter naming speed measure were administered in one session of approximately 20 minutes in length. In the days following this reading assessment the phonetic measure developed by Ehri and her colleagues (Ehri & Wilce, 1985; Scott & Ehri, 1990) was administered as discussed in the measurement section.

Winter Follow-up. Students were again assessed with the letter-naming speed and reading measures seven school weeks following completion of the post-training measurement. Similar to the previous assessment sessions, all measures were administered in one session of approximately 20 minutes in length.

Inter-experimenter Agreement and Procedural Integrity. During all measurement phases, sessions were audio taped and 40% of the protocols were rescored for inter-scorer agreement. Percent agreement between taped sessions and scoring by independent raters was calculated using procedures developed by House, House, and Campbell (1981). Mean percent agreement and range (rng) of agreement scores for the measures are as follows: Letter-naming speed, 98.31% (rng = 68.1% - 100%); Word-naming accuracy, 99.46% (rng = 92.8% - 100%); Word-naming speed, 98.29% (rng = 77.7% - 100%); Fall passage oral reading rate, 98.20% (rng = 59.5% - 100%); and Winter passage oral reading rate, 98.84% (90.9% - 100%).

Rating forms were developed to assess the procedural accuracy for the phonetic measurement and training phases of the project. These forms can be found in Appendix D. Experimenters were observed once during the phonetic measurement phase. During the training phase each experimenter was observed for an average of six sessions (48 of the 468 training phase sessions; 10.26% of all sessions) by a trained second year graduate student. Percent accuracy for phonetic measurement and training sessions was 100% and 97.8% (rng = 81.3% - 100%) respectively. Information regarding errors was shared with experimenters as corrective feedback during the regularly scheduled training sessions.

Design and Analysis.

This study employed a 3 x 2 (Time x Training Group) factorial design. Differences in letter-naming speed between the two groups at post-training, and follow-up were assessed using one-tailed t-tests, while differences at pre-training were evaluated with a two-tailed t-test. A two-tailed test was used at pre-training because a difference in scores was not expected to occur in any predictable direction. One-tailed tests were appropriate for post-training and follow-up because it was anticipated that letter-naming speeds of the trained students would be faster than the letter-naming speeds of the non trained students. Effects of letter-naming training on reading measures was assessed using a repeated measures multivariate analysis of variance.

To compare the ease of learning phonetic word spellings with letter naming training two different approaches were employed. The effect of letter training on mean trials to criterion and total words learned measures was assessed using oneway (Training Group) analyses of variance (ANOVA). Differences in the number of words read correctly per trial were measured using a 2 x 7 (Training Group x Trials) repeated measures ANOVA. All statistical operations were completed using the SPSS-X computer program.

Chapter IV

Results

The results of this study are presented in two parts. Throughout this chapter data are presented in relationship to their demonstration of a training effect, and examination of hypothesized effects. All results were measured against a predetermined alpha level of $p < .05$.

Demonstration of Training Effect

Data for letter-naming speed at pre-training, post-training, and follow-up are reported in Table 4-1 and graphically represented in Figure 4-1. Visual inspection of trained and untrained student group means (Figure 4-1) suggests a steady increase in letter-naming speed for untrained students across time. However, trained students demonstrated comparatively more rapid improvement between pre-training and post-training with some leveling of performance between post-training assessment and follow-up. When group means are put along side each other there is a slight, but non-significant (two-tailed t = .33; df = 39; p <.742) difference between trained and untrained students at pre-training. When compared at post-training, students who received letter-naming training demonstrate a significant (one-tailed t = 2.05; df = 37; p <.024) improvement in letter-naming speed, of approximately 11 letters correct per minute (see Table 4-1), compared to students who did not receive

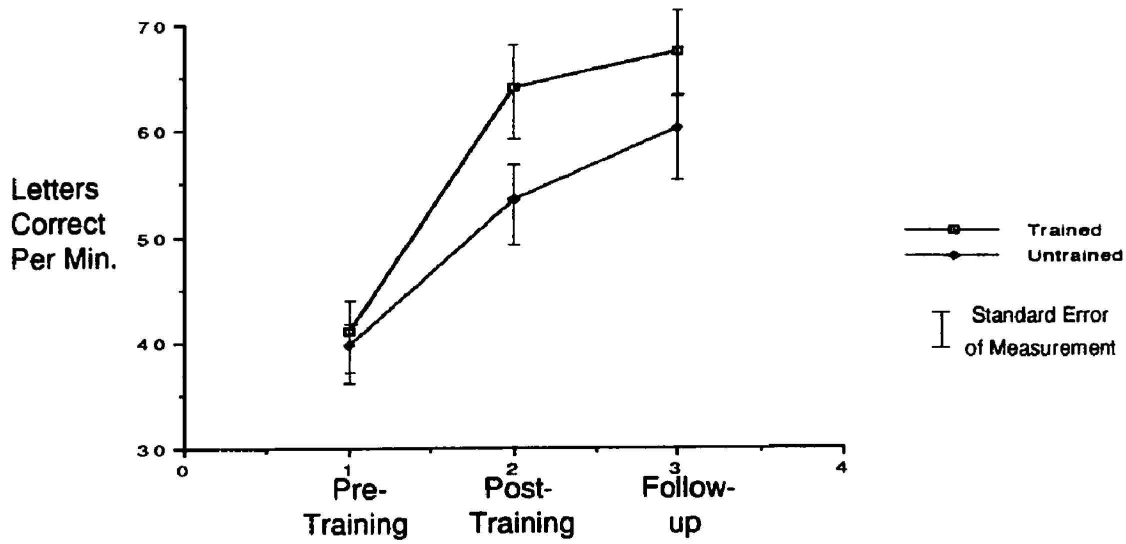


Figure 4-1: Graphed mean letter naming speed for trained and untrained students at pre-training, post-training, and follow-up

Table 4-1

Means, standard deviations, standard errors of measurement*, and t-test results of letter naming speed for trained and untrained students

	Trained (N = 20)			Untrained (N = 19)			T-Test**	
	M	SD	SEM	M	SD	SEM	t-value	Prob.
Pre-Training	41.10	13.90	3.11	39.81	10.77	2.35	.33	.742
Post-Training	64.00	17.60	3.94	53.42	14.58	3.35	2.05	.024
Follow-up	67.00	15.81	3.54	61.74	14.73	3.38	1.08	.145

*Note: Scores represent letters read correctly per minute.

**Note. T-test results represent 1-tailed probability for post-training and follow-up; two-tailed for pre-training.

letter-naming training. Although this effect was again demonstrated at follow-up, there was some narrowing of the interval between group means and the difference was not significant (one-tailed $t = 1.08$; $df = 37$; $p < .145$).

Analyses of Hypothesized Effects

Given that letter-naming training resulted in a significant difference at post-training between the letter-naming speed of trained versus untrained students, the next analyses of interest examined the effects of letter-naming training within measured reading skill and ability to make use of phonetic cues in word identification.

Hypothesis 1: Analysis for Effect of Letter Training on Reading Skill

The first hypothesis speculated that first-grade students given direct training to increase their facility in letter-naming would demonstrate significantly better reading skills than their untrained peers. Essentially, significant differences between the measured reading skills of trained and untrained students were not demonstrated. However, patterns of difference between groups can be noted across time. Differences between group means across time are illustrated in Figures 4-2 through 4-5. Means, standard deviations, and standard errors of measurement for the four reading measures at pre-training, post-training, and follow-up assessment are provided in Tables 4-2 through 4-5.

When all the reading measures were combined for analysis, in a repeated measures (Time x Training Group) multivariate analysis of variance, the effect of letter training on reading skill did not reach, significance ($F = 2.26$; $df = 4, 34$; $p < .083$; see Table 4-6) level. There also was a non-significant interaction (Time x Training) effect ($F = 1.07$; $df = 8, 30$; $p < .407$). However, there is a significant ($F = 24.29$; $df = 8, 30$; $p < .001$) main effect for time which suggests that all students, with and without letter training, demonstrated significant increases in reading skill throughout the 4 months of the project. This time effect was also noted across all the reading measures individually (F's range from 37.31 to 95.14; $df = 8, 30$; $p < .001$).

Although an overall significant effect for letter training was not demonstrated, there were patterns of differences among individual measures which would support the value of replicating this study in the future. Two reading measures, word-naming accuracy and Fall passage oral reading rate, exhibit a similar pattern of results (Figures and Tables 4-2 & 4-3). In each case mean differences between trained and untrained students were small at pre-training, demonstrated improvement in scores is greater for trained students at post-training, but by follow-up mean performance of the untrained students is on an path toward equality with that of the trained students. As can be noted in Table 4-6, neither of these measures demonstrated a significant main

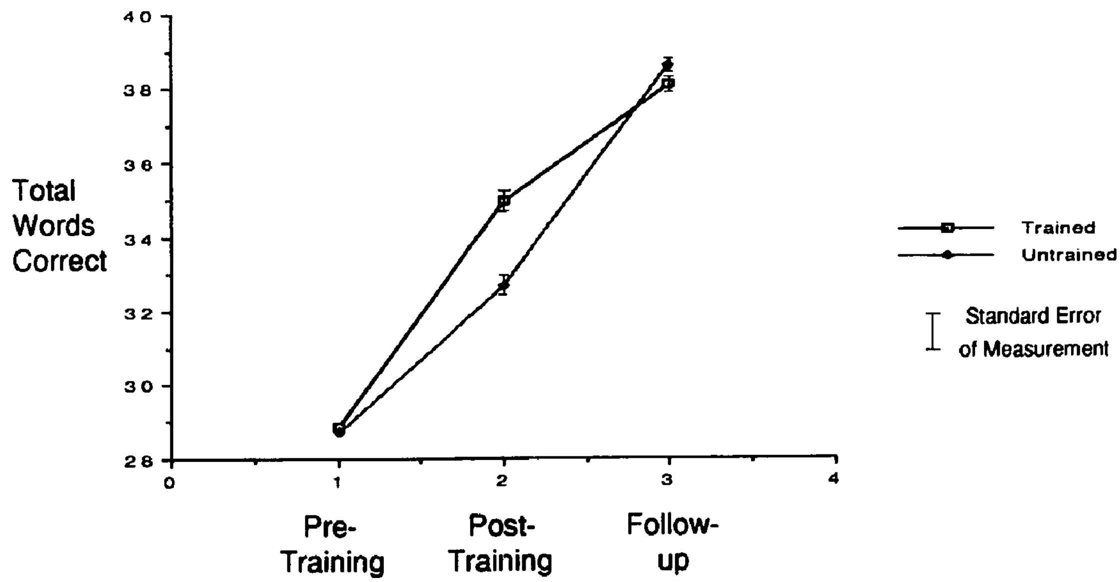


Figure 4-2: Graphed mean word naming accuracy for trained and untrained students at pre-training, post-training, and follow-up

Table 4-2

Means, standard deviations, and standard errors of measurement* of word naming accuracy for trained and untrained students

	Trained (N = 20)			Untrained (N = 19)		
	M	SD	SEM	M	SD	SEM
Pre-Training	28.85	8.56	1.92	28.71	8.13	1.77
Post-Training	34.95	5.71	1.28	32.68	6.40	1.47
Follow-up	38.05	3.41	.76	38.58	2.87	.66

*Note: Scores represent the total number of words read correctly from a list of 41 words.

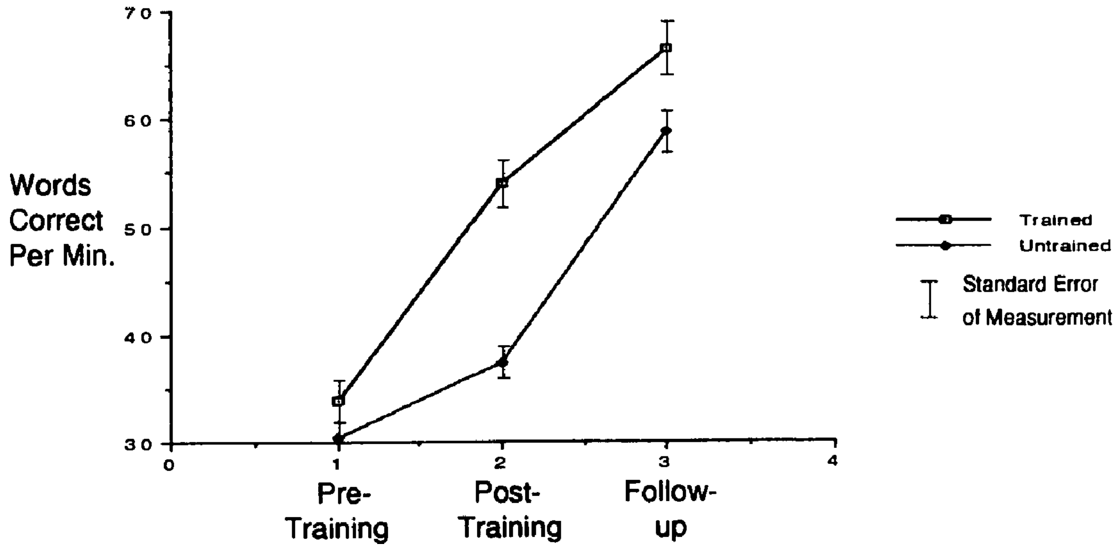


Figure 4-3: Graphed mean oral reading rate on fall passage for trained and untrained students at pre-training, post-training, and follow-up

Table 4-3

Means, standard deviations, and standard errors of measurement* of oral reading rate on fall passages for trained and untrained students

	Trained (N = 20)			Untrained (N = 19)		
	M	SD	SEM	M	SD	SEM
Pre-Training	33.90	30.17	6.75	30.48	20.87	4.55
Post-Training	54.00	35.87	8.02	37.37	22.78	5.23
Follow-up	66.65	37.57	8.40	58.37	30.29	6.95

*Note: Scores represent words read correctly per minute.

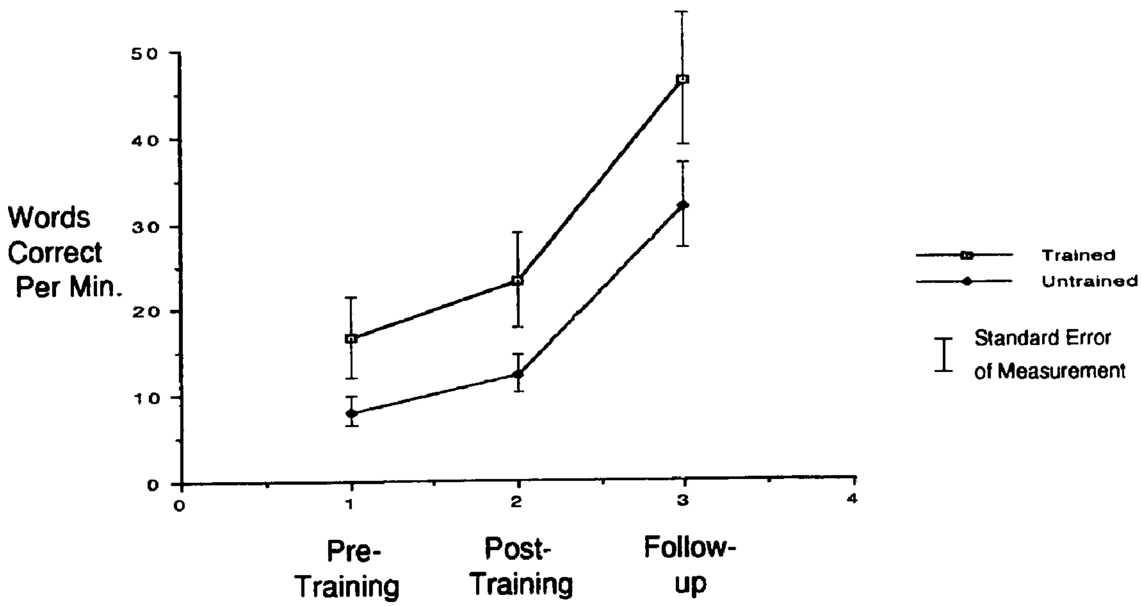


Figure 4-4: Graphed mean oral reading rate on winter passage for trained and untrained students at per-training, post-training, and follow-up

Table 4-4

Means, standard deviations, and standard errors of measurement *of oral reading rate on winter passages for trained and untrained students

	Trained (N = 20)			Untrained (N = 19)		
	M	SD	SEM	M	SD	SEM
Pre-Training	16.60	21.93	4.90	7.95	7.80	1.79
Post-Training	23.15	27.86	6.23	12.16	12.90	2.96
Follow-up	46.05	34.93	7.81	31.63	22.24	5.10

*Note: Scores represent words read correctly per minute.

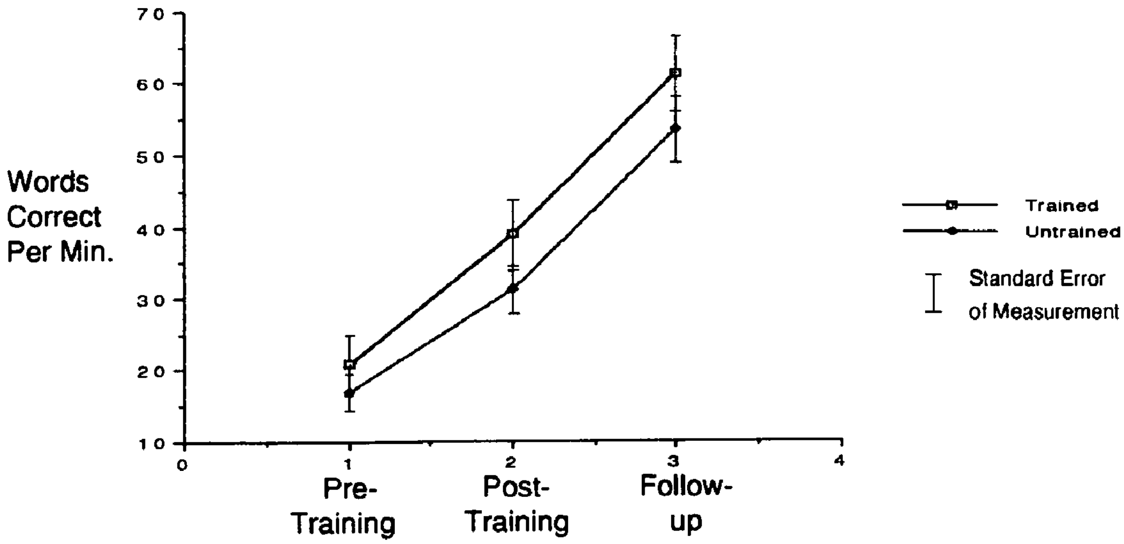


Figure 4-5: Graphed mean word naming speed for trained and untrained students at pre-training, post-training, and follow-up

Table 4-5

Means, standard deviations, and standard errors of measurement* of word naming speed for trained and untrained students

	Trained (N = 20)			Untrained (N = 19)		
	M	SD	SEM	M	SD	SEM
Pre-Training	20.80	20.86	4.67	17.10	12.51	2.73
Post-Training	38.85	25.71	5.75	31.32	16.16	3.71
Follow-up	61.05	25.94	5.80	53.32	22.11	5.07

*Note: Scores represent words read correctly per minute.

Table 4-6

F statistics from repeated measures MANOVA and ANOVAs for all variables

	Time		Treatment Group		TGroup by Time	
	Exact F	F Prob.	Exact F	F Prob.	Exact F	F Prob.
Reading Skill Measures						
Manova	24.29	.001	2.26	.083	1.07	.407
Word-Naming Accuracy	37.31	.001	.24	.626	2.66	.084
Word-Naming Speed	95.14	.001	1.11	.298	.49	.648
Fall Passage Oral Reading Rate	76.61	.001	1.19	.282	4.06	.026
Winter Passage Oral Reading Rate	46.60	.001	2.62	.114	.63	.541
Phonetic Word Cue Measure						
Words Read Correctly	16.18	.001	1.71	.199	1.80	.131

effect for letter training. The time by training interaction effect is significant ($F = .24$; $df = 8, 30$; $p < .026$) for Fall passage oral reading rate and approached significance ($F = 2.66$; $df = 8, 30$; $p < .084$) for word-naming accuracy.

Different patterns of performance were displayed within the Winter passage oral reading rate and word-naming speed measures. Inspection of the Winter passage oral reading rate data (Figure 4-4 and Table 4-4) suggests a more of a difference between group means at pre-training assessment. From this starting point both groups exhibit very similar progress. However, the trained students made slightly greater gains at post-training assessment and more moderate gains by follow-up. Differences between group means progress from approximately 9 words correct per minute at pre-training, to 11 at post-training, to 15 at follow-up (see Table 4-4). As visual examination of the data suggests, analysis of this measure (see Table 4-6) fails to produce a significant main effect for training ($F = 2.62$; $df = 4, 34$; $p < .114$) or a significant training by time interaction ($F = .63$; $df = 8, 30$; $p < .541$).

The measure of word-naming speed (Figure 4-5 and Table 4-5) follow a similar pattern to that of Winter passage oral reading rate. Trained and untrained students demonstrated small mean differences at pre-training assessment, then followed essentially parallel paths of performance through post-training and follow-up assessment.

There was a slight increase in performance for the letter trained group at each point, but performance for both groups was nearly identical. In Table 4-6 it can be observed that the both the main effect for training ($F = 1.11$; $df = 4, 34$; $p < .298$) and the time by training interaction ($F = .49$; $df = 8, 30$; $p < .648$) effects are non-significant.

Hypothesis 2: Analysis for the Effect of Letter Training on the Ability to Use Phonetic Word Cues

Hypothesis two suggested that students who received training to increase letter-naming ability would be significantly more able to learn alphabetic access routes to word learning that their untrained peers. The phonetic cue word access task designed by Ehri and colleagues (Ehri & Wilce, 1985; Ehri & Scott, 1990) yielded three different scores: number of words read correctly per trial (number of words read), total number of words learned to the criterion of two successive correct trials (total words learned), and number of trials needed to learn each word to criterion (trials to criterion). It should be noted that all trials occurred following letter speed training.

Training group difference data for number of words read can be found in Figure 4-6 and Table 4-8. The letter trained group generally maintained a one word per trial advantage throughout the seven trials of the task, with the exception of trials 2 and 7. Although the letter trained group reached peak performance two trials faster than the untrained

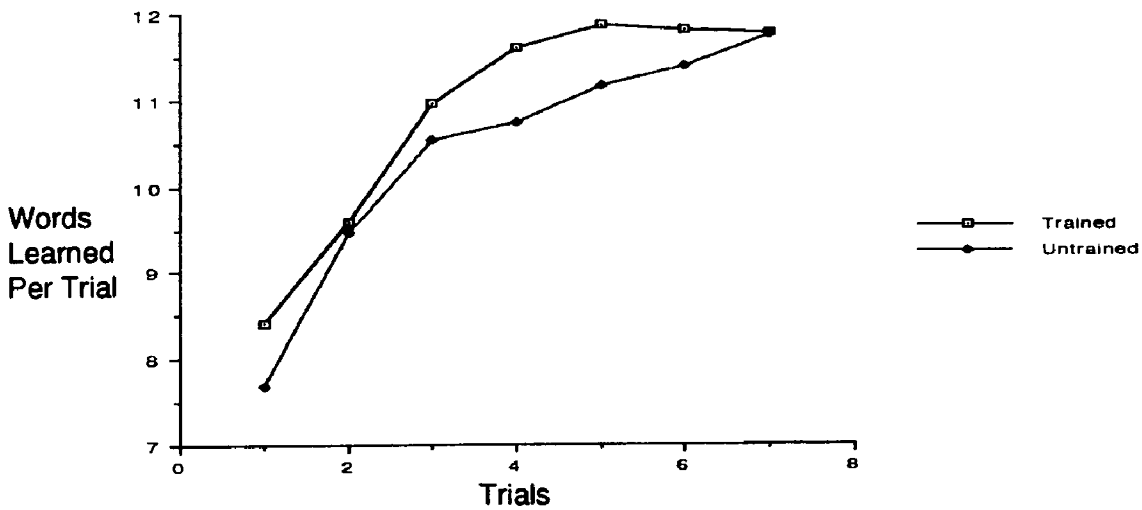


Figure 4-6: Graphed mean words read correctly per trial on phonetic word cue task for trained and untrained students

Table 4-7

Means, standard deviations, and standard errors of measurement of words read correctly per trial on phonetic word cue task for trained and untrained students

	Trained (N = 20)			Untrained (N = 19)		
	M	SD	SEM	M	SD	SEM
Trial 1	8.40	2.56	.57	7.68	2.50	.57
Trial 2	9.60	2.48	.55	9.47	1.81	.41
Trial 3	10.95	1.50	.34	10.53	1.74	.40
Trial 4	11.60	.68	.15	10.74	1.59	.37
Trial 5	11.85	.49	.11	11.16	1.34	.31
Trial 6	11.80	.41	.09	11.37	1.07	.24
Trial 7	11.75	.55	.12	11.74	.65	.15

students, both groups reached maximum by trial 7. Similar to the reading measure results, there was a significant (F = 16.18; df = 6, 32; p <.001) main effect for time (see Table 4-6) as the performance of both groups improve significantly with practice. The main effect for training was non-significant (F = 1.71; df = 1, 37; p <.199) as is the training by time interaction (F = 1.80; df = 6, 32; p <.131).

Similarly differences between trained and untrained students on total words learned and mean trials to criterion were not significant (see Table 4-8). In an unusual occurrence, all members (100%) of the letter trained group learned all 12 words to criterion earning perfect total words learned scores. All but three (84%) of the untrained students learned all the words as well, resulting in a non-significant (F = 2.98; df = 1, 37; p <.093) between groups mean score variance. Both groups again exhibited nearly equivalent performance on the mean trials to criterion measure leading to a non-significant (F = .62; df = 1, 37; p <.437) between groups difference.

Table 4-8

Means, standard deviations, standard errors of measurement, and F statistics of mean trials to criterion and total words learned for trained and untrained students on the phonetic word cue task

	Trained (N = 20)			Untrained (N = 19)			Exact	F
	M	SD	SEM	M	SD	SEM	F	Prob.
Total Words Learned	36.00	.00	.00	35.63	.96	.22	2.98	.093
Mean Trials to Criterion	5.25	.67	.15	5.09	.64	.15	.62	.437

Chapter V

Discussion

The primary purpose of this project was to determine whether increasing students letter-naming speed would result in subsequent increases in early reading skills. The two hypotheses suggested that increases in letter-naming speed among first-grade students would result in subsequent increases in beginning reading skills, and provide an advantage in the ability to develop phonetic, alphabetic, access routes to word learning. Unfortunately, the data collected failed to provide a definitive answer to this question.

Although students who received letter-naming training demonstrated significantly improved letter-naming speed, as compared to untrained peers, this difference in letter-naming speed did not lead to significantly improved beginning reading skills. Repeated measures multivariate analysis of variance among the primary reading measures demonstrated a non-significant difference ($F = 2.26$; $df = 4, 34$; $p < .083$) between the reading skills of trained and untrained students. Similarly, the demonstrated ability of both groups to use phonetic, alphabetic, access routes to word learning was nearly equivalent. Essentially, what can be concluded from these data is that letter-naming speed correlates well with reading skill in general, that appropriate drill can significantly improve (if perhaps temporarily) the letter-naming speed of trained versus untrained students, and that this increase in letter-naming speed might, but then again might not, have a positive effect on the development of early reading skills.

The following discussion of these findings emphasizes the need to understand the developmental aspects of reading skill and the location of the first-grade students who participated in this study along this developmental continuum. First-grade is a transitional time of rapid changes in reading development. During this initial stage of reading development emphasis shifts from basic letter-naming skills to learning to use letter-sound relationships to decode printed words. In second grade the emphasis turns to fluency and word mastery (Mercer & Mercer, 1993). Even though the letter-naming speed of students within this transition has not been previously studied, previous research does offer evidence concerning what happens on either side of this period in skill development.

For example, Walsh, et al. (1988) have noted that the letter-naming speed of kindergarten students is variable, and that letter-naming speed late in kindergarten correlates well with reading scores late in first grade. In second-grade the relationship between letter-naming speed and reading skill weakens as letter-naming speeds among students are less variable, and those differences which exist are generally unrelated to measured reading skill. These authors (Walsh, et. al., 1988) have correctly concluded that the importance of letter-naming speed in the development of initial reading skills may be critical, but short lived, as the critical nature of this skill has dissipated by second-grade. Other research reported in Chapter II has noted sizable correlations between late kindergarten letter-naming speed and subsequent reading performance (Blachman, 1984; Good & Kaminski, 1991), and the weak relationship between these variables in later years (Stanovich, 1981; Stanovich, et. al., 1983; Stanovich,, et al., 1986). However, what happens to letter-naming speed in its relationship to reading skills during the initial stages of development in first-grade occurs in a "black box".

Life in the Box: Concurrent Correlations Between Letter-Naming Speed and Beginning Reading Skills

Initially the current project was designed to enhance the letter-naming skills of students, at what is thought to be a critical point, on the kindergarten side of the box and measure subsequent effects on the development of reading skills. The first-grade students who were the subjects for this study were well into the box before pre-training assessment took place and letter training began. While this late start may have ultimately interfered with the "critical" timing of the project, the delay does afford a snapshot of what occurs in the box.

The first-graders in this study were able to accurately

Table 5-1

Means*, standard deviations, and standard errors of measurement of all reading variables at pre-training for all students

	Mean	SD	SEM
Letter-Naming Speed	40.44	12.26	1.91
Word-Naming Speed	18.90	16.99	2.65
Word-Naming Accuracy	28.78	8.25	1.21
Fall Passage Oral Reading Rate	32.15	25.56	3.99
Winter Passage Oral Reading Rate	12.38	16.99	2.72

*Note: Speed and rate measures represent letters and words correct per minute; word-naming accuracy represents number correct of a possible 41 words.

Table 5-2

Correlation* coefficients between all variables at pre-test

Variables	LNS	WNS	WNA	FOR
Letter Naming Speed (LNS)				
Word Naming Speed (WNS)	.68			
Word Naming Accuracy (WNA)	.54	.71		
Fall Passage Oral Reading Rate (FOR)	.69	.77	.65	
Winter Passage Oral Reading Rate	.63	.93	.58	.69

*Note. (N = 41), All correlations are statistically significant ($p < .001$).

read an average of 29 words from their basic word list (41 words) at the time of initial assessment (see Table 5-1). The oral reading rate of these students on passages used in the classroom at this time was approximately 32 words correct per minute (Fall Passage Oral Reading Rate). It is safe to say that these students were well on their way in developing basic reading skills. Yet, at this time correlations between letter-naming speed and measures of reading skill remained moderately strong (.54 to .69; see Table 5-2). It is important to note that concurrent correlation coefficients between letter-naming speed and beginning reading measures have not been reported to date. Given no previous data for comparison, it seems most appropriate to place these scores in developmental perspective.

It has previously been observed that the relationship between letter-naming speed and reading skills in second grade and beyond is weak. It can also be assumed, that given the variability of letter naming speed in late kindergarten and the general minimal development of reading skill at this time, the correlation between letter-naming speed and reading ability would also be weak in late kindergarten. Based on previous pre-post, late kindergarten-late first grade, correlations it has been assumed that letter-naming speed played an important role in the development of beginning reading skills. However, the demonstration of a significant concurrent relationship between letter-naming speed and reading skill of first-grade students did not exist.

Although the correlation coefficients reported in the present study (see Table 5-1) do not imply causality, they do provide some additional support for the concept that letter-naming speed may be associated with the development of early reading skills. These correlations are only a snapshot in time. They may support the importance of letter-naming speed but its value at different points within the "box" remains unknown. Demonstrations of the relative importance of letter-naming speed throughout time would require use of a time-series experimental design.

The Transitory Nature of Letter Naming Speed

When interpreting their second-grade, and late kindergarten-late first grade, data Walsh, et. al. (1988) reported a diminishing returns effect in the relationship between letter-naming speed and measured reading skill. This concept of diminishing returns is primarily based on two pieces of data; the lack of correlation among the letter-naming speed and reading scores of second graders, and a regression line calculated for the late-kindergarten-late first grade data which suggests a level of diminishing returns within the relationship. The present data provide some support for both of these conclusions.

Scatterplots and simple regression lines for letter-naming speed and the four reading measures at pre-training assessment can be found in Figure 5-1. Visual inspection of the plots suggests considerable variability between patterns on individual measures and moderate scatter among individual plots. Correlations between the reading measures at pre-training tend to range from moderate to strong (.54 to .93; see Table 5-2). However, it is evident that while these measures assess some common aspects of reading ability, some differing abilities are measured as well.

In an effort to stabilize the variability in the data, and to perhaps provide a more broad measure of reading ability, scores from all pre-training reading measures were combined into a single score. This was accomplished by converting individual scores for each measure into transformed standard scores (*z'*; mean = 100; standard deviation = 15; Schmidt, 1979) and averaging the standard scores across the four measures.

Figure 5-2 provides scatterplots and regression lines representing the relationship between letter-naming speed and combined reading measures at pre-training. Similar to the Walsh, et.al. (1988) data, when a polynomial regression equation(R^2 = .580), rather than simple regression (R^2 - .550), is used the R^2 value increases, indicating a line of better fit. When applied to the present data the adjusted line of regression suggests an ever increasing rather than a diminishing returns effect. There are several possible explanations for the difference between the two data sets. It is possible that the diminishing returns effect noted by

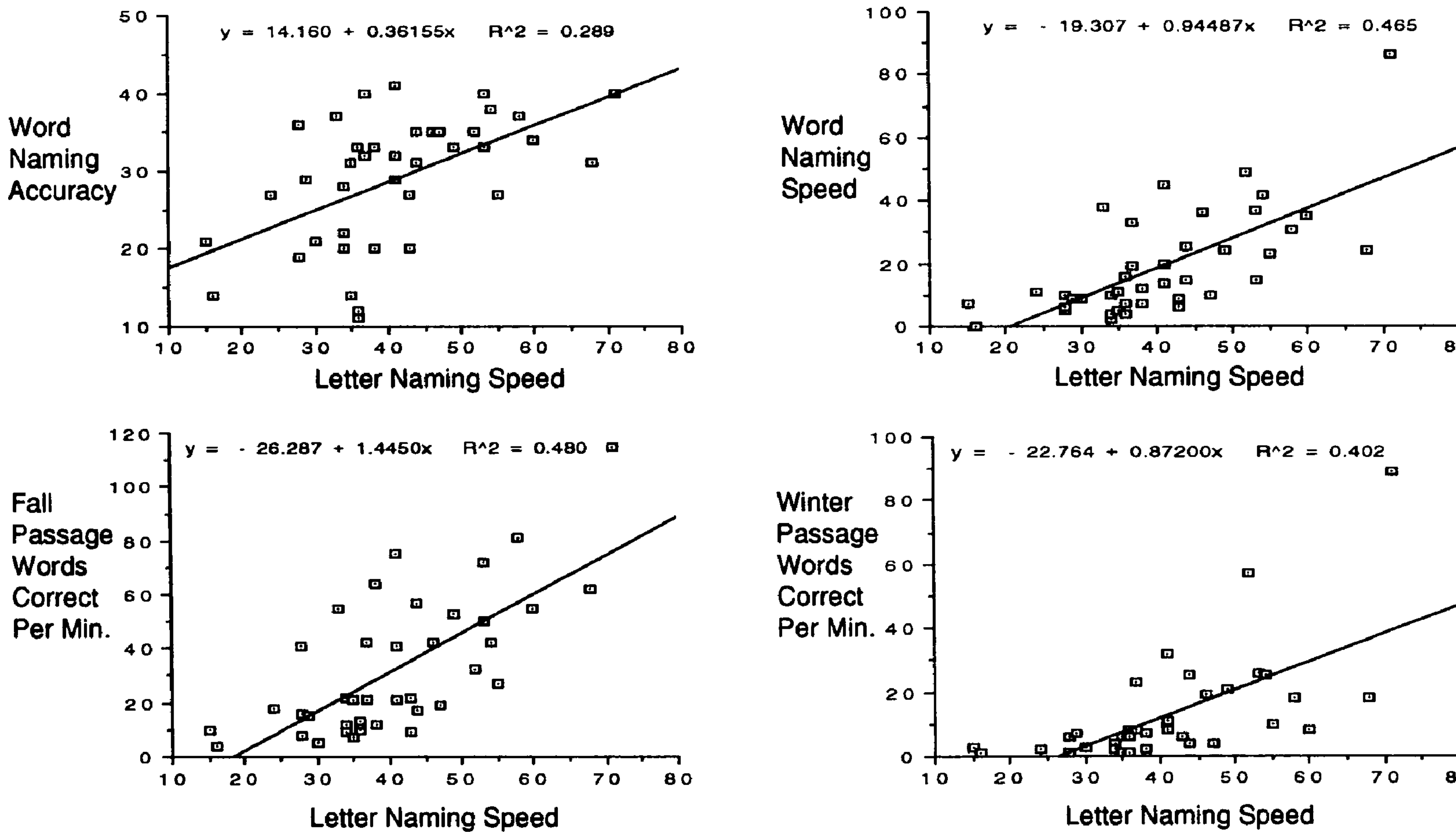


Figure 5-1: Scatter plots and simple regression lines for letter-naming speed and all reading measures at pre-training

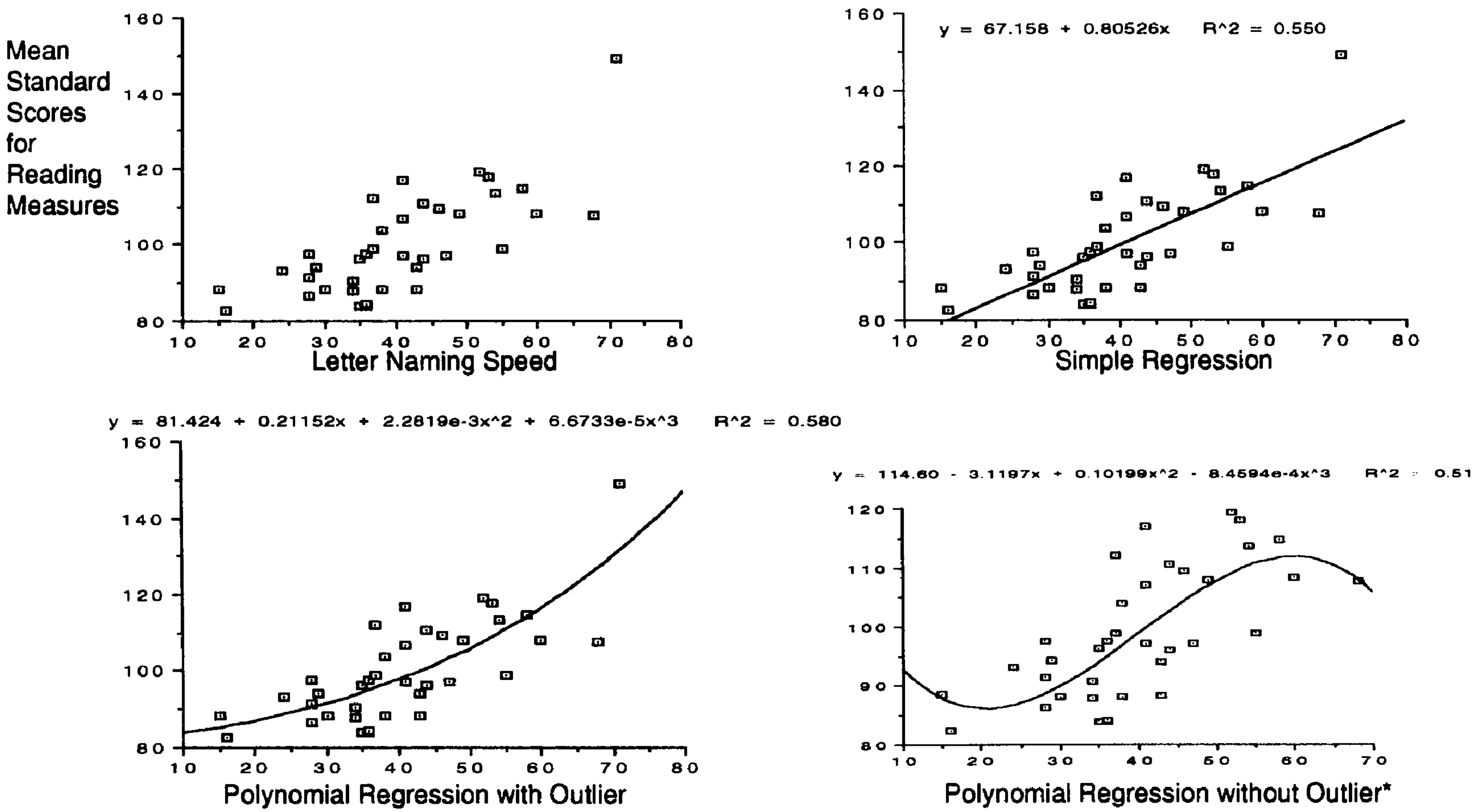


Figure 5-2: Scatter plots and regression lines for letter-naming speed and mean standard scores of reading measures at pre-training

*Note: Scaling change occurs in graph without outlier.

Walsh, et al. (1988) is a phenomenon related to a time factor involved in their pre-post data collection, while the concurrent aspect of the present data results in a regression line which reflects the influence of letter-naming speed at a specific point in time relatively early in the development of reading skills.

Visual inspection of the scatterplot reveals another possible explanation for the differing result. It is evident that one data point was a significant outlier. When the outlier is removed, and the polynomial regression equation calculated, a regression line which might suggest a diminishing returns effect emerges. These data suggest a threshold effect between 60 and 70 letters correct per minute. However, as measured by the R^2 value (R^2 = .514), this new regression line does not fit the adjusted data set as well as the original line fit the unadjusted data set. Therefore, while it is possible that the present scatter plot data could be used to support the concept of a diminishing returns relationship between letter-naming speed and reading skill, it might not be prudent.

Now consider the present data relative to the diminished variability of letter-naming speed among the second grade students in the Walsh, et. al.(1988) study. In Figure 4-1 and Table 4-1 it can be noted that both the trained and untrained students group means for letter-naming speed were essentially equivalent at pre-training. Immediately following training a significant difference between the group means is evident. While both groups demonstrate increased letter-naming speed, training has produced a significantly accelerated rate of letter-naming speed among the trained students. By follow-up the performance of the trained students is beginning to plateau, as is, to a lesser extent, the performance of the untrained students. If this trend were to continue it is conceivable that the mean letter-naming speed of both groups would converge (at about 70 letters correct per minute) at some point later in time.

The present scatterplot data when combined with this trend still is lacking in its ability to offer strong support for a diminishing returns relationship. However, the trend within the letter-naming speed data would support the assertion of Walsh, et al. (1988) that the advantage some students may possess, by virtue of good letter-naming speed early in the reading process, is indeed transitory. What has yet to be demonstrated is the "critical" effect this advantage may have in the development of beginning reading skills.

The Effect of Letter Speed Training on Beginning Reading Skills

When scores on the reading measures in this study were combined in a repeated measures multivariate analysis of variance, the main effect for letter training approached, but did not reach, significance ($F = 2.26$; $df = 4, 34$; $p. < .083$).

However, there was a significant (F = 24.29; df = 8, 30; p.<.001) main effect for time. This maturation effect would be anticipated as it is expected that all students should demonstrate significant growth in reading skills over time.

Although the main effect for letter training was not statistically significant, there were patterns in the data which suggest the value of continuing this line of research. Again, it is important to consider the development of reading skill when inspecting individual reading measures.

The fact that this project occurred at a time of year when the reading curriculum was in transition, resulted in the development of two sets of oral reading rate passages. Fall passages were selected from material which was current during the training phase and post-test, Winter passages from material that was current during follow-up. The Fall and Winter passages differed in degree of difficulty, reflective of expected growth in reading skill development between the two points in first-grade. Word lists for accuracy and speed measures were constructed only of ultimately less difficult Fall words.

Of the four reading measures, word-naming speed which demonstrated essentially parallel performance for both trained and untrained students over time (see Figure 4-5 & Table 4-5). With the remaining three reading measures the most substantial differences between trained and untrained students group means occurred at the point where the assessment material reflects what was currently being taught in the classroom.

With both Fall oral reading rate and word-naming accuracy, measures reflective of Fall curriculum, the greatest difference between group means occurred at post-training assessment (see Figures & Tables 4-2 and 4-3). Although the groups were nearly equivalent at pre-training assessment, a marked difference appeared at post-training, then the group means again approach equivalence at follow-up.

Given the developmental perspective it could be anticipated that a pseudo-ceiling effect might occur among "Fall" material by mid-winter. No matter what differences may appear in the Fall when the material is current, it is expected that most students would demonstrate mastery of "Fall" curriculum material by mid-Winter. With Fall oral reading rate the difference at post-training along with the trend toward equivalence at follow-up results in a significant (F = 4.06; df = 8, 30; p <.026) time by training group interaction effect. In the case of word-naming accuracy an actual ceiling effect occurred, as mean scores for both groups came within three words of 100% accuracy at follow-up. In hindsight, it might be possible that the discriminant ability of this measure could have been improved by choosing words from both Fall and Winter curriculum materials.

While a training effect might be most expected to occur in the post-training assessment for word-naming accuracy and Fall oral reading rate measures, effects in the Winter oral reading rate measure might most likely occur during follow-up assessment. It might be expected that both trained and untrained students would find "Winter" passages equally troublesome at pre-training assessment, with perhaps a small advantage for letter trained students by post-training assessment. However, if letter training were to demonstrate an advantage it might most likely be at follow-up when the "Winter" passages are current. With the exception of a not quite equivalent start at pre-training, this is the pattern which is present within the Winter oral reading rate data (see Figure 4-4 and Table 4-4).

As can be seen, trends among three of the four reading measures suggest that letter-naming speed training may result in sizable, but to this point not significant, differences in beginning reading skill during instructional periods within the curriculum. Given these patterns in the data, it may be possible that a more causal relationship between letter-naming speed and the development of beginning reading skills could be demonstrated in another study. However, if there might indeed be a causal relationship between letter-naming speed and beginning reading skill, why is it not evident within this data set.

One possibility, for the failure of the present data to demonstrate a causal relationship between letter-naming speed and beginning reading skill, is that the correlational relationship which continually recurs between letter-naming speed and reading skill is associative rather than causal. In this light letter-naming speed might be an indicator of some yet unknown mediating factor in the development of reading skills. Previous research has consistently concluded that this mediator most probably is not a general processing speed factor (Blachman, 1984; Walsh et al., 1988; Wolf, 1991). Although the possibility that letter-naming speed is an indicator of some form of information processing speed specific to reading may still exist.

On the other hand, it may also be possible that if relationship between letter-naming speed and reading skills is associative, the effect of the training may indirectly provide a more significant impact on the development of beginning reading skill might occur across a period of time longer than the seven week follow-up of this study. It could be that increases in letter-naming speed would enhance the development of a mediating factor, which in turn would enhance the development of beginning reading skill. Given the possibility that this indirect process may be more long-term in developing, it might be that follow-up measurement of the subject's reading skills in late first or second grade might required to demonstrate significant differences in reading skill between trained and untrained students.

Some authors which have explored the relationship between letter-naming speed and reading skills have suggested that letter-naming speed may be an indirect measure of some other causal variable such as exposure to print (Biemiller, 1977-1988; Walsh, Price, & Gillingham, 1988; Good & Kaminski, 1991). If letter-naming speed is indeed an indirect measure of other causal variables which are known to effect the development of reading skills, then measures of letter-naming speed might best serve as an indicator of students who might be more at risk for reading failure due to limited exposure to, or development of, these other causal variables.

Another possibility might be that letter-naming speed does not work independently from other variables which are also known to be prominent in the development of beginning reading skill. In this way letter-naming speed may be one of several important variables which in combination assist in the development of reading ability. For example, the phonemic awareness of end-of-the-year kindergarten students has been demonstrated to correlate with end-of-the-year first grade reading ability at a level generally equivalent to that of letter-naming speed (Blachman, 1984; Good & Kaminski, 1990). However, correlations between letter-naming speed and phonemic awareness are generally weak (Blachman, 1984). It is possible that letter-naming speed and phonemic awareness are not so independent as previously assumed, and that some combination of both variables may provide greater influence on the development of reading skill than either variable can provide in isolation.

Finally, it is possible that limitations of this study have interfered with the expression of a causal effect. One major limitation may have been the amount of reading instruction which subjects received before letter training began. Scott and Ehri (1990) have suggested that there may be a critical learning point when students demonstrate mastery of letters but still lack knowledge of words. According to these authors the phonetic word cue task, used as a post-training measure in this study, is most sensitive to differences in ability at this point in time. Both the pre-training reading scores and general equivalence of trained and untrained students on the phonetic word cue task speak to the fact that this possible window of opportunity for letter training was missed by this study.

This problem with the timing of the study may be a primary limiting factor. It might be that for letter-naming speed training to be significantly effective, it needs to occur at that point in time when students have a general knowledge of letters but lack the mastery which may be needed to promote word learning. Initially first-graders were chosen as subjects for pragmatic reasons. It was assumed that beginning of the year first-grade students would not vary substantially from late year kindergarten students in their letter-naming speed and level of reading skill. It is clear that the reading skills of the subjects in this study were beyond the initial stage of development. At pre-test the subjects in this study were able to accurately read an average of 28 of the 41 words on the word list (see Table 5-1). In order for letter speed training to be most effective it may need to occur at a point in time when students are just beginning to associate letter names with sounds. It is most probable that this point in most students' reading development occurs in the second half of kindergarten.

In future research an adjustment of the reading measures might be beneficial. Regarding measures used in this project, care should be taken in the selection of curriculum-based measures. Word-lists might benefit from a selection of words from a more broad range of the curriculum. There are two approaches which could be employed. One approach would be to provide a wide ranging list to avoid a ceiling effect and provide for increased discriminant ability. Alternatively, a Winter word list could have been constructed and administered as a fifth measure. This would have provided for possible verifications of the trends among the data. Also, the psychometric properties of the word-naming accuracy measure would need to be more thoroughly evaluated.

The curriculum shift from Fall Passages to Winter Passages may have also created additional difficulties in measuring change in reading skills across time. Examination of the two sets of reading passages reveals that the Fall Passages emphasize initial word code development while in the winter instruction, and therefore the Winter Passages, moves more to a word meaning emphasis. It is likely that this difference, between the more regular words used in fall and the irregular words used in winter, may result if differing sensitivity to change among these two measures. It seems possible that Fall Passages, whose words are more dependent upon letter names and sounds for successful decoding, may be more sensitive to changes which might result from training to improve letter-naming speed. On the other hand, successful reading of words in the Winter Passages places less emphasis upon letter codes and therefore scores may be influenced less by the letter-naming skills.

It is also possible that differences between the types of basal series used in the selection Winter Passages resulted in measures with differing sensitivity to change. Of the two basal series employed in the first grade classrooms one (Houghton-Mifflin Reading Series, 1983) is a standard basal series, while the other (Literature Experience Reading Series, 1991) provides a whole language orientation to reading instruction. There is some evidence which suggests that passages from a literature based reading series, when used as curriculum-based measures, may be less sensitive in their ability to measure change over time than passages chosen from a more standard basal reading series (Hintze, Shapiro & Lutz, 1993).

The level of correlation among all the variables at pre-training might also pose a concern. While correlation between reading measures is expected, more independence among the measures might have been desirable. This is especially true of the pre-training relationship between letter-naming speed and the reading measures. To some degree this issue might be addressed by hitting the window of opportunity more appropriately, at a point where there is a wide range of letter mastery among subjects with minimal reading skill. Curriculum-based measures of reading were chosen because of their known sensitivity in monitoring academic progress. Yet more independence among the measures might have been promoted by the use of a published, norm-referenced measure of reading ability. Unfortunately, a measure that might be sensitive to changes at this beginning level of reading skill might be difficult to uncover. In a related issue, as the number of assessment devices increases, so does the fatigue factor among the young first-grade students. The value of added measurement must be weighed against this limitation.

Another limitation of the current study was the size of the subject pool and the population from which they were drawn. Even if the results had been significant it would have been difficult to make broad statements based on a training effect among 39 students. As well, the subjects in this study come from a small, rural, eastern school district of limited ethnic diversity. The results of this study can only be generalized to the extent that this group is representative of other populations.

Generally, while the data from this project has left some unanswered questions, the data do support previous research which demonstrates a significant relationship between letter-naming speed and reading skill. It has been demonstrated that appropriate drill can significantly improve (if perhaps temporarily) the letter-naming speed of students, but it has yet to be conclusively demonstrated that this increase in letter-naming speed might, have a causal relationship with the development of early reading skills.

Can training to increase the letter-naming speed of beginning readers significantly improve the development of their beginning reading skill? If an actuarial approach to interpreting the data from this study is employed, the answer would be no. A significant improvement in letter-naming speed among the trained students at post-training did not lead to a significant difference between groups on any of the reading measures. However, due to some of the limitations of the study, especially the delay of onset well into the first-grade year, it might also be said that the question has yet to be studied appropriately. The primary contributions of this project have been the demonstration of a training program which can significantly increase the letter-naming speed of beginning readers and the development of a methodology that, with some adjustment, can be used in the future to assess the effect of letter-naming speed on beginning reading skills.

The most basic question of this project has yet to be answered. However, should a more direct relationship between letter-naming speed and beginning reading skills be demonstrated in the future, the relationship of this factor to other factors, such as phonemic awareness, should be explored.

References

Adams, M. J. (1990). Beginning to read. Cambridge, MA: MIT Press.

Biemiller, A. (1977-78). Relationships between oral reading rates for letters, words, and simple text in the development of reading achievement. Reading Research Quarterly, 2, 223-253.

Blachman, B. A. (1984). Relationship of rapid naming ability and language analysis skills to kindergarten and first-grade reading achievement. Journal of Educational Psychology, 76, 610-622.

Bowers, P. G. & Swanson, L. B. (1991). Naming speed deficits in reading disability: Multiple measures of a singular process. Journal of Experimental Child Psychology, 51, 195-219.

Durrell, D. D. (1958). First-grade reading success study: A summary. Journal of Education, 140, 2-6.

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

Ehri, L. C. & Wilce, L. S. (1987). Cipher versus cue reading: an experiment in acquisition. Journal of Educational Psychology, 79(1), 3-13.

Good, R. H. & Kaminski, R. (1991, March). Criterion related validity of cbm pre-reading measures for kindergarten and first-grade children. Paper presented at the annual convention of the National Association of School Psychologists, Dallas, TX.

Heibert, E. H. , Cioffi, G., & Antonak, R. F. (1984). A developmental sequence in preschool children's acquisition of reading readiness skills and print awareness concepts. Journal of Applied Developmental Psychology, 5, 115-126.

Hintze, J. M., Shapiro, E. S., & Lutz, J. G. (1993). The effects of curriculum on the sensitivity of curriculum-based measurement in reading. Paper presented at the annual convention of the National Association of School Psychologists, Washington, D.C.

House, A. E., House, B. J. , & Campbell, M. B. (1981). Measures of interobserver agreement: Calculation formulas and distribution effect. Journal of Behavioral Assessment, 3, 37-57.

Houghton Mifflin (1983). Houghton-mifflin reading program. Boston: Author

Houghton Mifflin (1991). Literature experience reading series. Boston: Author

Jackson, N. E., Donaldson, G. W., & Cleland, L. N. (1988). The structure of precocious reading ability. Journal of Educational Psychology, 80(2), 234-243.

Jackson, N. E. & Meyers, M. G. (1982). Letter naming time, digit span, and precocious reading achievement. Intelligence, 6, 311-329.

Makar, B. W. (1985). Primary Phonics Picture Dictionary. Cambridge, MA: Educators Publishing Service.

Marston, D. B. (1989). A curriculum-based measurement approach to assessing academic performance: What it is and why do it? In M. R. Shinn (Ed.), Curriculum-based measurement: Assessing special children. (pp.18-78). New York: Guilford Press.

Mercer, C. D. & Mercer, A. R. (1993). Teaching Students with Learning Problems. New York: Macmillan Publishing Company.

Perfetti, C. A. (1985). Reading ability. New York, NY: Oxford University Press.

Read, C. (1971). Pre-school children's knowledge of English phonology. Harvard Educational Review, 41(1), 1-34.

Schmidt, M. J. (1979). Understanding and using statistics (2nd ed.). Lexington, MA: D. C. Heath and Company

Scott, J. A. & Ehri, L. C. (1990). Sight word reading in prereaders: Use of logographic vs. alphabetic access routes. Journal of Educational Psychology, 73(6), 809-815.

Shapiro, E. S. (1992). Gickling's model of curriculum-based assessment to improve reading in elementary age students. School Psychology Review, 21(1), 168-176.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. Reading Research Quarterly, 21, 360-407.

Stanovich, K. E., Feeman, D. J., & Cunningham, A. E. (1983). The development of the relation between letter-naming speed and reading ability. Bulletin of the Psychonomic Society, 21(3), 199-202.

Stanovich, K. E., Nathan, R. G., & Vala-Rossi, M. (1986). Developmental changes in the cognitive correlates of reading ability and the developmental lag hypothesis. Reading Research Quarterly, 21, 267-283.

Walsh, D. J., Price, G. G., & Gillingham, M. G. (1988). The critical but transitory importance of letter naming. Reading Research Quarterly, 23, 108-122.

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

Appendix A

Letter Assessment and Training Protocols*

Protocols found in this appendix are copies of the examiner's scoring probes. Student copies of the protocols contained only letters and did not include scoring guide numbers, probe identification codes (e.g. LP-1), and student identification data.

Included in this appendix are:

*Note: Size of the letters has been reduced from the original in order to meet margin requirements for binding.

LP-1

Name: ________________

Date: ________________

Teacher: ________________

R	W	U	Q	u	n	6
e	z	w	s	f	i	12
P	X	v	r	g	x	18
S	F	Z	q	d	h	24
c	O	D	j	l	t	30
K	N	k	C	B	m	36
T	L	o	M	p	J	42
a	V	y	A	G	Y	48
b	I	E	H		52	
9	18	27	36	44		

100

LP-2

Name: ____________________

Date: ____________________

Teacher: ____________________

B	u	k	O	S	V	6
X	M	h	x	W	H	12
N	o	K	r	I	y	18
Q	L	j	A	g	R	24
Z	E	J	i	b	f	30
v	l	p	m	c	w	36
n	C	Y	D	t	a	42
U	G	T	F	q	z	48
s	P	d	e		52	
9	18	27	36	44		

LP-3

Name: ________________
Date: ________________
Teacher: ________________

L	E	I	o	z	c	6
f	S	J	y	Y	P	12
r	n	e	F	V	k	18
b	u	g	A	X	M	24
s	D	G	O	T	p	30
h	C	H	N	j	m	36
x	v	W	t	q	w	42
a	Z	R	B	l	Q	48
i	K	U	d		52	
9	18	27	36	44		

LT-1

Name: ____________________

Date: ____________________

Teacher: ____________________

C	n	a	b	j	s
f	d	y	u	g	K
S	J	k	I	O	Z
R	U	F	c	Q	l
x	e	w	M	v	t
H	B	h	D	i	E
p	Y	W	m	q	N
X	L	A	G	P	o
r	T	V	z		

LT-2

Name: ____________________

Date: ____________________

Teacher: ____________________

f	p	i	C	u	D
N	P	v	M	k	E
b	z	r	o	c	A
H	s	q	X	L	x
B	W	e	Y	d	G
y	Q	V	m	F	l
Z	K	S	R	T	w
J	I	g	h	n	U
a	j	t	O		

LT-3

Name: ____________________

Date: ____________________

Teacher: ____________________

o	l	k	M	D	v
W	b	m	y	n	p
E	A	B	r	i	u
K	t	a	N	c	e
U	g	z	f	F	Q
Y	V	j	G	R	w
S	q	P	x	J	T
L	h	Z	O	s	X
C	d	H	I		

Appendix B

Protocols for Reading Measures*

Protocols found in this appendix are copies of the examiner's scoring probes. Student copies of the protocols contained only passages or words. Student protocols did not include scoring guide numbers, probe identification codes (e.g. WL-1), and student identification data.

Included in this appendix are:

*Note: Print size has been reduced for Fall and Winter Passages in order to meet margin requirements for binding.

W-1

Name: _______________

Date: ______________

Teacher: ______________

The Sad Dad. 3

Dad is mad. 6

Dad is mad at Tad. 11

Dad is mad at Tad so Dad is Sad. 20

W-2

Name: _______________

Date: _______________

Teacher: _______________

Mom and the red hot chair. 6

Mom and dad had a dog. 12
The dog is Lad. 16

The dog Lad had a cap on the can. 25
A cap on the can! 30

Mom and dad had a black and white 38
and Brown cat. 41
The cat is Tag. 45

Tag and Lad got on the red hot 53
chair. 54
Mom and dad are mad. 59

W-3

Name: ____________________

Date: ____________________

Teacher: ____________________

Sid the pig. 3

The big tan pig is Sid. 9
Sid hid the brown mitt. 14
Did Sid get rid of the brown mitt? 22
No! He hid the brown mitt. 28
Sid hid the brown mitt in the 35
black chair. 37

P-1

Name: ____________________

Date: ____________________

Teacher: ____________________

Chad and I 3

Chad and I chop a log. 9
Chad got the log hot. 14
The log got red. 18

I had a ham and three hots. 25
I got the ham and three hots hot. 33

Chad had the ham. 37
I had the three hots. 42
Hot dog. 44

P-2

Name:____________________

Date:____________________

Teacher:____________________

Tim 1

A black cat ran to Tim. 7

The cat hit him on the lip. 14

Tim's lip is red. 18

Tim ran to the pit. 23

He sat on the rim. 28

Tim is sad. 31

Tim's dog ran to him. 36

The dog did lap him. 41

Tim is glad. 44

P-3

Name: ___________________

Date: ___________________

Teacher: ___________________

The Tan Can 3

Dan got on the sand. 8
Can Dan land a cod? 13
Dan can land a cod. 18

Can Dan land two cod? 23
Dan got a tan can. 28

Sad Dan. 30
Sad Mom and Dad. 34

the
do
yellow
on
white
you
is
me
will
ask
has
what
to
orange
purple
black
for
be
was
gray
come
blue
so
brown
his
she
us
red
green
go
he
up
I
it
with
and
we
of
an
at
no

Name:______________
Date:________________
Teacher:_____________

WL-2

what
up
gray
ask
was
she
me
it
his
you
brown
black
no
purple
green
orange
do
to
red
the
I
so
go
and
is
be
we
us
with
blue
for
of
has
he
white
yellow
at
an
will
come
on

Name:_______________
Date:________________
Teacher:_____________

with
will
purple
the
on
it
you
white
I
me 10
up
ask
was
gray
what
of
us
come
his
brown 20
an
so
orange
red
at
to
for
he
black
no 30

has
we
blue
is
do
and
go
she
yellow
be 40
green

Name:_______________
Date:_______________
Teacher:_______________

Two Good Friends 3

Duck was looking at his clean house. 10

Just then someone came to the door. It was Bear. 20

"Come in," Said Duck, "but first you must clean your feet." 31

Bear cleaned his feet and went inside. 38

"Make yourself at home," said Duck. " Come and sit down." 48

"Thank you, I will," said Bear. 54

He sat down in Duck's rocking chair. 61

Then he put his feet on Duck's table. 69

"Bear, put your feet on this paper," said Duck. 78

"What do you have to eat?" asked Bear. 86

"Nothing," said Duck. 89

"Nothing to eat?" asked Bear. 94

"Today I cleaned house," said Duck. "I did not cook." 104

"Well, I have something," said Bear. 110

He took two cakes out of his pocket. 118

Name:____________________

Date:____________________

Teacher:____________________

PM-2

Winifred 1

Winifred made things. 4

She made old things and new things. 11

She made big things and little things. 18

But Winifred had a problem. 23

She made things so fast that they were never very good. 34

Winifred always gave the things she made to her friends. 44

Her friends said, "Thank you. Thank you, Winifred." 52

But they didn't know what to do with the things she gave them. 65

One day the woman next door said, 72

"Winifred, I know you like to make things. 80

Why don't you make things we can use? 88

Why don't you make signs?" 93

"Signs," said Winifred. "What a good idea!" 100

The next time Winifred went for a ride, 108

she read all the signs she saw. 115

When Winifred got home, she sat right down and went to work. 127

She made signs just like the ones she had seen. 137

Name:____________________

Date:____________________

Teacher:____________________

PM-3

Moon Mouse 2

One night Mother Mouse called, "Come, Arthur, 9
Now that you are older, you may stay up after dark. 20
Let us look at the night sky." 27
Arthur ran to the door and looked out. 35
Darkness was everywhere. The night was very still. 43
"So this is what the night is like! 51
It is wonderful!" he said. 56
Arthur looked up. 59
There in the darkness was something big and round and yellow. 70
"Look! What is that?" he asked. 76
"It is just the moon," his mother said. 84
"It is the big, round, yellow moon." 91
"Where is the moon?" asked Arthur. 97
"Very far away," his mother said. "Way up in the sky." 108
"What is the moon for?" asked Arthur. 115
Mother Mouse said, "It lights up the sky at night." 125

Name:__________________________

Date:___________________________

Teacher:________________________

And I Mean It, Stanley 5

Listen, Stanley. I know you are there. 12

I know you are in back of the fence. 21

But I don't care, Stanley. I don't want to play with you. 33

I don't want to talk to you. You stay there, Stanley. 44

Stay in back of the fence. I don't care. 53

I can play by myself, Stanley. 59

I don't need you, Stanley. And I mean it, Stanley. 69

I am having a lot of fun. A lot of fun! 80

I am making a great thing, Stanley. A really, truly great thing. 92

And when it is done, you will want to see it, Stanley. 104

Well, you can't. I don't want you too. 112

And I mean it, Stanley. 117

I don't want you to see what I am making. 127

You stay there, Stanley. Don't you look. 134

Name:________________________

Date:_________________________

Teacher:______________________

PR-2

Strange Bumps 2

Owl was in bed. 6

"It is time to blow out the candle and go to sleep," 18

he said with a yawn. 23

Then Owl saw two bumps under the blanket 31

at the bottom of his bed. 37

"What can those strange bumps be?" asked Owl. 45

Owl lifted up the blanket. He looked down into the bed. 56

All he could see was darkness. 62

Owl tried to sleep, but he could not. 70

"What if those two strange bumps grow bigger 78

and bigger while I am asleep?" said Owl. 86

"That would not be pleasant." 91

Owl moved his right foot up and down. 99

The bump on the right moved up and down. 108

"One of those bumps is moving!" said Owl. 116

Owl moved his left foot up and down. 124

Name:______________________________

Date:______________________________

Teacher:____________________________

No One Should Have Six Cats 6

We have six cats at my house. But soon that will change. 18

This morning my mom told me, 24

"No one should have six cats, David." 31

I can tell that Mom thinks I should give one cat away. 43

But which one? I love them all. 50

Herkie is cat number one. 55

I found him in an alley one day. 63

He had a hurt paw. He looked so sad and lonely. 74

Nobody knew where Herkie lived. And nobody wanted him. 83

What could I do? I had no choice. 91

I let him live with us. Now Herkie's paw is all better. 103

He can run and play and climb trees. 111

He and I are good friends. 117

I just can't give Herkie away. 123

Name:____________________________

Date:_____________________________

Teacher:__________________________

Appendix C

Card Templates and Score Sheet for

Phonetic Word Cue Task*

Included in this appendix are:

Note: Template size has been reduced to meet margin requirements for binding.

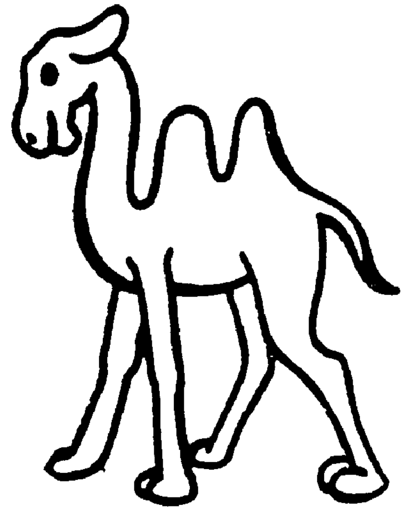
BH

ER

BH

ER

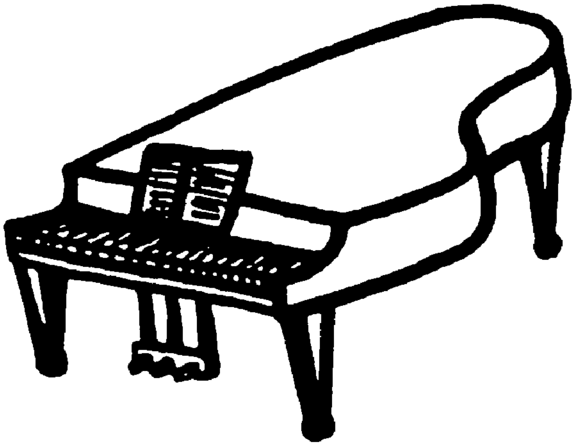
JL



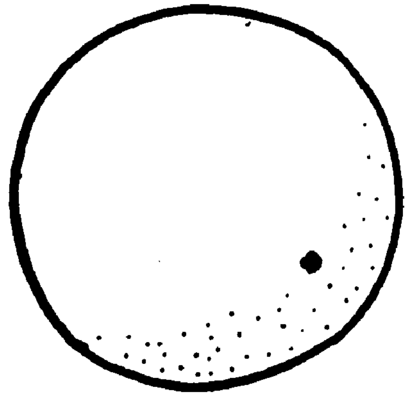
KML

JL

KML



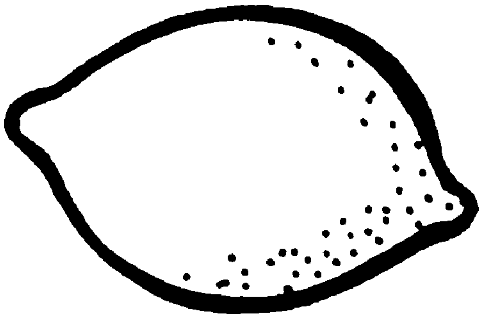
PNO



ORNG

PNO

ORNG

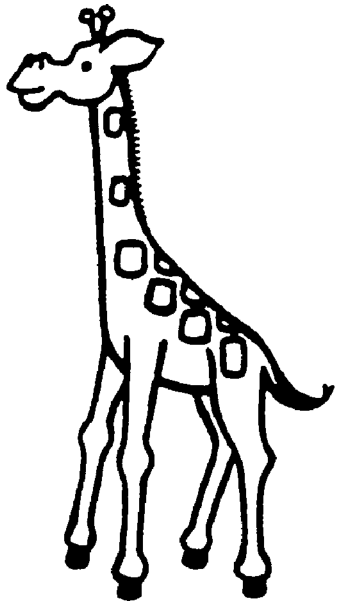


LMN

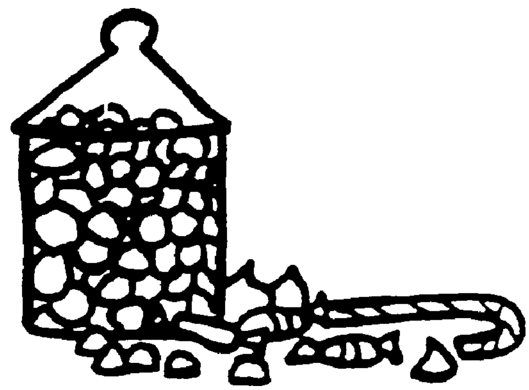
NDN

LMN

NDN



JRF



KND

JRF

KND

ANGL

RM

ANGL

RM

Picture/Word Score Sheet

Name________________________Date__/__/__ Teacher______________________

Trial 1			Trial 2			Trial 3			Trial 4			Trial 5			Trial 6			Trial 7		
KML	+	-	JL	+	-	ANGL	+	-	NDN	+	-	ORNG	+	-	PNO	+	-	LMN	+	-
JL	+	-	PNO	+	-	KND	+	-	LMN	+	-	PNO	+	-	RM	+	-	NDN	+	-
BH	+	-	NDN	+	-	JRF	+	-	ORNG	+	-	KND	+	-	JRF	+	-	PNO	+	-
NDN	+	-	KND	+	-	BH	+	-	KML	+	-	RM	+	-	KML	+	-	JL	+	-
ANGL	+	-	RM	+	-	KML	+	-	ER	+	-	BH	+	-	ANGL	+	-	ER	+	-
JRF	+	-	BH	+	-	RM	+	-	BH	+	-	ER	+	-	ORNG	+	-	JRF	+	-
PNO	+	-	ANGL	+	-	PNO	+	-	KND	+	-	JRF	+	-	KND	+	-	RM	+	-
KND	+	-	ORNG	+	-	LMN	+	-	JRF	+	-	LMN	+	-	BH	+	-	KND	+	-
LMN	+	-	KML	+	-	NDN	+	-	RM	+	-	NDN	+	-	ER	+	-	ORNG	+	-
ORNG	+	-	JRF	+	-	ORNG	+	-	ANGL	+	-	KML	+	-	NDN	+	-	BH	+	-
RM	+	-	ER	+	-	JL	+	-	PNO	+	-	JL	+	-	LMN	+	-	ANGL	+	-
ER	+	-	LMN	+	-	ER	+	-	JL	+	-	ANGL	+	-	JL	+	-	KML	+	-

WdsLnd
Per Trl ___ ___ ___ ___ ___ ___ ___

BH	0	1	2	3	6	5	4	3	2	1	0
ER	0	1	2	3	6	5	4	3	2	1	0
JL	0	1	2	3	6	5	4	3	2	1	0
KML	0	1	2	3	6	5	4	3	2	1	0
LMN	0	1	2	3	6	5	4	3	2	1	0
NDN	0	1	2	3	6	5	4	3	2	1	0
PNO	0	1	2	3	6	5	4	3	2	1	0
ORNG	0	1	2	3	6	5	4	3	2	1	0
JRF	0	1	2	3	6	5	4	3	2	1	0
KND	0	1	2	3	6	5	4	3	2	1	0
ANGL	0	1	2	3	6	5	4	3	2	1	0
RM	0	1	2	3	6	5	4	3	2	1	0

Ttl Wds Lnd _____ Trls to Critron _____

Appendix D

Examiner Instructions and Integrity Checklists

Included in this appendix are:

Turn on tape recorder.

I am going to give you a page of letters.
When I tell you to start I would like you to read the letters, starting here, (point) until I tell you to stop.
Are you ready to begin?
Start.

Time for one minute.

Now I am going to give you a list of words to read.
When I tell you to start I would like you to read the words, starting here, (points) until I tell you to stop.
Are you ready to begin?
Start.

Time for one minute.
On the first word list let the child read the entire word list but mark where they were at the end of the minute.

This time I am going to give you a story to read.
When I tell you to start I would like you to read the story, starting here, (point) until I tell you to stop.
Are you ready to begin?
Start.

Time for one minute.

Turn off tape recorder.

Name of Examiner:______________________________

Date: ____/____/____ **Time:** ___:___

Name of Observer:______________________________

Administrative Checklist for CBM probes

Letter Probes:	*Circle One*
1. Reads directions verbatim	yes no
2. Reads directions clearly	yes no
3. Points to appropriate starting point	yes no
4. Circles all errors	yes no
5. Marks hesitations	yes no
6. Prompts unknowns at 5 seconds	yes no
7. Correctly times for 1 minute	yes no
8. Clearly marks stopping point	yes no
9. Correctly administers all three probes	yes no

Word Lists

1. Reads directions verbatim	yes no
2. Reads directions clearly	yes no
3. Points to appropriate starting point	yes no
4. Circles all errors	yes no
5. Prompts unknowns in 5 seconds	yes no
6. Correctly times for 1 minute	yes no
7. Clearly marks stopping point	yes no
8. Correctly administers all three probes	yes no

Passages

1. Reads directions verbatim	yes no
2. Reads directions clearly	yes no
3. Points to appropriate starting point	yes no
4. Circles all errors	yes no
5. Prompts unknowns in 5 seconds	yes no
6. Correctly times for 1 minute	yes no
7. Clearly marks stopping point	yes no
8. Correctly administers all three probes	yes no

Comments:______________________________

Name of Examiner: ______________________________

Date: ____/____/____ **Time:** ___:___

Name of Observer: ______________________________

Administrative Checklist for Treatment Conditions

Treatment:	*Circle One*	
1. Has child read probe	yes	no
2. Correctly chooses two unknown letters	yes	no
3. Correctly adapts eight known letters	yes	no
Letter one		
4. Begins with unknown letter	yes	no
5. Uses folding in appropriately	yes	no
Letter two		
6. Begins with second unknown letter	yes	no
7. Adds letter one next	yes	no
8. Uses folding in correctly	yes	no
9. Has child read probe again	yes	no

Control:

1 Reveiws task with student	yes	no
2. Interacts with child first time	yes	no
3. Interacts with child second time	yes	no
4. Interacts with child third time	yes	no
5. Interacts with child fourth time	yes	no
6. interacts with child fifth time	yes	no
7. Reveiws task	yes	no

Comments: ______________________________
____
____

Name of Examiner: ______________________________

Date: ____/____/____ **Time:** ___:___

Name of Observer: ______________________________

Administrative Checklist for Phonetic Trials

Study Trial:	*Circle One*
1. Shows pictures of objects with spelling	yes no
2. Pronounces the word while pointing to the spelling	yes no
3. Has subject repeat the word	yes no
4. Has subject name the letters while they point to each in order	yes no
5. Has subjects repeat the word again	yes no
6. Correct procedure for each word	yes no

Test Trials:	
1. Shows spelling without picture	yes no
2. Correctly scores first response	yes no
3. Shows picture with word speling	yes no
4. Has subject name letters	yes no
5. Correct procedure for each trial	yes no
6. Correct administration of all seven trials	yes no

Comments: ____

____

____

____

VITA

Mark H. Fugate

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Education

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1981 - 1984 Indiana University of Pennsylvania; Indiana, PA.
M.A. (Clinical Psychology), December 1984

1988 - 1993 Lehigh University; Bethlehem, PA.
Ph.D. (School Psychology) October 1993

Professional Experience

1992 - present Alfred University; Alfred, NY.
Instructor of School Psychology

1991 - 1992 Sarah A. Reed Children's Center; Erie, PA.
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1988 - 1991 Lehigh University; Bethlehem, PA.
Graduate Assistant to Professors E. S. Shapiro, A. R. Spokane, B. J. Blandford, D. M. Murphy, & B. Hawks

1984 - 1988 Clearfield - Jefferson Community Mental Health Center; DuBois, PA. Child Therapist

1985 - 1987 Indiana University of Pennsylvania; Indiana, PA.
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1979 - 1983 Central Western Pennsylvania Youth for Christ, Inc.; Punxsutawney, PA. Executive Director

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Publications

Refereed Journals

Bazler, J. B., Spokane, A. R., Ballard, R., & Fugate, M. H. (In Press) The jason experience: An attitude toward science careers. Journal of Career Development.

Non-refereed

Fugate, M. H., Turco, T. L., Benecke, R. L., & Beck, M. M. (1991) Predictive validity of school readiness measures. The Pennsylvania Psychologist Quarterly, (Feb), 12 - 13.

Presentations

Fugate, M. H. (August, 1991). Validity of curriculum-based assessment. In E.S. Shapiro (Chair) Recent advances in curriculum-based assessment. Symposium conducted at the annual meeting of the American Psychological Association, San Francisco.

Shapiro, E. S. & Fugate, M. H. (August, 1991). Assessing instructional level in curriculum and student progress. Presented at the annual meeting of the American Psychological Association, San Francisco

Turco, T. L., Brown, R. L., & Fugate, M. H. (June, 1990). The predictive validity of the Gesell School Readiness Test. Presented at the annual meeting of the Pennsylvania Psychological Association, Split Rock, Pa.

Fugate, M. H., Brown, R., Turco, T. L., & Yeager, W. (April 1990). A longitudinal study of a curriculum-based screening measure: Year one. Presented at the annual meeting of the National Association of School Psychologists, San Francisco.

Brown, R. L., Fugate, M. H., & Turco, T. L. (March, 1990). A study of the Gesell School Readiness Test. Presented at the annual meeting of the Association of School Psychologists of Pennsylvania, Harrisburg, Pa.

Murphy, D. M. & Fugate, M. H. (March, 1989). A computerized scoring program for identifying at risk children. Presented at the annual meeting of the National Association of School Psychologists, Boston.