PHONEMIC AWARENESS INSTRUCTION: EFFECTS OF LETTER MANIPULATION AND ARTICULATION TRAINING ON LEARNING TO READ AND SPELL

by

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Abstract

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This study investigated the effect of two types of phonemic awareness instruction on learning to read and spell words. English speaking preschoolers were taught to segment words into phonemes using either letters or letters combined with articulation pictures. Participants possessed letter name knowledge but were nonreaders prior to training. Triplets were formed based on similar scores on the segmentation, word reading and vocabulary pretests and members were randomly assigned to three conditions: letter manipulation only (LO), letter manipulation plus articulation (LPA), and no treatment control conditions. LO children were taught letter-sound correspondences and use of letters to spell phonemes in words. LPA children received LO training and in addition the use of articulatory pictures to spell phonemes. Control children remained in their classrooms.

Posttests were administered one and seven days after training ended. The three groups were compared in their ability to segment words into phonemes, to learn to read a set of words over trials, to decode nonwords, to invent word spellings and to repeat nonwords. Binomial logistic regressions and ANCOVAs were computed to assess the effects of training. Results demonstrated that trained children outperformed controls in

phoneme segmentation, spelling, word learning, nonword decoding and nonword repetition. LPA children outperformed LO children in spelling on the one-day posttest but not on the seven-day posttest. LPA children outperformed LO children in phoneme segmentation and word learning at both tests points and in nonword decoding on the one-day posttest. Trained children demonstrated equivalent performance on the one-day nonword repetition posttest

The results help to clarify the phonemic processes that underlie and support reading words from memory, as portrayed in Ehri's (1995) theory of sight word learning. The favored explanation for the effect of articulatory training on word learning is that it enhanced the identities of phonemes within phonological representations and this allowed phonemes to become more securely attached to letters as connections were formed during word learning. Superior performance of treatment groups over controls in repeating nonwords suggests that learning to represent phonemes with letters improves phonological short-term memory.

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Table of Contents

Chapter		Page
1	Introduction	1
2	Literature Review	7
	Phonemic Awareness	7
	Difficulty of Acquiring Phonemic Awareness	12
	Reciprocal Relationship between Phonemic Awareness and Literacy Acquisition	14
	Phonemic Awareness and the Alphabetic Principle	21
	Contribution of Phonemic Awareness to Word Reading and Spelling Development	24
	Phonemic Awareness Instruction	28
	Phonemic Awareness Training with Alphabet Letters	30
	Phonemic Awareness Training with Articulatory Movements	36
3	Rationale and Hypotheses for the Study	42
	Pilot Study	46
	Methods	51
	Results	57
	Dissertation Study	63
4	Methods	65
	Participants	65
	Materials and Procedures	70
	Pretest	70
	Experimental Conditions	78

Chapter		Page
	One-Day Posttest	87
	Seven-Day Posttest	94
	Design and Statistical Analyses	97
5	Results	100
	Characteristics of Participants	100
	Performance During Training	104
	Posttest Performance	107
6	Discussion	135
	Summary of Results	135
	Acquisition of Phonemic Awareness	138
	Acquisition of Developmental Spelling Ability	144
	Acquisition of Word Reading Ability	148
	Acquisition of Nonword Repetition Ability	162
	Strengths and Limitations	167
	Preschoolers in Literacy Research	170
	Implications for Practice and Future Research	173
Appendixes		
A	Parental Informed Consent Letter	175
B	Scripts for Pretests, Posttests and LO/LPA Training	183
C	Drawing of the Mouth	255
D	Drawing of the Ear	256
E	Word/Nonword Lists	257

Chapter	Page
References	260

List of Tables

Table		Page
1	Characteristics of Children, Means, Standard Deviations, and Test Statistics for the Letter Plus Articulation (LPA) Group, the Letter Only (LO) Group, and the Control (C) Group on the Pretests	68
2	Means and Standard Deviations during Training as a Function of Treatment	105
3	Means, Standard Deviations, Test Statistics, Post Hoc Pairwise Tests, and Effect Sizes to Compare the Letter Plus Articulation (LPA), Letter Manipulation Only (LO), and Control (C) Groups on One-Day and Seven-Day Posttests	108
4	Numbers of Children in Each Treatment Condition Who Used Each Strategy at Least One Time Across the First Five Sight Word Learning Trials	124
5	Correlations between Pretests and Posttests	131
6	Hierarchical Regression Analyses to Predict Gains in Nonword Repetition Task from Pretest to Posttest	133

List of Figures

Figures		Page
1	Pictures of articulation gestures and their associations to phonemes	79
2	Word segmentation with letters and articulatory movement pictures	84
3	Mean number of words read correctly on the first eight learning trials by LPA, LO and Control groups as a function of condition on the one-day sight word learning posttest	121
4	Mean number of words read correctly on the first eight learning trials by LPA, LO, and Control groups as a function of condition on the seven-day sight word learning posttest	122

Chapter 1

Introduction

Young children must overcome a number of challenges on their way to becoming skilled readers. The first major challenge faced by beginning readers of any alphabetic language, such as English, is the discovery of the alphabetic principle (National Early Literacy Panel, 2008; Snow, Burns, & Griffin, 1998). The alphabetic principle involves the knowledge that letters in written words systematically represent the sounds in spoken words. The ability to understand and use the alphabetic principle is critical for reading development because it provides the foundation necessary for the acquisition of skilled decoding ability. Children who fail to master the alphabetic principle will encounter difficulties with word recognition and text comprehension.

Mastery of the alphabetic principle depends on the acquisition of phonological awareness skill, specifically phonemic awareness (Adams, 1990; Byrne & Fielding-Barnsley, 1989; Snow et al, 1998). Phonemic awareness is a meta-linguistic skill which involves the understanding that, within the English language, spoken words are constructed of sequences of phonemes. When children possess phonemic awareness they are able to attend to and manipulate the phonemes in spoken words (Liberman, Shankweiler, Fischer, & Carter, 1974).

Research investigating the relationship between phonemic awareness and reading ability has consistently demonstrated the important role that phonemic awareness plays in reading development (Ehri, Nunes, Willows, Schuster, Shanahan, & Yaghoub-Zadeh, 2001). Correlational research has found that children's level of phonemic awareness skill and letter name knowledge, at the start of kindergarten, are strongly predictive of reading achievement through 2nd grade (Juel, Griffith, & Gough, 1986; Share, Jorm, Maclean, &

Mathews, 1984). The National Reading Panel (Ehri et al, 2001) conducted a meta-analysis of experimental studies involving phonemic awareness interventions and found that instruction in phonemic awareness skill benefited students' decoding, spelling, and comprehension skill. However, the relationship is reciprocal. Studies have also shown that the processes involved in learning to read and spell strengthen phonemic awareness (Byrne & Fielding-Barnsley, 1993; Ehri & Wilce, 1980, 1987a; Hohn & Ehri, 1983; Mann, 1986; Share et al., 1984; Perfetti, Beck, Bell, & Hughes, 1987; Perin, 1983; Santoro, Coyne, & Simmons, 2006).

Whereas the majority of young children acquire spoken language with little effort, the same is not true of phonemic awareness which requires direct instruction for most children to acquire. The difficulty in acquiring phonemic awareness may be due to the way in which speech is perceived. Spoken language is perceived as an unbroken flow of sound with no distinction between the individual phonemes in words. Adjacent phonemes in spoken words are coarticulated making it difficult to pronounce the individual sounds separately without distorting them (Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967).

Because of the importance of phonemic awareness to reading development and the difficulty of acquiring phonemic awareness without explicit instruction, it is important to develop effective instructional programs aimed at fostering phonemic awareness in beginning readers. It is generally agreed that phonemic awareness can be increased with instruction and that phonemic awareness skill can transfer to reading and spelling. However, there is a lack of agreement as to the most effective instructional

approaches for optimizing phonemic awareness development and its transfer to reading and spelling.

One approach to phonemic awareness training which has been found effective in increasing phonemic awareness, reading and spelling skill involves the use of letters in order to mark the phonemes in words (Bradley & Bryant, 1983; Ehri & Wilce,1987a; Hohn & Ehri, 1983; Uhry & Shepherd, 1993). According to the National Reading Panel's meta-analysis (Ehri et al., 2001) phonemic segmentation training that includes letters results in greater increases in phonemic segmentation, reading, and spelling skill than phonemic segmentation training that does not include letters. Including letters during phonemic segmentation training may foster the acquisition of phonemic awareness because alphabet letters are visible, concrete representations of the transient sounds that make up spoken words. In addition, letter markers may allow children to hold phonemic segments in memory and to inspect and manipulate them during training (Lindamood & Lindamood, 1998). Including instruction in letter-sound correspondences during phonemic segmentation training may increase transfer to reading and spelling by facilitating the transition from spoken language segmentation to written language segmentation.

Another approach to phonemic awareness training that has been found to effectively increase phonemic awareness, reading, and spelling skill compared to no training involves teaching children to attend to their articulatory movements during phonemic segmentation training (Castiglioni-Spalten & Ehri, 2003; Ehri & Sweet, 1991; Lindamood & Lindamood, 1998). During articulation training children are taught to attend to the shape and position of their mouth, lips, and tongue as they articulate specific

phonemes. The effectiveness of articulation training for enhancing phonemic awareness instruction and its transfer to reading and spelling is consistent with the motor theory of speech perception proposed by Liberman (1999). According to Liberman, the individual phonemes that occur during speech production are created by a series of linguistically specialized articulatory movements. These specialized articulatory movements are considered to represent the only invariants of the phonemes that make up speech. As a result phonemes are perceived based on the articulatory movements used to create them, rather than by the sounds that are created by the artuculatory movements (Liberman, 1999; Liberman et al., 1967; Liberman & Shankweiler, 1985). Articulation training may cause children's phonological representations to become more segmental and phonemic in nature which should facilitate children's ability to segment words into phonemes.

While both types of instruction have been shown to facilitate the acquisition of phonemic awareness and transfer to reading and spelling, the exact nature of the contribution made by each type of instruction is unclear. It is possible that letter and articulation training may each make a separate contribution to the development of phonemic awareness, reading and spelling development. This was an issue of interest within this dissertation study.

The focus of this study was on phonemic awareness instruction. Two forms of instruction were compared in order to investigate the effect of training on the phonemic awareness, reading and spelling ability of beginning readers. One group of preschoolers was taught phonemic segmentation combined with explicit instruction in letter-sound correspondences and letter manipulation (Letter manipulation only or LO condition). A second group was taught phonemic segmentation combined with explicit instruction in

letter-sound correspondences and attention to articulatory movements (Letter plus articulation or LPA condition). A third no treatment control group received regular preschool instruction in their classrooms.

A battery of pretests was administered in order to determine children's eligibility for participation in the study. In order to participate, children were required to possess limited phonemic awareness ability and be capable of using their letter knowledge to function at Ehri's (2005) partial alphabetic phase of word reading. The tasks administered during the pretest session included a name writing task, a letter naming task, a phoneme segmentation task, a nonword reading task, a word reading task, a developmental spelling task, a vocabulary task and a nonword repetition task.

Both instructional conditions consisted of correspondence training followed by segmentation training. During correspondence training, children were taught to associate 15 target sounds with the letters used to represent them. In addition, the LPA group was taught associations between sounds and the articulatory movements used to create them. During segmentation training, children were taught to use either letters or both letters and articulatory movements in order to segment words.

Following training, the three groups were compared in their ability to segment words into phonemes, to learn to read a set of words spelled with target letters over trials, to decode nonwords, to invent nonword spellings, and to repeat nonwords. Posttests were administered one day and seven days after training ended. Binomial logistic regressions, a form of the generalized linear model, and ANCOVAs were computed in order to assess the effects of training.

A question of interest in the study was whether segmentation training involving articulatory movement pictures and letters would prove superior to segmentation training involving letters only for teaching phonemic segmentation to preschoolers. Further questions of interest involved whether the segmentation training would transfer and facilitate sight word learning as well as nonword decoding performance. Transfer was expected in the word learning task but not in the decoding task.

Chapter 2

Literature Review

Phonemic Awareness

For normally developing children, the task of acquiring spoken language competence begins early in the course of development and is accomplished with relative ease (Garton & Pratt, 1998; Snow et al.1998). By the start of their formal education, children possess the basic speaking and listening skills necessary for effective communication. During the early period of language development, children tend to focus on the ways in which speech is used in order to convey meaning. The main concerns of the young language learner revolve around understanding the speech of others and creating speech that can be understood by others.

One consequence of this early focus on meaning is that many preschoolers begin their formal education possessing little or no explicit knowledge of the internal structural features of their language. For these young children the processes involved in speech production and comprehension have become largely automatic and unconscious (Liberman, Shankweiler, Liberman, Fowler, & Fischer, 1977). While these children are capable of effectively communicating through spoken language, they are largely unable to articulate the rules that guide their language usage. For example, young children may be able to recognize the fact that ‘map’ and ‘mat’ are different words that convey different meanings but are unable to explain that the difference between the two words is in the final sound. These children may also be able to produce sentences that are grammatically correct while being unable to explain the syntactic rules used to produce these sentences.

The ability to explicitly reflect on and manipulate the internal structural features of spoken language is known as meta-linguistic awareness (Garton & Pratt, 1998; Snow et al., 1998). When children possess meta-linguistic awareness they are able to deliberately and consciously think about language as an object separate from the meaning it conveys. The four areas of language in which meta-linguistic ability can develop are phonological, word, syntactic, and pragmatic (Tunmer, Herriman, & Nesdale, 1988). This conscious awareness of the internal structural features of a language is not necessary for effective speech production and perception. However, it is believed to play a critical role in aiding the transition from spoken to written language. Phonological awareness, specifically phonemic awareness, is the meta-linguistic skill which has been shown to have the most significant impact on early literacy development (Garton & Pratt, 1998; Snow et al., 1998).

Phonological awareness is a spoken language skill defined as the ability to attend to and manipulate the sounds in spoken words separate from their meanings (Snow et al., 1998). Phonological awareness is a general term which encompasses the larger sound units of language - the word and the syllable - as well as the smallest sound unit or phoneme. Phonemic awareness is a specific type of phonological awareness which involves the understanding that, within the English language, spoken words are constructed of sequences of individual phonemes. Children who possess phonemic awareness skill are able to consciously attend to and manipulate the individual phonemes that make up spoken words. Phonemic awareness has been referred to by a variety of different terms within the research literature, including phonemic analysis, phonemic segmentation, auditory analysis, auditory discrimination, and phonological sensitivity.

The smallest unit of sound within spoken English is the phoneme. When taken alone, the individual phonemes that make up the English language are meaningless. However, phonemes can be systematically combined in order to create an indefinite number of meaningful words. Phonemes are the sound units in spoken language that are represented by the printed letters in written language. The English language contains more than 40 phonemes all of which are represented systematically by the 26 letters of the English alphabet. This is possible because correspondences between the phonemes in spoke words and the letters in written words are not always one to one. Within the English writing system, a single phoneme can be represented by ether a single letter or by a combination of letters. As a result, there may be more letters in the spelling of a written word than there are phonemes in the spoken word. For example, the written form of the word *shake* involves five letters while the spoken form of the word only contains three phonemes - /sh/ - /a/ - /k/.

A hierarchical progression in children's acquisition of phonological awareness skill has been identified by researchers (Adams, 1990; Bryant, Maclean, Bradley, & Crossland, 1990; Griffith & Olson, 1992; Lomax & McGee, 1987). Over time, children move from a shallow understanding of the larger phonological units of language, such as words and syllables, to a deeper understanding of the smallest phonemic units. Evidence supports the view that phonemic awareness skill develops later than does the ability to identify and manipulate syllables (Chaney, 1992; Liberman et al., 1974; Treiman & Baron, 1981). Liberman, et al (1974) examined the phonemic awareness of 4, 5, and 6 year olds by requiring children to tap a wooden block once for each phoneme or syllable in a spoken word. More children in each age group were able to successfully segment

words into syllables than were able to segment words into phonemes. The ability to segment words into phonemes appeared at 5 years of age and the number of children who were successful at phonemic segmentation increased from age 5 to age 6.

According to Adams (1990), children move through five levels of phonological awareness on their way to acquiring phonemic awareness. During the first two levels of phonological awareness, children demonstrate the ability to attend to the larger sound units in words. At the first level, children are able to remember familiar rhymes (Maclean, Bryant, & Bradley, 1987). At the second level, children are able to recognize patterns of rhyme and alliteration. Children's position at this level has been measured through the use of categorization tasks, in which children are asked to determine the word in a list that does not start with the same initial phoneme as the others (Bradley & Bryant, 1983).

As children move through the last three levels they acquire an increasingly sophisticated understanding of the phonemic structure of language. At the third level children demonstrate an understanding that syllables can be divided into their constituent phonemes. Children's position at this level has been measured through the use of blending and syllable splitting tasks. Blending tasks require that children listen to a word divided into its onset and rhyme or into its constituent phonemes and blend the sounds into a recognizable word (Perfetti et al., 1987). Syllable–splitting tasks require that children isolate the initial phonemes in words (Share et al., 1984). At the fourth level, children demonstrate the ability to segment spoken words into their constituent phonemes. Children's position at this level has been measured through the use of tapping

tasks which require that children listen to a word and then tap a wooden block on the table once for each phoneme in the word (Liberman et al., 1974).

At the fifth level, children demonstrate the deepest understanding of the phonemic structure of words. They become able to add, remove and manipulate phonemes in spoken words in order to create new words or pseudowords. These tasks require children to segment words into their constituent phonemes, hold the phonemes in memory, manipulate the phonemes and then blend the sequence of phonemes into a new word.

A wide range of measures has been developed for the assessment and instruction of phonemic awareness in both children and adults. These tasks include:

1. Phoneme isolation which involves hearing a word and being asked to say the initial, medial or final sounds.
2. Phoneme segmentation which involves hearing a word and being asked to pronounce all the individual sounds in the word.
3. Phoneme blending which involves hearing the individual sounds in order and being asked to blend these sounds into a recognizable word.
4. Phoneme deletion which involves hearing a word and being asked to delete the initial or final sounds to form a new word.
5. Phoneme identity which involves hearing a list of words and being asked to identify the common sound that occurs across these words.
6. Phoneme categorization which involves hearing a list of words and being asked to recognize the word with the odd sound.

In the proposed study, a more advanced form of phonemic awareness will be studied. Preschoolers will be taught to segment words into their separate phonemic constituents in order to promote development at level 4 in Adams' (1990) scheme.

Difficulty of Acquiring Phonemic Awareness

Whereas, normally developing children acquire spoken language with little effort, the same is not true of phonemic awareness. The understanding that spoken words can be broken down into their constituent phonemes is difficult for most young children to acquire without explicit instruction. In fact, acquiring phonemic awareness skill may be an especially difficult task for children who develop later reading disabilities (Snow et al., 1998; Chall, 1983; Gough & Tunmer, 1986; Scarborough, 1990, 2001).

Young children's difficulty in acquiring phonemic segmentation skill is believed to be largely due to the way in which spoken language is perceived (Liberman, 1998). The phonemes that make up words in spoken English are not articulated as individual, discrete sound units. Rather, monosyllablic words are perceived as a single unit of sound. For example, the word 'cat' is perceived as one unit of sound rather than as three discrete units of sound, /c/ /a/ /t/. In addition, multisyllabic words are perceived as a series of sound units which roughly correspond to the number of syllables in the word. For example, the word 'sweater' is perceived as two units of sound - /sweat/ - /er/.

This occurs because the phonemes that are adjacent to one another during speech are coarticulated. Coarticulation means that the adjacent phonemes are blended and merged with one another in the speech stream. As a result of this coarticulation, spoken language is perceived as an unbroken flow of sound with no distinction between the individual phonemes in words (Liberman et al., 1967; Liberman et al., 1977). Because

speech is perceived as an unbroken flow of sound, the phonemes which compromise spoken English are not obviously perceived by either speakers or listeners.

The coarticulation of phonemes during speech benefits communication by allowing for rapid, efficient speech production and perception. Coarticulation allows speech to proceed at a more rapid rate than could otherwise occur if phonemes were produced as individual units of sound. In addition, coarticulation allows listeners to accurately recognize words and understand sentences. If phonemes were not coarticulated during speech production, listeners would be required to hold strings of phonemes in memory until they could be organized into the appropriate words and sentences. The heavy load placed on short term memory would make comprehension slow and often inaccurate.

While coarticulation benefits speech it makes it difficult for children to develop an awareness of the phonemic structure of language. There are no markers within the flow of speech that would make the boundaries between phonemes easily discernable. In addition, the adjacent phonemes in words share acoustic information making it impossible to pronounce the individual phonemes in isolation without some distortion (Liberman et al., 1977). For example, breaking the word ‘cat’ into its constituent phonemes results in /cu/ –/ a /– /tuh/ not /c/-/a/-/t/.

The dissertation study examined two types of phonemic awareness instruction designed to facilitate the development of children’s ability to detect the individual phonemes in words. One type of instruction taught children to mark the individual phonemes in words with the letters that represent those sounds. The second type of

instruction taught children to mark the individual phonemes in words with both the letters that represent the sounds and the articulatory movements used to create the sounds.

Reciprocal Relationship Between Phonemic Awareness and Literacy Acquisition

The fact that a relationship exists between phonemic awareness skill and early reading and spelling development is well supported by research (Adams, 1990**;** Blachman, 2000; Ehri et al., 2001; Liberman & Shankweiler, 1985**;** Lyon, Shaywitz, & Shaywitz, 2003; Wagner & Torgesen, 1987; Williams, 1984). The exact nature of this relationship has been an issue among researchers, specifically, whether the relationship is causal, and the directionality of any causal relationship.

Ehri (1979) proposed three possible relationships that might exist between phonemic awareness and early reading and spelling skill. First, phonemic awareness might be a prerequisite for reading and spelling acquisition. In this case phonemic awareness would be necessary but not sufficient for the development of skilled reading and spelling ability. Second, phonemic awareness might be a facilitator of early reading and spelling acquisition. In this case phonemic awareness would be beneficial but not necessary for the development of skilled reading and spelling ability. Third, phonemic awareness might be a consequence of early reading and spelling acquisition. In this case phonemic awareness would develop as a result of reading and spelling development.

Correlational studies have provided consistent evidence that phonemic awareness may provide the foundation for the development of early reading and spelling ability. One group of correlational studies compared children's concurrent levels of phonemic awareness, reading and spelling ability. These studies have consistently identified a strong positive correlation between phonemic awareness skill and reading and spelling

ability when the skills are measured at the same point in time (Blachman, 1984; Blaiklock, 2004; Bryant et al., 1990; Calfee, Lindamood & Lindamood, 1973; Gottardo, Stanovich, & Siegel, 1996; Griffith, 1991; Juel et al., 1986; Nation & Hulme, 1997; Perfetti et al., 1987; Tunmer & Nesdale, 1985).

Juel et al (1986) collected longitudinal data on a variety of measures related to phonemic awareness, reading and spelling skill during first and second grade. In first grade, the correlation between phonemic awareness and word recognition was .81 and between phonemic awareness and spelling was .72. In second grade, the correlation between phonemic awareness and reading was .54 and between phonemic awareness and spelling was .67. These findings suggest that children's level of phonemic awareness may have a strong influence on reading and spelling ability during first and second grade.

Nation and Hulme (1997) examined the relationship between several measures of children's phonological, reading and spelling skill during the first three years of grade school. Phonemic segmentation was found to be highly correlated with both reading (.59) and spelling (.57), after controlling for age. Hierarchical multiple regression analyses were computed in order to predict reading and spelling ability from the phonological awareness measures. The multiple regression analyses demonstrated that phonemic segmentation accounted for a statistically significant amount of unique variance in both reading (5%) and spelling (9%) scores. This finding suggests that of all the measures of phonological awareness investigated within the study, phonemic segmentation was the best predictor of spelling and reading ability during the first three years of school.

Another group of longitudinal correlational studies has examined the contribution of children's early phonemic awareness skill on their later reading and spelling achievement (Blaiklock, 2004; Bradley & Bryant, 1983; Hoien, Lundberg, Stanovich & Bjaalid, 1995; Liberman et al., 1974; Muter, Hulme, Snowling, & Taylor, 1997; Muter & Snowling, 1998; Perfetti et al. 1987; Scarborough, 1990, 2001; Share et al., 1984; Tunmer et al., 1988). These studies involve measuring phonemic awareness prior to the start of formal reading instruction in order to assess the level of phonemic awareness before reading instruction exerted any influence. This procedure allows investigation of the possibility that phonemic awareness is a cause of enhanced development of reading skill when children subsequently enter school and are taught to read and it rules out the alternative possibility that reading ability accounts for the observed differences in phonemic awareness.

The finding that children's level of phonemic awareness prior to the start of formal reading instruction is predictive of later reading and spelling achievement has been consistently replicated across these studies. Children who demonstrate higher levels of phonemic awareness prior to the start of formal reading instruction tend to demonstrate higher levels of reading and spelling achievement up to two years later. Children who demonstrate lower levels of phonemic awareness prior to the start of formal reading instruction tend to demonstrate lower levels of reading and spelling achievement up to two years later.

Share et al (1984) found children's letter-name knowledge and phonemic awareness at the start of kindergarten to be the two best predictors of children's reading and spelling achievement at the end of kindergarten and first grade. Data analyses were

performed using a single composite reading achievement score which was created by combining participants' scores on the reading and spelling measures. Multiple regression analyses showed phoneme segmentation to be one of six measures that made a unique contribution to the prediction of the composite reading achievement variance.

Taken together, the results from these correlational studies indicate that a strong relationship exists between phonemic awareness and early reading and spelling development. The findings suggest that, within an alphabetic orthography such as English, the ability to segment spoken words into their constituent phonemes may be a prerequisite or a facilitator for early reading and spelling development. In addition, the findings indicate that phonemic awareness does not develop simply as a consequence of acquiring reading and spelling skill.

Among the correlational studies, the longitudinal studies provide the strongest evidence that phonemic awareness may exert a causal influence on early reading and spelling development. This is because the longitudinal studies control for the effects of other variables, such as IQ and reading ability. However, drawing direct causal interpretations based on the findings from correlational studies is problematic. In order to acquire direct evidence regarding the possible causal directionality of the relationship between phonemic awareness and early reading and spelling acquisition, we must examine the findings from experimental training studies with random assignment and control groups.

A number of experimental training studies have been conducted aimed at examining the effect of phonemic awareness instruction on reading and spelling achievement (Ball & Blachman, 1991; Bradley & Bryant, 1983; Byrne & Fielding-

Barnsley, 1991; Byrne, Fielding-Barnsley & Ashley, 2000; Castiglioni-Spalten & Ehri, 2003; Cunningham, 1990; Ehri & Wilce, 1987a; Fox & Routh, 1984; Hatcher, Hulme, & Ellis, 1994; Hohn & Ehri, 1983; Iversen & Tunmer, 1993; Lundberg, Frost, & Petersen, 1988; Ryder, Tunmer, & Greaney, 2008; Uhry & Shepherd, 1993; Vadasy, Sanders, & Peyton, 2006; Williams, 1980). The finding that instruction aimed at strengthening phonemic awareness has a beneficial impact on reading and spelling achievement has been consistently replicated across training studies despite the wide variety of designs represented within these studies. For example, the studies vary in the number and type of phonemic awareness skills that are taught to participants, as well as in whether the phonemic awareness skills are taught alone or in conjunction with other reading related skills.

A meta-analysis conducted by the National Reading Panel (Ehri et al., 2001) examined 52 studies that met their criteria for an experimental training study. The outcome measures of primary interest were phonemic awareness, reading and spelling. A variety of moderator variables were included in the meta-analysis, such as participant characteristics and properties of the phonemic awareness instruction. Participant characteristics included reader level i.e., normally developing, at risk, and disabled readers and grade level i.e., preschool, kindergarten, first grade, and second through sixth grades. The properties of phonemic awareness instruction included the number of phonemic awareness skills taught i.e., single, two, or three or more and manner of instructional delivery i.e., individual, small group, or classroom.

The results of the meta-analyses showed that phonemic awareness instruction increases phonemic awareness and facilitates reading and spelling acquisition. It was

also shown that the effectiveness of phonemic awareness instruction is influenced by some of the variables that differed across studies. For example, the transfer of phonemic awareness instruction to reading and spelling was found to be influenced by reader ability. Transfer effects for reading were statistically larger for younger at risk readers (*d* = 0.86) than for normally achieving (*d* = 0.47) and older disabled readers (*d* = .45). The impact of phonemic awareness instruction on reading for preschoolers was especially large (*d* = 1.25). These findings indicate that phonemic awareness instruction benefited the reading achievement of all three groups, with younger groups benefiting more than the others. Transfer effects for spelling were large and similar for at risk (*d* = 0.76) and normally achieving readers (*d* = 0.88) but were small and not statistically significant for disabled readers (*d* = 0.15). These findings indicate that while phonemic awareness instruction benefited the spelling achievement of at risk and normally achieving readers it had no significant impact on the spelling achievement of disabled readers.

The finding that phonemic awareness instruction benefits reading and spelling achievement does not support the view of phonemic awareness as a simple consequence of reading and spelling development. Instead, the results of the experimental training studies provide evidence that phonemic awareness plays a causal role in early reading and spelling development. However, evidence from another group of experimental studies reveals that the relationship between the skills runs in the opposite direction as well (Byrne, 1992; Ehri, 1979, 1993**;** Morais, Alegria, & Content, 1987; Williams, 1984).

The acquisition of reading and spelling skill, within an alphabetic orthography, appears to influence the development of phonemic awareness (Byrne & Fielding-Barnsley, 1993; Ehri & Wilce, 1980, 1987a; Hohn & Ehri, 1983; Mann, 1986**;** Santoro,

Coyne, & Simmons, 2006; Share et al., 1984; Perfetti et al., 1987; Perin, 1983). When children receive early reading and spelling instruction, they are trained in procedures that draw attention to the individual phonemes in words. For example, in order to decode unfamiliar words children are taught to pronounce the individual sounds represented by letters in spellings and to blend these sounds into a recognizable word. In addition, during early writing instruction children are taught to identify the individual sounds in spoken words in order to select letters corresponding to these sounds to write words.

Byrne & Fielding-Barnsley (1993) evaluated an instructional program (Byrne & Fielding-Barnsley, 1991) which attempted to increase kindergartners' phonemic awareness by teaching them to classify words based on shared sounds – phoneme identity. One year after the end of the program, only the children who were good readers and spellers could successfully delete phonemes from initial consonant clusters. It was concluded that the children had acquired this particular phonemic awareness skill as a result of developing skilled reading and spelling ability.

Children's understanding of the phonemic structure of spoken words is influenced by their developing knowledge of the English orthographic system (Ehri & Wilce, 1980; Perin, 1983). It has been demonstrated that children draw upon their knowledge of the conventionally correct spellings of words during their attempts at phonemic segmentation. Children who know the correct spelling of a word will often use the number of letters in the word's spelling in order to determine the number of phonemes in the word's pronunciation (Tunmer & Nesdale, 1982). According to Perin (1983), both good and poor spellers are able to use their knowledge of English orthography during phonemic segmentation tasks. She found that more segmentation errors were made, by

both good and poor spellers, when there were more letters than phonemes in words than when there were equal numbers of letters and phonemes in words. Ehri (1993) suggests that this is because children have retained the spellings of words in memory by connecting graphemes to phonemes. As a result, spellings influence how readers conceptualize the phonemic structure of words.

Ehri and Wilce (1980) found that children who knew the correct spellings of the words 'pitch' and 'rich' segmented 'pitch' into four phonemes and distinguished /t/ but they segmented 'rich' into three phonemes that did not distinguish /t/. Their segmentations were not simply a result of counting the number of letters in the words. Children had to produce sounds as part of the segmentation response, and they did not separate the digraph CH into two sounds but pronounced only one sound. According to Ehri and Wilce (1980), one phoneme was distinguished because both letters were secured to this single phoneme in memory.

In conclusion, evidence supports the view that the relationship between phonemic awareness and early reading and spelling is bi-directional and reciprocal in nature. An examination of the literature in this area shows that prereaders who possess greater phonemic awareness excel in early reading and spelling development, and that instruction aimed at increasing phonemic awareness facilitates early reading and spelling development. In addition, research shows that the processes involved in the development of skilled reading and spelling enhance the development of phonemic awareness.

Phonemic Awareness and the Alphabetic Principle

The relationship between phonemic awareness and early reading and spelling development results from the crucial role that phonemic awareness plays in the

acquisition of the alphabetic principle (Adams, 1990; Blachman, 2000; Snow et al., 1998). Discovery of the alphabetic principle is considered to be the first major challenge faced by beginning readers of any alphabetic language. Within an alphabetic orthography, the spellings of printed words are created from letters that systematically represent the phonemes in the corresponding spoken words. Once beginning readers acquire insight into the alphabetic principle they are able to understand how the sounds in spoken words are systematically represented by the letters in written words.

While English is an alphabetic orthography, a direct one to one correspondence does not always exist between the letters in word spellings and the phonemes in word pronunciations. Learning to read and spell in English requires that children deal with a variety of complexities not found in more transparent writing systems. The present study does not address the more complex aspects of the English orthographic system. Instead children were taught to create phonetic spellings by mapping the appropriate alphabet letters to the sounds they heard in word pronunciations.

A combination of phonemic awareness and letter knowledge is necessary in order for young children to acquire insight into the alphabetic principle (Byrne & Fielding-Barnsley, 1989, 1990; Griffith & Klesius, 1992). In turn, phonemic awareness and an understanding of the alphabetic principle provide children with the foundation necessary for the development of skilled reading and spelling ability (Liberman & Shankweiler, 1985; Perfetti, 1985; Rozin & Gleitman, 1977). When beginning readers possess phonemic awareness skill they are able to attend to and manipulate the individual sounds in spoken words. Once beginning readers possess an understanding of the alphabetic principle, they are able to use their letter-sound knowledge in order to map the letters in

written words onto corresponding sounds in spoken words. In this way, the two skills support the development of the early decoding and spelling skill necessary for the development of skilled word recognition and text comprehension.

Evidence supporting the view that phonemic awareness plays an important role in children's acquisition of the alphabetic principle comes from both correlational and experimental training studies (Bradley & Bryant, 1983; Byrne & Fielding-Barnsley, 1989; Griffith & Klesius, 1992; Jorm & Share, 1983; Juel et al., 1986; Tunmer & Nesdale, 1985; Tunmer et al., 1988). Two correlational studies that examined the relationship between children's level of phonemic awareness skill and their understanding of the alphabetic principle were conducted by Tunmer & Nesdale (1985) and Tunmer et al. (1988). In both studies, pseudoword decoding was used in order to measure children's knowledge of the alphabetic principle. Skilled pseudoword decoding requires both phonemic awareness skill and knowledge of the letter-sound correspondences. Tunmer and Nesdale (1985) measured phonemic segmentation ability and reading achievement at the end of first grade, after the children had received some formal reading instruction. In a second study, Tunmer et al., (1988) measured the phonemic segmentation ability of nonreaders at the beginning of first grade and again at the end of first and second grades. Pseudoword decoding ability was also measured at the end of first and second grades.

The two studies reported very similar findings. Tunmer and Nesdale (1985) found a significant positive correlation (r =.49) between phonemic segmentation and pseudoword decoding ability at the end of first grade. All the children who passed the pseudoword decoding task passed the segmentation task and all the children who failed

the segmentation task failed the pseudoword decoding task. The Tunmer et al. (1988) study found a significant positive correlation (r =.44) between the two skills at the end of first grade. Children who demonstrated lower levels of phonemic segmentation ability consistently demonstrated lower levels of pseudoword decoding ability. The results of both studies indicate that beginning readers must possess some level of phonemic awareness skill in order to develop an understanding of the alphabetic principle.

Byrne and Fielding-Barnsley (1989) performed a series of training experiments designed to investigate the types of knowledge required in order for nonreaders to demonstrate an understanding of the alphabetic principle. Children were considered to have acquired insight into the alphabetic principle when they demonstrated the understanding that the sounds in words could be represented by letters and that the same letter represents the same sound regardless of the sound's position in a word. Throughout the training experiments, children received instruction designed to increase both phonemic segmentation skill and knowledge of letter-sound correspondences. As a whole, results of the training experiments indicated that both phonemic awareness and knowledge of letter-sound correspondences were necessary in order for nonreaders to develop an understanding of the alphabetic principle.

Contribution of Phonemic Awareness to Word Reading and Spelling Development

Beginning readers of an alphabetic orthography can employ a number of different strategies in order to read words (Ehri, 1994). The strategies used in order to read unfamiliar words include prediction, analogy, and decoding while familiar words are read from memory. The effective use of all of these strategies is dependent on the reader possessing phonemic awareness, insight into the alphabetic principle, and knowledge of

letter-sound correspondences. Reading an unfamiliar word by prediction involves combining partial letter cues from the word's spelling with context cues from the surrounding text in order to determine the word's identity. In order to use prediction, a beginning reader must be able to match a few of the letters in the written word with a few of the sounds in the possible pronunciation. Reading an unfamiliar word by analogy involves recognizing that the unfamiliar word contains a spelling pattern that is similar to the spelling pattern contained in a familiar word. For example, reading 'catch' by recognizing its similarity to 'match'. In order to use analogy, a beginning reader must be able to segment both spelling and pronunciations of familiar and unfamiliar words into smaller units such as onset-rime segments.

Reading an unfamiliar word by decoding involves sounding out each grapheme in the word's spelling and then blending the sounds to produce a recognizable pronunciation. Beginning readers can also decode words by pronouncing larger spelling patterns within a word and then blending these larger sound units into a recognizable pronunciation. When readers become skilled decoders they are able to accurately and consistently identify unfamiliar words. Each successful decoding of an unfamiliar word provides beginning readers with the opportunity to fully analyze the relationship between all the letters in the word's spelling and the sounds in the word's pronunciation. After several successful decoding attempts, an unfamiliar word becomes a sight word and no longer needs to be decoded when it is encountered.

Familiar words are read from memory and any word that can be read from memory is considered to be a sight word. Sight words are secured in memory through the connections that are made between the letters in the written word and the sounds in

the word's pronunciation (Ehri, 1980, 1992; Ehri & Wilce, 1987b; Rack, Hulme, Snowling, & Wightman, 1994; Reitsma, 1983). When a reader encounters a word that is part of their sight word vocabulary, information regarding the word's spelling, pronunciation, and meaning is automatically accessed in memory. A reader's sight word vocabulary supports the speed and accuracy of word recognition necessary for successful text comprehension.

The strategies used in order to spell words are similar to those used in order to read words (Ehri, 1997). Unfamiliar words can be spelled by invention or by analogy and familiar words are spelled from memory. Spelling an unfamiliar word by invention, requires that children segment words into their constituent sounds and then match the appropriate letters to the sounds (Griffith, 1991). When children invent spellings they create spellings that may be phonetically accurate but not conventionally correct. Young children lack the orthographic knowledge required to produce conventionally correct spellings of words so they rely on their phonemic awareness and knowledge of letter-sound correspondences in order to invent phonetic spellings of words (Read, 1975). Because of this, phonemic awareness may play an even more important role in early spelling than it does in early reading (Perin, 1983; Snowling & Hulme, 1991).

Spelling an unfamiliar word by analogy requires that children retrieve from memory the spelling of a familiar word with a similar pronunciation to that of the unfamiliar word. Children must be able to recognize the shared spelling pattern and then determine which letters differ between the two words. Spelling by analogy requires that children are able to segment pronunciations into onset and rhyme units as well as recognize the similarities and differences between words.

Familiar words are spelled by retrieving the conventionally correct spelling of the word from memory. The conventionally correct spellings of words are secured in memory by the connections between sounds in the word's pronunciation and letters in the word's spelling. These connections are made through repeated successful attempts at reading and spelling a word.

The use of phonemic information during spelling tasks can be seen in the spelling errors of beginning readers (Bryant & Bradley, 1980; Read, 1975). Two types of spelling errors, phonetic and non-phonetic, have been identified. Phonetic spelling errors preserve the sound structure of the target word. For example, the word 'cake' spelled as 'kak'. Non-phonetic spelling errors bear no relationship to the sound structure of the target word. For example, the word 'cake' spelled as 'dngb'. Frith (1980) proposed that young spellers make non-phonetic spelling errors because they lack phonemic segmentation skill. These children are unable to determine the letters that correspond to the phonemes in words because they cannot accurately segment words into their constituent phonemes.

In sum, it is apparent from the above descriptions that the ability to segment pronunciations of words into subsyllabic and phonemic units is central to the various ways that words are read and spelled. In the present study two forms of phonemic awareness instruction were developed in an effort to strengthen the transfer effects of phonemic segmentation training on the reading and spelling ability of beginning readers. One form of phonemic awareness instruction incorporated letter-sound training with training in phonemic segmentation. The other form of phonemic awareness instruction incorporated letter-sound and articulation training with training in phonemic segmentation. It was expected that both the letter and the articulation training would

facilitate beginning readers' ability to form the letter-sound/sound-letter connections necessary for the development of skilled reading and spelling ability.

Phonemic Awareness Instruction

Because of the important role played by phonemic awareness during early reading and spelling development and the difficulty of acquiring phonemic awareness without explicit instruction, it is important to develop effective instructional programs aimed at fostering phonemic awareness in beginning readers. It is generally agreed that phonemic awareness can be increased through training and that phonemic awareness instruction can transfer to reading and spelling achievement (Ehri et al., 2001).

A number of experimental training studies have demonstrated that children as young as preschool and kindergarten benefit from training aimed at fostering phonemic awareness (Ball & Blachman, 1991; Bradley & Bryant, 1983; Byrne & Fielding-Barnsley, 1991; Castiglioni–Spalten & Ehri, 2003; Cunningham, 1990; Ehri & Wilce, 1987a; Fox & Routh, 1984; Hohn & Ehri, 1983; Lundberg et al., 1988; Ryder et al., 2008; Santoro et al., 2006; Vadasy, Sanders, & Peyton, 2006). The National Reading Panel's meta-analysis (Ehri et al., 2001) examined the effect of phonemic awareness instruction across the grade levels – preschool, kindergarten, first grade, and second through sixth grades. According to the results of the meta-analysis, the two groups who started with the least phonemic awareness, the preschoolers and kindergartners, demonstrated the greatest gains in phonemic awareness. It is important to note that while the effect size for the phonemic awareness outcomes of preschoolers was large (d = 2.37), the value's reliability is low because it was created from only two comparisons. The effect size for the phonemic awareness outcomes of kindergartners (d = 0.95) involved

more comparisons (N = 39) and was statistically larger than for both first graders (*d* = 0.48) and second – sixth graders (*d* = 0.70).

According to an analysis of the reading outcomes, all the grade levels benefited significantly from phonemic awareness instruction. The effect sizes for kindergartners, first graders, and second through six graders (*d* = 0.48 – 0.49) were all statistically significant but did not differ statistically from each other. The effect size for preschoolers (*d* = 1.25) was statistically larger than for the other grades, showing that they received the greatest gains.

The studies which included preschoolers did not measure the transfer of phonemic awareness instruction to spelling. An analysis of the spelling outcomes for the other grade levels shows that kindergartners (*d* = 0.97) received the greatest benefit from phonemic awareness instruction followed by that of first graders (*d* = 0.52). There was no transfer to spelling for second through six graders (*d* = 0.14).

In the present study, the participants were preschoolers who received phonemic awareness instruction. The effectiveness of this training was assessed with phonemic awareness posttests. In addition, transfer to sight word reading and developmental spelling tasks were assessed following training. Based on previous studies, it was expected that effect sizes would be large when trained children were compared to children who did not receive this training.

Despite evidence supporting the beneficial effects of providing beginning readers with instruction aimed at fostering phonemic awareness skill, there is a lack of agreement as to the most effective instructional approaches for optimizing phonemic awareness development and transfer to reading and spelling. This is due to the variety of

instructional variables included in experimental training studies. Two instructional approaches which have received attention from researchers and which are the focus of this dissertation study involve combining phonemic segmentation training with instruction in alphabet letters and articulatory movements.

Phonemic awareness training with alphabet letters. One instructional approach involves combining phonemic segmentation training with children's knowledge of alphabet letters. Both correlational and experimental training studies have consistently demonstrated a link between phonemic awareness and various aspects of children's letter knowledge (Byrne & Feilding-Barnsley, 1989, 1990; Caravolas, Hulme, & Snowling, 2001; Foy & Mann, 2006; Griffith & Klesius, 1992; Mann & Foy, 2003; Share et al., 1984). For example, Griffith and Klesius (1992) found that phonemic awareness and letter name knowledge accounted for 30% of the variance for the implicit understanding of the alphabetic principle and 50% of the variance for the explicit understanding of the alphabetic principle. Standardized regression analysis found that phonemic awareness and letter name knowledge had an equal influence on the implicit understanding of the alphabetic principle. A scatter plot of the relationship between phonemic awareness and letter name knowledge indicated that phonemic awareness is rarely acquired in the absence of letter name knowledge.

The expectation that combining letter knowledge with phonemic awareness training should increase transfer to reading and spelling is suggested by evidence indicating that young children use their knowledge of alphabet letters in order to read words, even at the earliest phases of reading development (Ehri & Wilce, 1985, 1987b; Laing & Hulme, 1999; Rack et al., 1994; Roberts, 2003; Treiman & Rodriquez, 1999).

Ehri & Wilce (1985) investigated the strategies used by children at different reading levels in order to learn to read words. Kindergartners at three different reading levels were taught to read two types of word spellings. The reading levels included prereaders, who could read no words, novice readers, who could read a few words, and veteran readers, who could read several words. The children at each reading level were taught to read two types of word spellings – simplified phonetic and visually distinct. The simplified phonetic spellings involved letters which corresponded to the sounds in the words' pronunciations. The visually distinct spellings involved letters which were visually distinct but had no correspondence to the sounds in the words pronunciations. The results demonstrated that prereaders were better at learning to read the visually distinct spellings than were the novice and veteran readers. In contrast, the novice and veteran readers were better at learning to read the simplified phonetic spellings than were the prereaders. This finding supports the view that children shift from a visual word reading strategy to a phonetic word reading strategy early in their reading development. This shift from the use of visual information to the use of phonetic information during word learning is dependent on children acquiring some knowledge of letter-sound correspondences.

Ehri (2005) proposed that children pass through four phases of word reading on the way to developing sight word reading ability. Each phase is characterized by the amount of alphabetic knowledge available for children to use during word reading. The phases are pre-alphabetic, partial alphabetic, full alphabetic, and consolidated alphabetic. During the pre-alphabetic phase, children remember how to read words by making connections between some salient visual features of a word and the word's meaning or

pronunciation. Word reading at this phase does not involve the use of letter-sound correspondences.

As early as the partial alphabetic phase, young children remember how to read a word by forming connections between a few of the letters in a word's spelling and some of the sounds in the word's pronunciation. This is known as phonetic cue reading. In the full alphabetic phase, children remember how to read words by forming connections between all the letters in a word's spelling and all the sounds in the word's pronunciation. Once children reach this phase they are able to accurately decode unfamiliar words. In the consolidated alphabetic phase, children use their knowledge of the common spelling patterns that occur across words in order to facilitate sight word reading.

Phonemic awareness training does not need to involve alphabet letters in order to have a positive effect on the development of phonemic segmentation, reading and spelling ability (Cunningham, 1990; Fox & Routh, 1984; Lundberg et al., 1988; Torneus, 1984; Treiman & Baron, 1983). However, evidence indicates that using letters during phonemic awareness training facilitates the acquisition of phonemic segmentation skill and the transfer to reading and spelling above that of phonemic awareness training that does not include letters (Ehri et al., 2001; Hohn & Ehri, 1983). The National Reading Panel's (Ehri et al., 2001) meta-analysis found that phonemic awareness instruction which involved alphabet letters resulted in greater increases in phonemic awareness, reading, and spelling skill than did phonemic awareness training in which children were taught to manipulate phonemes without letters.

Several studies have examined the effect of using letters in order to mark the phonemes in words during segmentation training (Bradley & Bryant; 1983; Ehri &

Wilce, 1987a; Fuchs, Fuchs, Thompson, Al Otaiba, Yen, Yang, Braun, & O'Connor, 2001; Hohn & Ehri, 1983; Uhry & Shepherd, 1993). Hohn and Ehri (1983) compared phonemic segmentation training in which letters were used in order to mark the sound units of words with phonemic segmentation training in which blank markers were used in order to mark the sound units of words. At the end of training, children who were taught to use letters in order to segment words demonstrated greater increases in phonemic segmentation ability than did children who were taught to use blank markers.

Another study, conducted by Ehri and Wilce (1987a), investigated the effects of training kindergarten students to create phonetic spellings of words. Children who received spelling training demonstrated greater phonetic cue reading ability than did children who received training in letter-sound correspondences alone. Spelling training also resulted in increased phonemic segmentation and spelling recognition skill.

Santoro et al (2006) provided kindergartners with phonological awareness instruction combined with training in letter-sound correspondences and the reading of decodable CVC words. One instructional group received additional instruction in writing and spelling and the other instructional group received additional instruction aimed at increasing vocabulary and comprehension. The spelling group outperformed the storybook and control groups on the spelling, word attack and nonword reading posttest measures.

The use of alphabet letters in order to mark the phonemes in words during segmentation training may facilitate the development of phonemic awareness because alphabet letters are visible, concrete representations of the transient sounds that make up spoken words. Letter markers may aid children in holding phonemic segments in

memory and in inspecting and manipulating them during training (Lindamood & Lindamood, 1998). Hohn & Ehri (1983) proposed that being able to refer to letters during segmentation training may help children develop a clearer understanding about the size of the sound units which represent phonemes.

Combining phonemic awareness instruction with explicit instruction in letter-sound correspondences has also been found to have a beneficial effect on phonemic awareness, reading and spelling ability (Ball & Blachman, 1991; Bradley & Bryant, 1983; Byrne & Fielding-Barnsley, 1991, 1993; Castle, Riach & Nicholson, 1994; Hatcher et al., 1994; Ryder et al., 2008; Santoro et al., 2006; Vadasy et al., 2006). In fact, instruction that combines the two types of training results in greater increases in phonemic awareness, reading and spelling than does either type of training alone. Ball & Blachman (1991) found that providing kindergarten students with training in phonemic awareness, letter names and letter- sound correspondences resulted in significant increases in early reading and spelling skill compared to providing letter instruction alone. In addition, providing letter instruction alone did not result in significant increases in phonemic awareness, reading and spelling skill compared to the no treatment control condition.

Hatcher et al. (1994) conducted a longitudinal intervention study within the context of regular classroom instruction. Seven year old poor readers were randomly assigned to one of four conditions – reading with phonology, reading alone, phonology alone, and no treatment control. The phonology alone group demonstrated the greatest increase in phonemic awareness but the reading with phonology group demonstrated the greatest increase in reading and spelling ability. The findings indicate that phonemic

segmentation instruction may have the greatest impact on reading and spelling skill when it occurs in the context of instruction aimed at increasing knowledge of letter-sound correspondences.

Instruction in letter-sound correspondences may facilitate children's attempts to segment words into their constituent phonemes through its impact on the nature of children's phonological representations (Treiman & Bourassa, 2000). The possibility of a relationship between phonological representations and phonemic awareness has been proposed within a number of theories (Elbro, Borstrom, & Petersen, 1998; Metsala & Walley, 1998; Snowling, Hulme, Smith & Thomas, 1994). As children learn letter-sound correspondences their phonological representations may become more segmental and phonemic in nature. In addition, children's phonological representations may become linked to the letters that are used to create written words.

In conclusion, phonemic segmentation instruction that makes explicit the connection between the phonemic structure of words and the alphabet letters which represent phonemes may aid children in making the transition from spoken to written language. Cunningham (1990) found that phonemic segmentation instruction that explicitly taught young children about the value, application and utility of phonemic awareness for reading resulted in greater transfer to reading than did simply teaching children to segment and blend phonemes. Instructional activities, such as the use of letter markers in order to create phonemic spellings of words, serve the purpose of placing phonemic segmentation skill into the context of early reading and spelling tasks. This study incorporated training in letter-sound correspondences and the use of letters as markers within both phonemic awareness training conditions.

Phonemic awareness training with articulatory movements. Another instructional approach involves combining phonemic awareness instruction with training aimed at teaching children to attend to their articulatory movements during speech (Lindamood & Lindamood, 1998). Specifically, children are taught to attend to the shape and position of their mouth, lips, and tongue as they articulate specific phonemes. Mirrors and mouth pictures are used during training in order to allow children to examine and manipulate their mouth movements.

There are theoretical reasons for believing that teaching children to be aware of their articulatory movements during phonemic awareness instruction may facilitate the acquisition of phonemic segmentation skill and transfer to reading and spelling. It has been proposed that phonemes are perceived based on the articulatory movements by which they are produced not based on the sounds that are produced by the articulatory movements (Liberman, 1999; Liberman & Mattingly, 1985; Liberman & Shankweiler, 1985; Liberman et al., 1967). Phonemes which are adjacent to one another within the speech flow share acoustic information. Because of this, the sound of each individual phoneme is context dependent and will vary based on the phoneme's position within the speech flow and on the other phonemes which surround it. This means that each time a phoneme is produced during speech it can be represented by a slightly different sound. In contrast, individual phonemes are produced by a specific set of articulatory movements regardless of the surrounding context.

Massaro and Chen (2008) challenged the view that speech perception is rooted in motoric behavior at the phonemic level. They proposed that the articulatory movements used to create a specific phoneme can vary as much or more than the sound that is created

for that phoneme. In fact, vocal tract imaging and tracking techniques used to examine American speakers' production of the phoneme, /r/, demonstrated that a variety of different tongue shapes can be used to produce a recognizable /r/ sound (Nieto-Castanon, Guenther, Perkell, & Curtin, 2005). Massaro and Chen (2008) proposed that the open syllable (V, VC and CV) acts as a more invariant perceptual unit than the phoneme. This is based on the consistent coarticulation of the phonemes that make up the open syllable rather than on the articulatory movements involved in the production of the phonemes that make up the open syllable.

However, a recent experimental study has provided partial support for the view that the articulatory movements used to create phonemes contribute to the perception of those phonemes (D'Ausilio, Pulvermuller, Salmas, Bufalari, Begliomini & Fadiga, 2009). Transcranial magnetic stimulation was used to examine the role of the motor cortex during speech perception. The areas of the motor cortex controlling the lips (LipM1) and the tongue (TongueM1) were stimulated while participants completed a phoneme discrimination task. The four phonemes involved in the task were /b/ and /p/, labial sounds involving lip movements and /d/ and /t/, dental sounds involving tongue movements. The study demonstrated that lip-articulated phonemes were identified faster than tongue-articulated phonemes when the LipM1 area was stimulated and tongue-articulated phonemes were identified faster than lip-articulated phonemes when the TongueM1 was stimulated. These findings provide support for the view that the motor cortex makes a specific contribution to speech perception. However the researchers proposed that this contribution occurs as part of a larger network.

Based on the view that articulatory movements are involved in the perception of phonemes, it makes sense to propose that training children to attend to the articulatory gestures used in order to produce phonemes during speech should have positive benefits for the development of phonemic segmentation, reading, & spelling skill (Liberman & Mattingly, 1985). Training preschoolers to attend to the articulatory movements that are used to create specific phonemes may impact the quality of the phonological representations held by these children. Articulatory training may foster the development of a representational system that is phonemic in nature and which supports children's attempts to segment words into phonemes. Knowledge of the articulatory movements that are used to create specific phonemes may also provide children with information that helps them determine the boundaries between the phonemes in words.

Articulatory awareness training may benefit reading by facilitating the connection forming process believed to be necessary for sight word reading. Ehri (1992) has proposed that sight words are stored in memory based on phonetic representations that are constructed from the connections formed between the letters in a word's spelling and the sounds in a word's pronunciation. If the articulatory movements used to produce the sounds in words provide the basis for these phonetic representations, then increasing beginning readers' ability to attend to their articulatory movements should strengthen their ability to make the connections necessary for sight word learning.

Several studies have found evidence indicating that pre- and beginning readers, who have not received articulation training, may attend to the place of articulation of phonemes during word learning tasks (Rack et al., 1994; Laing & Hulme, 1999). A training study conducted by Rack et al. (1994) investigated the early word learning of

beginning readers. Young children, who were unable to decode CVC words, were taught to read two types of cue word spellings for each target word in a series. The two cue word spellings of each target word differed from the phonetic spelling of the target word by only one letter. For the phonetic cue spellings, the letter that differed was phonetically similar to the letter it replaced in the phonetic spelling of the target word. For the control cue spelling, the letter that differed was phonetically dissimilar to the letter it replaced in the phonetic spelling of the target word. For example, the phonetic cue spelling for the word *beaver* was *bfr* and the control cue spelling was *bzr*. The beginning readers in the study had more success in associating the phonetic cue spelling with the target word than in associating the control cue spelling with target word.

Examinations of young children's invented spellings have indicated that beginning readers can use articulatory information to inform their attempts to create phonetic spellings of words (Read, 1971, 1975; Treiman, 1985). Beginning readers are able to use their letter name knowledge in order to gain articulatory information that aids them in creating invented spellings of words (Read, 1971; 1975). In addition, analyses of children's spelling errors demonstrated that the place of articulation tends to be preserved within children's spelling errors (Treiman, 1985).

While there is theoretical support for the view that articulation training can increase the beneficial effects of phonemic awareness instruction, experimental training studies have provided conflicting evidence as to the effectiveness of combining the two types of instruction. Several studies have examined the effects of providing phonemic awareness training with or without articulation training and have found no significant difference between the groups on measures of phonemic awareness and reading (Olson,

Wise, Ring, & Johnson, 1997; Wise, Ring, & Olson, 1999; Wise, Ring, Sessions, & Olson, 1997). However, it is important to point out that these studies involved older reading disabled children (2^{nd} to 5^{th} grade) and therefore the findings may not apply to younger or normally achieving readers. In addition, it is difficult to determine the exact contribution that the articulation training may have made to participant's reading and spelling development due to the variety of instructional elements included within these studies

In contrast, studies involving younger participants have demonstrated the beneficial effects of combining phonemic awareness instruction with articulation training for phonemic awareness, reading and spelling skill (Castiglioni-Spalten & Ehri, 2003; Ehri & Sweet, 1991). Ehri and Sweet (1991) used articulatory pictures in order to teach kindergarten students to segment words into phonemes. The study found that the articulation training increased children's phonemic awareness ability. Castiglioni – Spalten & Ehri (2003) compared segmentation training involving the manipulation of blocks with segmentation training involving attention to articulatory movements and found that both methods helped beginning readers acquire segmentation and spelling skill. However, only segmentation plus articulation training was found to result in increased sight word reading skill.

In conclusion, there is both theoretical and research evidence supporting the importance of providing beginning readers with phonemic awareness instruction combined with instruction that aids children in forming the connections between the sounds in spoken language and both the articulatory gestures used to produce these sounds and the alphabet letters used to represent these sounds. However, more research

is needed in order to determine the separate contributions made by letter knowledge and articulatory awareness, in the context of phonemic segmentation training, for the development of phonemic awareness, reading and spelling skill. This was the primary purpose of this dissertation study.

Chapter 3

Rationale and Hypotheses for the Study

The present study is a replication and extension of a study performed by Castiglioni-Spalten and Ehri (2003) in which kindergartners were taught to attend either to articulatory movements or to sounds as they manipulated blocks during phonemic awareness training. Castiglioni-Spalten and Ehri (2003) hypothesized that both types of phonemic awareness training would improve novice readers' ability to read and spell compared to students not receiving training. However, it was expected that teaching novice readers to attend to articulatory movements would result in a greater ability to read and spell words than teaching readers to attend to sounds.

The kindergartners (N = 45) who participated in the Castiglioni-Spalten and Ehri (2003) study were in the partial alphabetic phase of word reading (Ehri, 2005) as indicated by their having limited phonemic awareness and little if any decoding skill. The kindergartners who qualified to participate in the study were matched to form triplets, based on similar scores on the segmentation, word reading, and vocabulary pretests. The members of each triplet were randomly assigned to each of the three conditions: the mouth (articulatory) treatment condition, the ear (sound) treatment condition, or the no treatment control condition. The kindergartners who participated in the mouth treatment condition were taught to associate their mouth movements with eight mouth pictures representing 16 target sounds. The children were then taught to pronounce the individual phonemes in a series of two, three and four phoneme words and pseudowords and to select the appropriate mouth picture that corresponded to each phoneme. The kindergartners who participated in the ear treatment condition were taught

to pronounce the individual phonemes in the same series of words and pseudowords and to represent each phoneme with a wooden block. The kindergartners in the no treatment control condition remained in the regular classroom.

Both treatment conditions involved one pretest session, three to six training sessions, an one-day posttest session and a seven-day posttest session. All training and testing was individually administered to participants. All the sessions lasted between 20 and 30 minutes. The one-day posttest took place on the day after the last training session and the seven-day posttest took place one week later.

The tasks administered during the posttest sessions included a phoneme segmentation task, a decoding pseudowords task, an invented spelling task, and a word reading task. The modified Yopp (1988) segmentation task was administered during both the one-day and seven-day posttest sessions in order to assess the effect of the two types of phonemic awareness training on children's ability to segment words into their constituent phonemes. The procedures employed during the posttest segmentation task differed from the procedures employed during the phonemic awareness training. This was done for the purpose of examining whether children were able to generalize the construct of phoneme segmentation from the phonemic awareness training to the novel posttest phoneme segmentation task. The one-day posttest segmentation task involved 15 words – one VC, two CV, eight CVC and four words containing consonant clusters. The seven-day posttest segmentation task involved 14 words – one VC, two CV, seven CVC and four words containing consonant clusters. All the words in both word lists were constructed from the sounds encountered during training. The experimenter pronounced each word and the children attempted to pronounce each phoneme in the word. During

the seven-day posttest, children who correctly segmented the first word were not required to segment any more of the words. The phoneme segmentation task was scored based on the total number of phonemes segmented correctly.

The pseudoword decoding task was administered during the one-day posttest session in order to assess the effect of the two types of phonemic awareness training on children's ability to decode unfamiliar letter strings. In order to successfully decode nonwords children must be able to pronounce the appropriate sound for each letter in the nonword's spelling and to blend the sounds into an accurate pronunciation. During the pseudoword decoding task, children were asked to read five CVC pseudowords constructed from the sounds encountered during training. The pseudoword decoding task was scored based on the total number of correct responses.

The invented spelling task was administered during both the one-day and seven-day posttest sessions in order to assess the effect of the two types of phonemic awareness training on children's ability to invent phonetic word spellings. In order to successfully invent phonetic word spellings children must be able to break word pronunciations into their constituent phonemes and to match the appropriate letter to each phoneme. The word list for the invented spelling task consisted of five words and two nonwords. All of the words on the list included consonant clusters and were constructed from the sounds encountered during training. During the invented spelling task, children were instructed to write either the correct spellings or the sounds they heard for each word. The experimenter pronounced each word and said the word in a sentence. The child repeated the word and then wrote the word. The task was scored based on the total number sounds represented phonetically.

The word reading task was administered during both the one-day and seven-day posttest sessions in order to assess the effect of the two types of phonemic awareness training on children's word reading ability. According to Ehri (1995), children progress through four phases on their way to developing sight word reading ability. Each of the phases is characterized by the amount of alphabetic knowledge children are able to use during word reading. In order to participate in the Castiglioni-Spalten and Ehri (2003) study children were required to be in the partial alphabetic phase of word reading at the start of training. Children in the partial alphabetic phase of word reading combine their limited knowledge of letter names and sounds with their limited phonemic segmentation ability in order to read words. At this phase children remember how to read words based on connections formed between only a few of the letters in a word's spelling and some of the sounds in the word's pronunciation. This is known as phonetic cue reading and results in frequent misreadings of words with similar spellings. Children move into the full alphabetic phase of word reading as their knowledge of letter-sound correspondences becomes more complete and their ability to segment words into their constituent phonemes becomes more sophisticated. At this phase children remember how to read words based on connections formed between all the letters in a word's spelling and all the sounds in the word's pronunciation. This allows children to accurately decode unfamiliar words and results in consistently correct word reading. A major question addressed in the Castiglioni-Spalten and Ehri (2003) study involved whether either form of phonemic awareness training would be sufficient to move children from the partial alphabetic to the full alphabetic phase of word reading.

The word list employed during the one-day posttest word reading task was constructed of eight words each of which began with /s/. The word list employed during the seven-day posttest word reading task was constructed of eight words each of which began with /f/. The words for both lists were constructed from the sounds encountered during training and many of the words contained consonant clusters. During the first trial the experimenter read each word to the children, used the word in a sentence, and had the children repeat the word. During the next five trials the experimenter presented the word to the children and the children attempted to read the word. If the children read the word incorrectly the experimenter read the word to them. The task continued for five trials or two perfect trials. The word reading task was scored based on the total number of correct responses and on the total number of correct or incorrect responses that share at least two sounds with the target word. The latter score provides a measure of phonetic cue reading.

The results of the study demonstrated that both types of phonemic awareness training were effective for increasing children's phonemic segmentation and spelling ability. However, only when children were trained to attend to their articulatory movements during phonemic segmentation training did phonetic cue reading ability increase significantly. It was suggested that attending to articulatory movements may facilitate the process of making connections between the letters in spellings and the sounds in pronunciations that allows written words to be secured in memory.

Pilot Study

A pilot study was conducted in order to inform the present dissertation study. The pilot study extended the Castiglioni-Spalten and Ehri (2003) study by investigating the effect that combining phonemic segmentation training with letter training and articulation

training would have on beginning reader's phonemic awareness, reading, and spelling development. The pilot study compared two types of phonemic awareness instruction. The letter manipulation only condition involved providing kindergartners with phonemic segmentation training combined with instruction in letter-sound correspondences. The letter plus articulation condition involved providing kindergartners with phonemic segmentation training combined with instruction in letter-sound correspondences and articulatory movements.

Both of the instructional conditions examined within the Castiglioni-Spalten and Ehri (2003) study were equally effective for increasing kindergartners' ability to invent phonetic word spellings despite the fact that neither condition involved letter training. The researchers proposed that the children in their study may have combined letter knowledge they possessed at the start of the study with segmentation training they received during the study in order to invent phonetic word spellings. In an effort to strengthen the transfer effects of phonemic segmentation training on children's ability to create phonetic word spellings, both training conditions in the pilot study received explicit instruction in letter-sound correspondences and the use of letters as sound markers. It was expected that combining phonemic segmentation instruction with letter training would make explicit for children the connection between the sounds in word pronunciations and the letters used to represent these sounds in word spellings.

The results of the Castiglioni-Spalten and Ehri (2003) study demonstrated that only articulation training resulted in increased levels of phonetic cue reading ability for the children who participated in their study. One possible explanation for this finding is that the articulation training provided during the study supported phonetic cue reading by

increasing children's ability to form connections between the letters in word spellings and the sounds in word pronunciations. It was expected that incorporating letter training into phonemic segmentation instruction in the pilot study would strengthen transfer to reading even more by facilitating beginning reader's ability to use letter cues in learning to read words. It is possible that letter training and articulatory training may make separate, independent contributions to the word learning processes of beginning readers. If this is true, then both instructional conditions should result in increased phonetic cue reading ability. However, letter plus articulation training should result in greater increases in phonetic cue reading ability than letter training alone.

Another possible explanation for the effect of articulation training on word reading ability is that teaching children to attend to their articulatory movements may facilitate phonetic cue reading through its effect on phonological memory. Articulation training may enhance phonological memory and in turn phonological memory may play an important role in word reading. In order to examine the possible effect of articulation training on phonological memory, The Children's Test of Nonword Repetition (Gathercole & Baddeley, 1996) was added to the pilot study as a pre- and posttest measure. If articulation training facilitates the development of phonological memory, then children in the letter plus articulation condition should demonstrate higher scores on the posttest than on the pretest measures of nonword repetition and also higher scores than children in the letter manipulation only condition. Alternatively it is also possible that both articulation and letter training may benefit phonological memory in which case children in both conditions should demonstrate similar scores which are higher on the

posttest measure than the pretest measure of nonword repetition, and also higher than the control group.

The pilot study also attempted to address several limitations of the Castiglioni-Spalten and Ehri (2003) study. One possible limitation involved the length of the instruction provided to children during training. During the study, instruction time was limited to a maximum of six sessions of 20 to 30 minutes in length. The results demonstrated that children who participated in the instructional conditions were able to acquire phonemic awareness within this time frame. However, none of the children was able to attain mastery levels of performance on the phonemic awareness posttests. The pilot study attempted to address this issue by increasing training to seven sessions of 30 minutes in length. It was expected that providing children with more instructional time would result in more children attaining mastery levels of performance on the phonemic awareness posttests. It was also expected that increasing the time spent on the phonemic segmentation training would facilitate greater transfer of segmentation skill to word reading and spelling ability.

Another feature of the Castiglioni-Spalten and Ehri (2003) study which may have prevented children from attaining mastery levels of phonemic awareness performance involved the design of the segmentation training. During segmentation training for both instructional conditions, children were informed of the number of phonemes in each word prior to being asked to segment the word. Informing children of the number of phonemes in words rather than requiring them to determine the number of phonemes may have interfered with the learning process. This issue was addressed within the pilot study through the inclusion of a final word review phase. The word list for this phase was

constructed by mixing two and three phoneme words taken from the previous word lists. During this phase, children were required to determine the number of sounds in each word and to match each sound with the appropriate letters and/or articulatory movements. The word review phase was included in the pilot study in order to strengthen learning and to demonstrate that children were capable of independently segmenting words into their constituent phonemes by the end of training. It was expected that adding this phase to the segmentation training would result in more children attaining mastery levels of performance on the phonemic awareness posttests and demonstrating stronger transfer to reading and spelling.

Another change made to the design of the segmentation instruction involved the word lists which were employed during training. During the Castiglioni-Spalten and Ehri (2003) study, segmentation training involved learning a set of 26 CV and VC words, a set of 32 CVC words, a set of 17 CCV and VCC words and a set of 20 CCVC and CVCC words. Children cycled through each word set until they reached a criterion of eight consecutive words correctly segmented or until they completed six training sessions. Within the pilot study, segmentation training involved ten word sets of five words each. These sets included four sets of 20 CV and VC words, three sets of 15 CVC words, and three sets of 15 CCV and VCC words. Children were required to reach a criterion of each set perfectly segmented twice before they could move on to the next set. The change in the word sets employed during segmentation training was made in order to provide children with greater practice at segmenting words. It was expected that providing children with greater segmentation practice would result in more children

attaining mastery levels of phonemic awareness performance and in stronger transfer to reading and spelling.

Methods. During the pilot study two types of phonemic awareness training were compared. One group of kindergartners was taught phonemic segmentation combined with explicit instruction in letter-sound correspondences and letter manipulation (Letter manipulation only condition). A second group was taught phonemic segmentation combined with explicit instruction in letter-sound correspondences and attention to articulatory movements (Letter plus articulation condition). A third group received regular kindergarten instruction. It was hypothesized that both types of phonemic awareness training would improve novice readers' ability to segment, read and spell. In addition, it was hypothesized that teaching novice readers to both manipulate letters and to attend to articulatory movements during phonemic awareness training would result in a greater ability to segment, read and spell words than would teaching them to segment using letters only.

The kindergartners *(N* = 30) who participated in the pilot study were selected based on their capability for functioning in the partial alphabetic phase of word reading (Ehri, 2005) and on having only limited phonemic awareness and decoding skill. Kindergartners who qualified to participate in the study were matched to form triplets, based on similar scores on the segmentation, word reading, and vocabulary pretests. The members of each triplet were randomly assigned to one of the three conditions: the letter manipulation only condition (LO), the letter plus articulation condition (LPA), or the no treatment control condition.

The kindergartners who participated in the LO condition were taught to associate the 15 target sounds with the corresponding letters. The children were then taught to pronounce the individual phonemes in a series of two, three and four phoneme words and pseudowords and to select the appropriate letter that corresponded to each phoneme.

The kindergartners who participated in the LPA condition were taught to associate their mouth movements with eight mouth pictures representing the 15 target sounds. They were also taught to associate the 15 target sounds with the corresponding letters. The children were then taught to pronounce the individual phonemes in the same series of two, three and four phoneme words and pseudowords used in the letter manipulation only condition and to select the appropriate mouth picture and letter that corresponded to each phoneme.

The kindergartners in the no treatment control condition remained in the regular classroom. They completed all pretests and posttests but received no special training

In both treatment conditions, students completed one pretest session, a maximum of seven training sessions, a one-day posttest session and a seven-day posttest session. All training and testing was administered to participants on an individual basis. All the sessions lasted between 20 and 30 minutes. The one-day posttest took place on the day after the last training session and the seven-day posttest took place one week later.

The tasks administered during the one-day posttest session included a phonemic segmentation task (Yopp, 1988), a developmental spelling task, a sight word learning task, a sight word spelling recall task, a pseudoword reading task, and a nonword repetition task (Gathercole & Baddeley, 1996). The tasks administered during the seven-day posttest session included a sight word memory task, a phonemic segmentation task

(Yopp, 1988), a developmental spelling task, a sight word learning task, and a sight word spelling recall task.

The modified version of the Yopp-Singer segmentation task (Yopp, 1988) was administered during both the one-day and seven-day posttests in order to assess the effect of the two types of phonemic awareness training on children's ability to segment spoken words into their constituent phonemes. The procedures employed during the posttest segmentation task differed from the procedures employed during the phonemic awareness training. This was done for the purpose of examining whether children were able to generalize the construct of phoneme segmentation from the phonemic awareness training to the novel posttest phoneme segmentation task. The phoneme segmentation task consisted of 17 words constructed from the 15 target sounds that children encountered during training. Each word list included two VC, two CV, nine CVC, and one each of CCV, VCC, CCVC, CVCC words. None of the words used during the one-day posttest phoneme segmentation task were repeated during the seven-day posttest phoneme segmentation task. The experimenter said each word and the children attempted to say each phoneme in the word. The phoneme segmentation task was scored based on the total number of words segmented correctly, the total number of sounds segmented correctly and the total number of consonant clusters segmented correctly.

The developmental spelling task was administered during both the one-day and seven-day posttests in order to assess the effect of the two types of phonemic awareness training on children's ability to create phonetic word spellings. In order to create phonetic word spellings children must be able to accurately segment word pronunciations into their constituent phonemes and to match the appropriate letters to these phonemes.

The one-day posttest developmental spelling task consisted of 15 words constructed from the 15 target sounds that children encountered during training. The one-day posttest word list included six CVC, one VCC, two CCV, three CCVC and three CVCC words. None of the words employed during the one-day posttest were repeated during the seven-day posttest. The seven-day posttest developmental spelling task consisted of nine words constructed from the 15 target sounds that children encountered during training. The seven-day posttest word list included three CVC, three CCVC, three CVCC words. The experimenter pronounced each word, used each word in a sentence and asked the children to repeat each word. The children were told to listen to the sounds in each word and to write the letters that say the sounds they heard. The developmental spelling task was scored based on the total number of words spelled phonetically correct, the total number of sounds represented phonetically correct and the total number of consonant clusters represented phonetically correct.

The sight word learning task was administered during the one-day and seven-day posttests in order to assess the effect of the two types of phonemic awareness training on children's word learning ability. A major question for the pilot study involved whether combining letter-sound training and articulation training with phonemic awareness instruction would strengthen transfer to word reading ability enough to move children from the partial alphabetic phase of word reading ability to the full alphabetic phase of word reading. In order to participate in the pilot study children were required to be capable of functioning in the partial alphabetic phase of word reading at the start of training. At this phase children have limited letter knowledge and little phonemic awareness skill. They remember how to read words by making connections between a

few of the letters in a word's spelling and some of the sounds in the word's pronunciation. This is known as phonetic cue reading. Children move into the full alphabetic phase of word reading as their letter-sound knowledge and phonemic awareness skill increases. At this phase children remember how to read words by making connections between all of the letters in a word's spelling and all the sounds in the word's pronunciation. This allows for more consistently correct word reading than does phonetic cue reading.

During both the one-day and seven-day posttest sight word learning tasks children were taught to read a set of eight words constructed from the 15 target sounds that children encountered during training. All of the words on the one-day posttest word list began with /s/ and six of the words contained consonant clusters. On the seven-day posttest word list four words began with /f/ and four words began with /p/. Six of the words on the seven-day posttest word list contained consonant clusters. During the study trial children were shown each word printed in uppercase letters on an index card. The experimenter read each word to the children, used the word in a sentence and had the children repeat the word. A series of test trials occurred one-day following the study trial. The experimenter presented a word card and asked the children to read the word. If the children read the word incorrectly the experimenter read the word to them. Test trials were administered to a criterion of two perfect trials or a maximum of five trials. The sight word learning task was scored based on the total number of correct responses and the total number of correct or incorrect responses that shared at least two sounds with the target word. The latter score provided a measure of phonetic cue reading.

The sight word spelling recall task was administered during the one-day and seven-day posttests in order to assess the effect of the two types of phonemic awareness training on children's ability to remember the spellings of previously encountered words. If combining letter-sound training and/or articulation training with phonemic awareness instruction strengthens children's ability to make connections between the letters in a word's spelling and the sounds in the word's pronunciations then children should be able to remember the correct spellings of previously learned words. Each spelling list consisted of the eight words learned during the previous sight word learning task. The experimenter said each word and instructed the children to spell each word by remembering the letters they had seen while reading the word. The sight word spelling recall task was scored based on the total number of words spelled correctly as taught and the total number of letters recalled correctly as taught.

The pseudoword reading task was administered during the one-day posttest in order to assess the effect of the two types of phonemic awareness training on children's ability to decode unfamiliar letter strings. In order to successfully decode nonwords children must be able to pronounce the appropriate sound for each letter in the nonword's spelling and to blend the sounds into an accurate pronunciation. The pseudoword reading task consisted of eight nonwords – three CV and five CVC - constructed from the 15 target sounds that children encountered during training. The experimenter explained that the words were made up and had no meaning but that they could still be read. The nonwords were presented to the children on an index card and the children were given five seconds to read each word. The pseudoword reading task was scored based on the total number of nonwords read correctly.

The Children's Test of Nonword Repetition (Gathercole & Baddeley, 1996) was administered during the one-day posttest in order to assess the effect of the two types of phonemic awareness training on children's verbal short term memory. Letter training and articulation training may increase children's verbal short term memory which may in turn increase ability to make connections between letters and sounds during word reading. Children listened to a series of nonwords and attempted to repeat each word. The Children's Test of Nonword Repetition was scored based on the total number of correct repetitions.

The sight word memory task was administered during the seven-day posttest in order to assess the effect of the two types of phonemic awareness training on children's ability to remember how to read previously encountered words. Children were asked to read the eight sight words that began with /s/ taught during the one-day posttest. The sight word memory task was scored based on the total number of correct responses.

In order to assess whether children who received phonemic awareness training outperformed children who received no training, and whether one form of training was more effective than the other, ANOVAs were performed for both the one-day and seven-day posttest measures. When main effects of condition were found, post hoc Tukey pairwise comparisons were conducted. ANOVAs conducted on the pretest measures revealed no significant differences between the groups on any of the measures.

Results. Analyses of the posttest measures showed that children who received both types of phonemic awareness instruction performed better on the one-day posttest measure of segmentation skill than children who received no training. In addition, children who received LO instruction performed significantly better on the seven-day

posttest measure of segmentation skill than did children who received no training. However, the performance of children who received LPA instruction did not differ from the performance of children who received no training on the seven-day posttest measure of segmentation skill. This indicates that both types of phonemic awareness instruction were effective for increasing segmentation skill, but that the LO condition was more effective than the LPA condition.

On the transfer task of word learning, when children learned to read words over a series of trials, no differences were found between children who received the two forms of phonemic awareness instruction and children who received no training. In fact, scores were generally low, indicating that the words were hard to learn, no doubt because they were similarly spelled. However, when credit for the use of partial letter cues was given during word reading, children who received LPA instruction performed better on the one-day posttest measure of sight word learning than did children who received no training. However, the performance of children who received LO instruction did not differ from the performance of children who received no training. When credit for the use of partial letter cues was given, on the word reading seven-day posttest children who received both the LPA and LO forms of phonemic awareness instruction performed better than children who received no training. In addition, children who received LPA instruction performed better than children who received LO instruction. This indicates limited transfer from both types of phonemic awareness instruction to word reading processes.

On the transfer task of decoding skill that required sounding out and blending nonwords, all of the groups exhibited low levels of performance indicating no transfer from either type of phonemic awareness instruction.

On the transfer task of developmental spelling, no significant differences were found between children who received the two forms of phonemic awareness instruction and children who received no training on the number of words spelled phonetically correct. However, children who received both the LPA and LO forms of phonemic awareness instruction spelled more sounds in words correctly on the one-day posttest measure of developmental spelling than did children who received no training. In addition, children who received LO instruction spelled more sounds in words correctly on the seven-day posttest measure of developmental spelling than children who received no training while the performance of children who received LPA instruction did not differ from the performance of children who received no training. This indicates positive transfer from phonemic awareness instruction, especially letter manipulation only instruction, to spelling skill.

In conclusion, results of the pilot study indicate that both types of phonemic awareness instruction contribute to higher levels of segmentation, reading and spelling ability in kindergartners. The results also suggest that LO and LPA instruction make differential contributions to the development of reading and spelling skill. Attending to letters and articulatory movements during word learning may facilitate the formation of connections between the letters in written words and their pronunciations. Such connections are believed necessary in order to secure words in memory. Knowledge of letter-sound correspondences combined with phonemic segmentation ability may impact children's ability to invent word spellings by facilitating the ability to match the sounds in word pronunciations with the letters in word spellings. However, these conclusions remain tentative in light of several limitations encountered in the pilot study.

The training procedures employed in the LPA condition were flawed. During the pilot study, letter training and articulation training were presented concurrently during both the correspondence and the segmentation phases of instruction. During correspondence training children were taught the letter and the mouth picture that corresponded to each sound in a single session. During segmentation training children were asked to segment each word with the mouth pictures followed immediately by the letters. The experimenter observed that children had more difficulty learning to segment words with mouth pictures than they did learning to segment words with letters during training. For instance, children spent more time segmenting words with mouth pictures than they did segmenting the same words with letters. In addition, children incorrectly segmented more words with mouth pictures than with letters. Many children spontaneously expressed confusion over the mouth pictures during segmentation attempts. Children frequently expressed the desire to segment words using the letters before segmenting the same word using the mouth pictures.

In the present dissertation study, the procedures for the LPA condition were revised to separate the letter training from the articulation training during both the correspondence and segmentation phases of instruction. It was expected that separating the letter training from the articulation training would result in stronger learning of both types of correspondences with sounds. In addition, the new training procedure was expected to result in less confusion during segmentation attempts involving mouth pictures. Also, separating the letter and the articulation training procedures was expected to eliminate any advantages found in the pilot study for the LO condition over the LPA condition on the posttests.

In order to accommodate this new training procedure, the number of training sessions was increased in the dissertation study. During the pilot study children in both conditions received a maximum of seven training sessions. In the dissertation study children in both conditions received as many training sessions as were necessary in order for each child to reach criterion on all word sets. It was expected that this would result in more children mastering phonemic awareness and showing stronger transfer to reading and spelling.

In addition, the length of the training sessions was decreased from 30 minutes per session provided in the pilot study to 20 minutes per session for the proposed dissertation study. The length of the training sessions was decreased based on the examiner's observation that off task behavior displayed by children increased significantly after about 20 minutes of training. It was expected that shortening the length of the sessions but increasing the number of possible sessions would strengthen learning while maintaining children's level of motivation.

For both the LO and the LPA conditions, the criterion for moving from segmentation training for two sound words to segmentation training for three sound words was revised. During the pilot study, children were required to segment several four or five word sets to a criterion of two perfect, successive runs through the words. The examiner observed that children appeared to be memorizing how to correctly segment the particular words in each set rather than acquiring independent segmentation skill. During the dissertation study children were required to cycle through a set of 24 words of each type until they reached a criterion of eight correctly segmented words in a

row. It was expected that the new procedure would strengthen children's general segmentation skill.

Both training conditions in the pilot study taught children to segment words containing consonant clusters. The majority of the children did not reach criterion segmenting these word. On the posttests children from both training conditions failed to segment words with consonant clusters correctly. This was true even for children who received some training on consonant clusters. Based on this finding, the decision was made to remove words involving consonant clusters from segmentation training. This allowed more time for training on CV, VC, and CVC words and would possibly enable children to master phonemic segmentation on these word types.

During the pilot study, children were administered a word learning transfer task in which they were required to read a list of words over several trials. Scores for both the one-day and seven-day posttest measures of word learning were generally low across all the groups and no difference was found between the children who received phonemic awareness instruction and children who received no training. However, when given credit for the use of partial letter cues during word learning, children in the LPA condition demonstrated better performance than children in the LO and no treatment conditions. One reason for the poor performance was that the words were hard for children to learn, as a result of having very similar spellings (i.e. they all began with the same letter) and containing consonant clusters.

The word learning task was revised for the dissertation study. The word lists for the one-day and seven-day posttests contained six words – three CV and three CVC words. The word list employed during the one-day posttest contained one CV and one

CVC which began with /b/, one CV and one CVC which began with /s/ and one CV and one CVC which began with /t/. The word list employed during the seven-day posttest contained one CV and one CVC which began with /k/, one CV and one CVC which began with /l/ and one CV and one CVC which began with /p/. Children were taught to read phonetic spellings of the words. None of the words in either list involved consonant clusters. The revised word lists were expected to increase the number of words read correctly and hence precluded the need to score phonetic cue reading. The revised word lists were expected to show an advantage for children who received phonemic awareness instruction over children who received no training. In addition, it was expected that the use of the revised word lists would result in an increased advantage for the LPA over the LO condition.

Due to difficulties encountered in the identification of kindergartners who met the criteria for participation in the pilot study, the dissertation study involved preschool students who were required to meet the same criteria for participation. During the pilot study a large proportion of kindergartners pretested did not qualify for inclusion in the study because they either failed to name the 15 target letters or demonstrated a high level of phonemic awareness ability. In order to participate in the present study, preschoolers were required to be capable of functioning in the partial alphabetic phase of word reading (Ehri, 2005) and to have limited phonemic awareness and decoding skill.

Dissertation Study

The focus of the dissertation study was on phonemic awareness instruction. Two forms of instruction were compared. One group of preschooler received phonemic segmentation training combined with instruction in letter-sound correspondences that

were used to mark the sound segments in words. A second group of preschoolers received phonemic segmentation training combined with instruction in letter-sound and articulatory movement-sound correspondences. A third group remained in the regular preschool classroom. Following training, the three groups were compared in their ability to segment words into phonemes, to learn to read a set of words over trials and then recall their spellings, to decode pseudowords, to invent word spellings, and to repeat nonwords orally. It was hypothesized that both forms of phonemic awareness training would facilitate the acquisition of phonemic awareness and its transfer to reading and spelling tasks. In addition it was hypothesized that combining letter-sound with articulatory movement-sound training would benefit word learning more than letter training alone.

Chapter 4

Methods

Participants

Participants were 60 children, 35 female and 25 male, ranging in age from 4.1 to 5 .8 (*M* = 4.9 years). They were drawn from 6 classrooms in two private preschools serving predominantly middle and upper middle class students in Putnam, NY. IRB approval was obtained from the CUNY Graduate Center prior to any contact with the preschools. We spoke with teachers to obtain permission to work with children enrolled in their classrooms. When teacher permission was obtained, we sent consent letters to parents, explaining the study, and requesting permission to work with their children. The 74 children whose parents signed permission forms were pretested individually in order to determine whether they qualified for participation in the study. Prior to the start of any procedures, we explained to children what they would be asked to do and they were asked if they wished to participate in the study. Only children who agreed to participate did so and they were given the option to withdraw at any time. One child refused to leave the classroom to be pretested.

Since we were working with young children, we monitored their behavior during the course of the study. If a child displayed any sign of discomfort we inquired into the possible cause and either stopped the procedure or elicited the child's consent to continue the procedure. No child was dismissed from the study for this reason.

Children who qualified for the study (1) were proficient speakers of English, (2) capable of functioning in the partial alphabetic phase of word reading (3) possessed limited phonemic awareness ability, and (4) did not show any apparent hearing loss,

acquired neurological disorders, uncorrected vision problems, and/or severe emotional or behavioral problems. English proficiency was assessed by the PPVT- 4 (Dunn & Dunn, 2007). Children's phase of word reading development was determined through their scores on a word reading task (Boder & Jerrico, 1982), a pseudoword reading task, and a letter name task. Children's level of phonemic awareness was determined with a phoneme segmentation task (Uhry & Ehri, 1999).

In order to qualify for inclusion in the study children had to meet the following criteria: name all 15 target letters on one of three letter name tasks, segment no more than 3 two- or three- phoneme words correctly, read no more than one nonword correctly, read no target words correctly, spell all the sounds in no more than one nonword correctly, read no more than three preprimer and no more than 10 words on the Woodcock word identification test (Woodcock, 1987) correctly, and receive a minimum standard score no more than one standard deviation below the mean for their age on the PPVT – 4 (Dunn & Dunn, 2007). Of the 73 children who were pretested, seven failed to qualify for inclusion because they could not correctly name the 15 target letters, two because they could segment words, one because she could read more than one nonword, and one because she could segment words and could read more than one nonword.

Of the 62 children who qualified for inclusion in the study, 60 were matched to form triplets based on attendance in the same school and similar scores on the phoneme segmentation, nonword reading, preprimer word reading, developmental spelling and PPVT-4 pretest measures. Because word-level scores on all of the tests except the PPVT-4 were mostly zero, the matches were based primarily on the PPVT. The members of each triplet were randomly assigned to the three conditions: the letter manipulation

only (LO) condition, the letter plus articulation (LPA) condition and the no treatment control condition. Characteristics of the children in the three conditions are reported in Table 1. Children in the LO condition received instruction in phonemic segmentation and letter-sound correspondences. Children in the LPA condition received the same phonemic segmentation and letter-sound instruction as the LO condition, as well as, instruction in articulatory movement – sound correspondences. Children in the no treatment control condition remained in the regular preschool classroom and received no special instruction.

The literacy curriculum provided within the regular preschool classroom revolved around the philosophy that the children should be introduced to the joys of books without the pressure of learning to read. Because of this philosophy, formal reading instruction was not part of the curriculum. Teachers read storybooks to the class each day. Each story was chosen to correspond to a particular theme and was meant to tie the day's activities together. For example, the teacher read a story about the Easter bunny the same day the children decorated Easter eggs. The teacher drew children's attention to the pictures and often had them act out parts of the story as they read. When the teacher finished reading the story, she would lead a short discussion about the story. For example, they might discuss why a particular character was sad. Each Friday, children were encouraged to pick out a book for their parents to read to them over the weekend. Every week during the school year, the class would discuss a particular alphabet letter which would be prominently displayed in the classroom. During the week, children would be asked to think of words and to bring in objects that began with the letter sound. Daily classroom activities were adapted to incorporate the letter or letter sound of the

Table 1

Characteristics of Children, Means, Standard Deviations, and Test Statistics for the Letter Plus Articulation (LPA) Group, the Letter Only (LO) Group, and the Control (C) Group on the Pretests

	Experimental Condition								
Characteristics and	LPA		LO		C		Test	Post Hoc
Pretests	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	Statistic[a]	
Age (year;month)	4;9	(0.3)	4;9	(0.3)	4;7	(0.3)		
Gender	14F;6M		10F;10M		11F;9M			
Segmentation								
Words (10)	0.05	(0.2)	0.00	(0.0)	0.00	(0.2)		
% Zero	95%		100%		100%			
Phonemes (26)	4.10	(4.8)	4.95	(3.4)	2.30	(3.4)	*W*: 0.42 n.s.	LPA=LO
% Zero	40%		15%		45%		*W*: 2.00 n.s.	LPA=C
							W: 4.90*	LO>C
Target Letters (15)								
1st Task (15)[b]	65%[b]		95%[b]		70%[b]			
Time (sec.)	0.26	(0.1)	0.30	(0.2)	0.41	(0.2)	*F*: 5.75**	C>LPA=LO
Uppercase Letters (26)	24.3	(2.1)	25.1	(1.4)	23.3	(1.7)	*W*: 2.31n.s.	LPA=LO
							W: 2.15n.s.	LPA=C
							W: 8.83**	LO>C
Lowercase Letters (26)	17.8	(4.3)	18.1	(3.4)	17.4	(4.1)	*F*: 0.18n.s.	
Name Write (1)	0.80	(0.4)	0.70	(0.5)	0.75	(0.4)		
% Zero	20%		30%		25%			

Table 1 (Continued)

Characteristics of Children, Means, Standard Deviations, and Test Statistics for the Letter Plus Articulation (LPA) Group, the Letter Only (LO) Group, and the Control (C) Group on the Pretests

	Experimental Condition							
Characteristics and	LPA		LO		C		Test Statistic[a]	Post Hoc
Pretests	*M*	*(SD)*	*M*	*(SD)*	*M*	*(SD)*		
Nonword Read (9)	0.10	(0.3)	0.10	(0.3)	0.10	(0.3)		
% Zero	90%		90%		90%			
Preprimer (22)	0.10	(0.3)	0.15	(0.5)	0.05	(0.2)		
% Zero	90%		90%		95%			
Developmental Spell								
Nonword (9)	0.10	(0.3)	0.00	(0.0)	0.05	(0.2)		
% Zero	90%		100%		95%			
Phonemes (21)	6.05	(4.1)	5.90	(3.7)	4.90	(3.0)	*F*: 0.59n.s.	
% Zero	15%		15%		10%			
PPVT-4 (Standard score)	119.2	(7.1)	118.8	(6.9)	118.7	(7.1)	*F*: 0.03n.s.	
Nonword Repetition (40)	24.7	(6.2)	24.6	(8.4)	22.8	(7.3)	*F*: 0.41n.s.	

Note. *$p<.05$; **$p<.01$; n.s. = not statistically significant. There were 20 participants in each condition.

[a] *W* refers to Wald Chi Square values in the binomial logistic regression analyses. *F* refers to the *F*-statistic in ANOVAs with *df*=2,57.

[b]Percent of children who named all 15 letters correctly either during or at the end of the first task when the experimenter pointed to letters missed and asked for their names.

week. For example, children might make popcorn for snack time when P was the letter of the week.

Materials and Procedures

Children in both the LO condition and the LPA condition received three testing sessions and as many training sessions as were necessary in order for each student to reach criteria on all word sets. Children in the control condition received three testing sessions and no training sessions. Each testing session was approximately 30 minutes in length. Each training session was between 10 and 20 minutes in length. All testing and training were individually administered to each child by the experimenter. In one school children were trained and tested in an empty office. In the other school children were trained and tested at the end of a little used hallway. The pretest was administered during the first session. The one-day posttest was administered the session after the last training session and the seven-day posttest was administered one week after the one-day posttest. The one-day posttest was administered to each control child on the same day it was administered to the LO child from their triplet.

Pretest

The tasks administered during the pretest session included a name writing task, a letter naming task, a phoneme segmentation task (Uhry & Ehri, 1999), a pseudoword reading task, a word reading task, a developmental spelling task, a vocabulary task (PPVT-4, Dunn & Dunn, 2007) and a nonword repetition task (Gathercole & Baddeley, 1996). The pretest session lasted approximately 30 minutes. The experimenter provided children with a piece of lined paper and asked them to write their names. Their success was recorded and scored as one of the pretests. The pretest measures are presented below

in the order in which they were administered. Instructions for administering the tests and test items are given in the Appendices.

Name writing task. The purpose of the name writing task was to assess whether children were able to write their own names correctly. The name writing task was not used to determine children's eligibility for inclusion in the study. The majority of the children had some experience writing their own names and enjoyed demonstrating this skill. Performing the name writing task allowed children to become comfortable with the experimenter and to begin the pretest session with a sense of accomplishment. Children received a score of 1 if they wrote their first name correctly or a score of 0 if partial or no name was written correctly.

Letter name tasks. The purpose of the letter name tasks was to assess whether children knew the names of the 15 target letters representing the sounds that would be taught during training. The 15 target letters written in capital form were: A, B, D, E, F, K, L, M, N, O, P, S, T, V, Z. These letters were chosen because each contains in its letter name the target sound that was taught during segmentation training (e.g., B named "bee" contains /b/). In order to qualify for inclusion in the study, children were required to show knowledge of all 15 target letters in upper case form at least once during the three opportunities to show this knowledge (i.e., naming letters, writing letters, pointing to letters named by the experimenter).

For the first letter naming task, children were shown four index cards displaying alphabet letters. The first index card contained the 11 nontarget letters, in uppercase print, in a mixed up order. The second index card contained the 15 target letters, in uppercase print, in a mixed up order. The third index card contained the 11 nontarget

letters, in lowercase print, in a mixed up order. The fourth index card contained the 15 target letters, in lowercase print, in a mixed up order.

The experimenter used a stopwatch in order to time children's performance on each of the letter cards. The experimenter began timing when the child said the name of the first letter and stopped timing when the child said the name of the last letter. Children were told to point at each letter and to say the letter's name. Children were told to name each letter correctly but to then move quickly to the next letter and name it. Children were given the chance to practice the procedure by quickly naming a series of numbers.

If children missed a letter, the experimenter waited until they completed the card, pointed to the missed letter, and asked the letter's name. If children provided the correct response the second time they were asked to name a letter, this was accepted as evidence of knowledge. If children misidentified any of the target letters after the second chance provided during the first letter naming task, they were given two more chances to correctly identify those letters.

For the second letter naming task, the experimenter said the name of each of the misidentified target letters, along with a few of the correctly identified target letters, and children were asked to write the letter on a piece of paper.

For the third letter naming task, children were shown two cards, each printed with half the target letters in upper case print. The experimenter said the name of each of the misidentified letters, plus a few of the correctly identified letters, and children were asked to point to the letter on the card. The second and third letter tasks were given only to children who failed to name all of the letters on the first task.

Six measures were calculated from the letter name task: the number of uppercase target letters identified correctly on Task 1 and across Tasks 1 - 3 (15 maximum), the total number of uppercase letters identified correctly (26 maximum), the number of lowercase target letters identified correctly (15 maximum), and the total number of lowercase letters identified correctly (26 maximum). Also, the time taken to identify the uppercase target letters and the number of opportunities required for children to show knowledge of all of the 15 target letters were recorded.

Phoneme segmentation task. The purpose of the phoneme segmentation task was to assess children's level of phonemic awareness prior to the start of training. Children who participated in the study were required to possess limited or no phonemic awareness ability. Those who qualified for inclusion segmented no more than three words correctly.

The phoneme segmentation task involved 10 words constructed from the 15 target sounds that children encountered during training. The list included the same types of words that children were taught during segmentation training: two VC, two CV, and six CVC words. The words were: *aid, eat, foe, nay, bowl, cope, phase, seam, take, veal.* The procedure used to administer the phoneme segmentation task was identical to the Mrs. Magic Mouth procedure developed by Uhry and Ehri (1999). A picture of a woman's face was placed in front of the children and five blank tiles were placed on the picture of the woman's mouth. Children were told "Look at Mrs. Magic Mouth. She has sounds in her mouth and you can see them." The experimenter demonstrated how to segment one sample VC, one sample CV and one sample CVC word and had children practice segmenting each demonstrated word. During administration, children were

asked to segment the VC word set, then the CV word set and then the CVC word set. The experimenter said each word and asked the children to repeat the word. Then the children segmented the word by removing a tile from the woman's mouth as they said each phoneme in the word. If a child incorrectly segmented the first item in each of the three word sets, the experimenter demonstrated the correct segmentation of the word and had the child repeat the correct segmentation.

Two measures of the segmentation task were calculated: the number of words segmented correctly (10 maximum) and the number of individual sounds segmented correctly (26 maximum). Credit was given for consonant phonemes which were followed by a schwa sound (e.g., "buh" for B) as long as the consonant was not followed by the vowel sound that is present in the actual word (e.g., "bo" for B in "bowl").

Nonword reading. The purpose of the pseudoword reading task was to assess children's phase of word reading development at the start of training. Children who participated in the study were required to be capable of functioning in the partial alphabetic phase of word reading. In order to qualify for inclusion children were required to read no more than one nonword correctly.

The nine pseudowords included three VC, three CV and three CVC words constructed from the 15 training sounds children encounter during training. The words were: *af, eb, os, po, ta, ve, dem, nak, zol*. Children were shown an index card printed with the nine pseudowords, in upper case letters. The experimenter told the children that these are made-up words, that have no meaning, but that can still be read. The experimenter modeled how to sound out the pseudoword, "ZED". The pseudoword "ZED" was modeled using the long e pronunciation. Children were asked to point at

each pseudoword and to tell the experimenter what it says. If a child failed to read a pseudoword after five seconds the experimenter told them to try the next pseudoword.

One measure of the pseudoword reading task was calculated: the number of pseudowords read correctly (9 maximum). Credit was given for both long and short vowel pronunciations.

Preprimer/target words. The purpose of the word reading task was to assess children's word reading development at the start of training and to insure that children did not know how to read the target words that would be taught in the word learning tasks administered during posttesting. In order to qualify for inclusion children were required to read no more than three preprimer words and none of the 12 target words correctly.

Children were shown a series of index cards printed with words and pictures. The list included 22 preprimer words mixed with 12 target words and eight pictures. The 22 preprimer words were developed by Boder and Jerrico (1982). The 12 target words were taken from the one-day and seven-day posttest measures of sight word learning. The eight pictures were included in order to increase children's feelings of success. Children were given five seconds to respond to each index card. Children's word reading responses were recorded by noting whether they read the word immediately upon seeing it, indicating that they were reading it from memory, or whether they took longer to read it, indicating they were applying a strategy to figure it out. If they were observed to sound out the word or its parts before reading it, this was noted.

Two measures of performance on the word reading task were calculated: the number of preprimer words read correctly (22 maximum) and the number of target words

read correctly (12 maximum). None of the children was able to read four or more preprimer words correctly.

Developmental spelling. The purpose of the developmental spelling task was to assess children's level of spelling ability at the start of training. Any child who wrote letters for all of the sounds in more than one pseudoword correctly was excluded from the study.

The spelling list consisted of three VC, three CV, and three CVC pseudowords, constructed from the 15 target sounds. The pseudowords were: *an, ep, ol, ko, va, ze, bos, mef, tad.* Children used 26 tiles printed with the letters of the alphabet in order to spell words. The experimenter said each word using the long vowel pronunciation. The children were asked to repeat each word and to pick the letters that said the sounds they heard in the word.

Two measures of the developmental spelling task were calculated: the number of words spelled phonetically (9 maximum) and the number of sounds represented phonetically (21 maximum). In order to qualify for inclusion in the study, children were required to represent all the sounds in no more than one word correctly.

Peabody picture vocabulary test. The Peabody Picture Vocabulary Test (PPVT-4; Dunn & Dunn, 2007) was given to measure receptive vocabulary. The PPVT-4 was included to assess children's English proficiency. According to the test manual, the reliability varies from .89 to .97. In order to qualify for inclusion, children could score no more than one standard deviation below the mean for their age at the time of pretesting. For example, a child who is 5 years, 0 months at the time of pretesting had to

receive a raw score of at least 62 which corresponds to a standard score of 85 which is one standard deviation below the mean of 100.

The PPVT-4, Form A (Dunn & Dunn, 2007) was administered by the experimenter. Children were presented with four pictures. The experimenter said a word and asked children to point to the picture that best showed the meaning of the word. The experimenter established a baseline of 11 correct responses within a set and continued until children reached a ceiling of eight or more items missed in a set. Two measures of receptive vocabulary were calculated: the raw score and the standard score.

Nonword repetition task. The Children's Test of Nonword Repetition was developed by Gathercole & Baddeley (1996) to measure children's short term phonological memory skill as well as their ability to process and hear language. According to the test manual, the CNRep has a reliability of .77. The split half reliability calculated on the pretest scores was 0.85.

The CNRep was given to assess children's verbal working memory skill at the start of training. The CNRep was selected because it assesses verbal working memory skill by tapping the underlying phonological representations that are available for memorial processing (Gathercole & Baddeley, 1996). This is in contrast to conventional memory span tasks, such as digit span tasks, which tend to involve a rehearsal component.

The experimenter showed children the tape recorder and explained that when the recorder was turned on they would hear a funny made-up word. The children were told to repeat the word as soon as they heard it. The experimenter presented the children with a practice nonword and provided feedback until the children were able to make an

acceptable repetition attempt. Then the experimenter turned on the tape and administered the test.

Five measures of the CNRep were calculated: the number of correct two-syllable repetitions (10 maximum), the number of correct three-syllable repetitions (10 maximum), the number of correct four-syllable repetitions (10 maximum), the number of correct five-syllable repetitions (10 maximum), and the total number of correct repetitions (40 maximum).

Experimental Conditions

Letter plus articulation condition. Children in the LPA condition used eight tiles printed with mouth pictures and 15 tiles printed with uppercase target letters, in order to segment and spell words. The children were encouraged to use a hand mirror in order to examine their mouth movements during training.

I. Correspondence training – articulation. Correspondence training, involving mouth tiles, occurred during the first few training sessions. The experimenter discussed and demonstrated how the mouth moves when words are pronounced. The children were provided with a hand mirror and encouraged to examine their mouth movements. The children were then taught to associate their mouth movements with the eight mouth pictures and their related sounds. These associations are shown in Figure 1. Sounds are represented by symbols between back slashes. Each picture may depict from one to four sounds.

Four sets of 3 or 4 mouth pictures, representing the articulation of 3 or 4 different sounds were taught. For example, in one set they learned to associate the pictures corresponding to the sounds /p/, /t/, /f/, and long /a/. The experimenter explained each

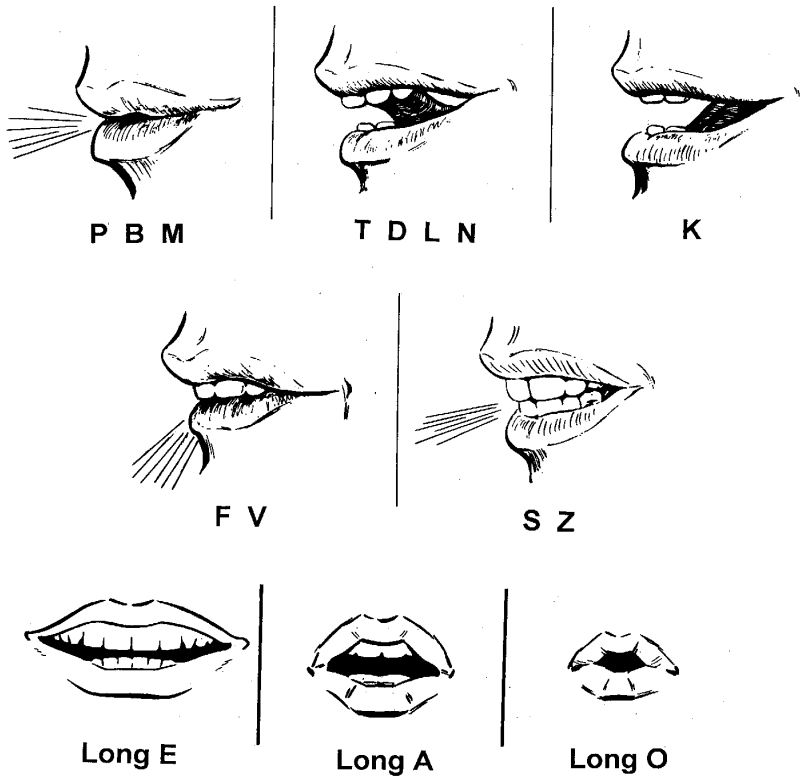


Figure 1. Pictures of articulation gestures and their associations to phonemes.

mouth picture in the set. The children viewed the pictures, listened to the sounds represented by the mouth pictures in random order, repeated each sound and pointed to the mouth picture that matched each sound. The children learned each set to a criterion of two perfect successive trials pointing to all the pictures correctly. After children successfully learned the four sets of mouth pictures, they reviewed the mouth pictures representing the 15 sounds. All of the mouth pictures were placed on the table in front of each child. The children listened to each of the sounds in random order, repeated each sound and pointed to the mouth picture that matched that sound. The experimenter cycled through the sounds of the 15 mouth pictures until the children reached a criterion of two perfect sets in a row.

II. Segmentation training - VC/CV words with mouth pictures. Segmentation instruction involving the mouth tiles occurred immediately following correspondence training. Thirteen mouth tiles were placed on the table in front of each child along with a laminated piece of paper printed with a horizontal series of three squares. The examiner placed a black tile in the last square. The 13 mouth pictures consisted of one mouth picture for each of the three long vowel sounds and two copies each of the five mouth pictures that represented the 12 consonant sounds. The experimenter demonstrated the procedure for segmenting a word using the mouth tiles and had the children practice the procedure. The children were administered a set of 24 VC/CV words constructed from the 15 target sounds. The experimenter pronounced a word and told children the number of sounds in the word. The children were asked to repeat the word. The children then pronounced each sound in the word separately and selected the mouth picture which corresponded to each sound. The mouth tiles were placed in the squares sequentially,

from left to right. A mirror was provided so that children could observe their own mouth movements. Corrective feedback was provided when necessary. The experimenter cycled through the list of words until the children reached a criterion of eight words correctly segmented in a row.

III. Correspondence training – letters. Correspondence training involving uppercase letter tiles occurred once children reached criterion on the VC/CV words segmented with mouth pictures. The children were taught to associate the 15 target letters with their related sounds. The experimenter explained how each letter sound can be heard in the letter name and encouraged the children to use the letter names to remember the letter sounds. The experimenter taught the children four sets of 3 or 4 sound-letter relations. The children listened to the sounds represented by the letters in each set, in random order, and pointed to the letter that matched each sound. The children were required to learn each letter set to a criterion of two perfect successive trials through all the letters. After the children had successfully learned all four letter sets, they reviewed all 15 sound-letter relations. All of the letter tiles were placed on the table in front of each child. The children listened to the sounds in random order, repeated each sound and pointed to the letter that matched each sound. The experimenter cycled through the sounds of the 15 target letters until the children reached a criterion of 2 perfect successive trials.

IV. Segmentation training - VC/CV words with letters. Segmentation instruction involving the letter tiles occurred immediately following correspondence training. The 15 letter tiles were placed on the table in front of each child along with a laminated piece of paper printed with a horizontal series of three squares. The examiner placed a black

tile in the last square. The experimenter demonstrated the procedure for segmenting a word using the letter tiles and had the children practice the procedure. The children were then administered the same set of VC/CV words used during the segmentation training conducted with mouth tiles. The experimenter pronounced a word and indicated the number of sounds in the word. The children were asked to repeat the word. The children then pronounced each sound in the word separately and selected the letter tile which corresponded to each sound. The letter tiles were placed in the squares sequentially, from left to right. Corrective feedback was provided when necessary. The experimenter cycled through the list of 24 VC/CV words repeatedly as necessary until the children reached a criterion of eight words correctly segmented once.

V. Segmentation training - CVC words with mouth pictures. Segmentation training for CVC words using the mouth pictures occurred as soon as children reached criterion segmenting the VC/CV words using letter tiles. The examiner removed the black tile from the last square on the laminated paper. The children were administered a list of 24 CVC words constructed from the 15 target sounds. The procedure for learning to segment the CVC words with mouth pictures was identical to the procedure for learning to segment the VC/CV words with mouth pictures. The experimenter cycled through the list of CVC words repeatedly as necessary until the children reach a criterion of eight words correctly segmented in a row.

VI. Segmentation training – CVC with letter tiles. Segmentation training for CVC words using the letter tiles occurred as soon as the children reached criterion segmenting the CVC words using mouth tiles. The children were administered the same list of 24 CVC words just segmented with mouth pictures. The procedure for learning to

segment the CVC words with letter tiles was the same as the procedure for learning to segment the VC/CV words with the letter tiles. The experimenter cycled through the list of CVC words repeatedly as necessary until the children reached a criterion of eight words correctly segmented in a row.

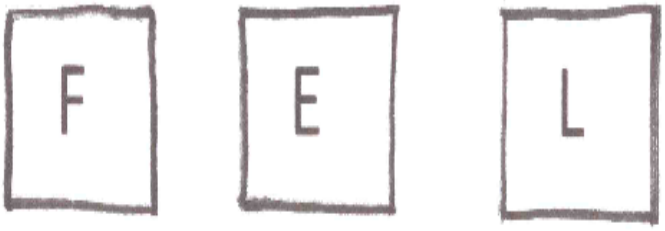
VII. Word review – mouth pictures and letter tiles. The word review occurred as soon as the children reached criterion segmenting the CVC words with letter tiles. The children were presented with a set of 48 words. The word set contained all the words from the previous VC/CV and CVC sets presented in random order. The experimenter no longer provided information regarding the number of sounds in each word and the black tile was not used to cover the last square on the laminated paper. The children were presented with a laminated paper printed with a 2 x 3 set of squares. The mouth pictures and letter tiles were placed on the table in front of each child. The letter tiles were covered with a piece of blank paper. The experimenter pronounced a word. The children were asked to repeat the word. The children then pronounced each sound in the word separately, counted the number of sounds in the word, and selected the mouth picture which corresponded to each sound. The mouth pictures were placed along the top line of squares sequentially, from left to right. The experimenter then uncovered the letter tiles. The children repeated the word again and selected the letter tiles which corresponded to the sounds in the word. The letter tiles were placed along the bottom line of squares sequentially, from left to right. Word segmentation with letters and articulatory movement pictures is shown in Figure 2. Corrective feedback was provided as necessary. The experimenter cycled through the word list repeatedly as necessary until the children reached a criterion of eight words correct in a row.

1. The child hears the word "Feel".

2. The child repeats the word "Feel" and segments the word into its individual phonemes - /f/ /e/ /l/.

3. The child selects the letter or articulatory movement picture that corresponds to each phoneme and places them in the correct order on a card printed with three empty squares.

Letter segmentation



Articulatory Movement Picture Segmentation

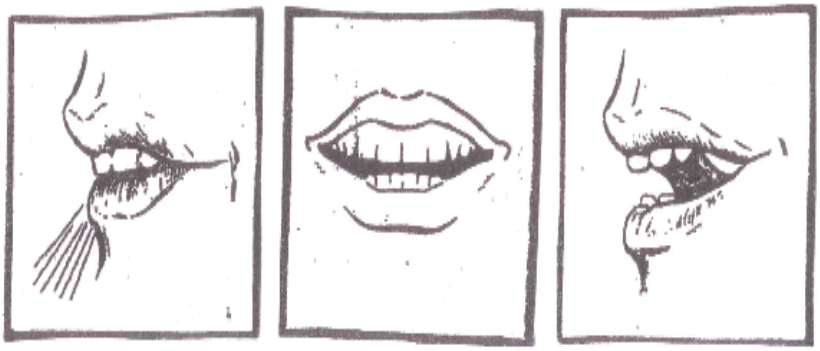


Figure 2. Word segmentation with letters and articulatory movement pictures.

Letter manipulation only condition. Children in the LO condition used 15 tiles printed with the uppercase target letters, in learning to segment and spell words.

I. Correspondence training. Correspondence training occurred during the first few training sessions. The procedure here was identical to the procedure followed in Step II of the LPA condition described above. The children were taught to associate the 15 target letters with their related sounds. The experimenter taught the children four sets of target letters. The experimenter explained how each letter sound can be heard in the letter name and encouraged the children to use the letter names in order to remember the letter sounds. The children listened to the sounds represented by the letters in each set in random order, repeated each sound, and indicated the letter that matched the sound. The children were required to learn each letter set to a criterion of two perfect successive performances of a set. After the children had successfully learned all four letter sets, they reviewed all of the sounds for the 15 target letters. All of the letter tiles were placed on the table in front of each child. The children listened to the sounds in random order and pointed to the letter that matched each sound. The experimenter cycled through the sounds of the 15 target letters until the children reached a criterion of eight correct sounds identified in a row.

II. Segmentation training - VC/CV words. Segmentation instruction for the VC/CV words occurred immediately following correspondence training involving the letters tiles. The procedures were identical to those followed in Step IV of the LPA training described above. The 15 letter tiles were placed on the table in front of each child along with a laminated piece of paper printed with a horizontal series of three squares. The experimenter placed a black tile in the last square. The experimenter

demonstrated the procedure for segmenting a word using the letter tiles and had the children practice the procedure. The children were then administered a set of 24 VC/CV words constructed from the 15 target sounds. The experimenter pronounced a word and indicated the number of sounds in the word. The children were asked to repeat the word. The children then pronounced each sound in the word separately and selected the letter tile which corresponded to each sound. The letter tiles were placed in the squares sequentially from left to right. Corrective feedback was provided when necessary. The experimenter cycled through the list of words repeatedly as necessary until the children reached a criterion of eight words correctly segmented in a row.

III. Segmentation training – CVC words. Segmentation training for CVC words occurred as soon as the children reached criterion segmenting the VC/CV words. The procedure here was identical to the procedure followed in Step VI of the LPA condition described above. The children were administered a list of 24 CVC words constructed from the 15 target sounds. The procedure for learning to segment the CVC words was the same as the procedure for learning to segment the VC/CV words. The experimenter cycled through the list of CVC words until the children reached a criterion of eight words correctly segmented in a row.

IV. Word review. The word review occurred as soon as the children reached criterion segmenting the CVC words. The children were presented with a set of 48 words. The word set contained all the words from the previous VC/CV and CVC sets presented in random order. The procedure for the word review was similar to the procedure for segmenting VC/CV and CVC words except that the experimenter no longer provided information regarding the number of sounds in each word. The children were

presented with a laminated paper printed with a horizontal series of three squares. The letter tiles were placed on the table in front of each child. The experimenter pronounced a word. The children were asked to repeat the word. The children then pronounced each sound in the word separately, counted the number of sounds in the word, and selected the letter tile which corresponded to each sound. Corrective feedback was provided as necessary. The experimenter cycled through the word list repeatedly as necessary until the children reached a criterion of eight words correct in a row.

No treatment control condition. Children in the no treatment control condition remained in their regular preschool classroom.

One-Day Posttest

The tasks administered during the one-day posttest session included a phoneme segmentation task (Uhry & Ehri, 1999), a developmental spelling task, a sight word learning task, a sight word spelling recall task, a pseudoword reading task, a nonword repetition task (Gathercole & Baddeley, 1996), a letter-sound correspondence task, and an articulatory picture-sound correspondence task. The one-day posttest session lasted approximately 30 minutes. The one-day posttest measures are presented below in the order in which they were administered. All words and nonwords included in the posttests were not those used during training.

Phoneme segmentation task. The purpose of the phoneme segmentation task was to compare the effects of the two types of phonemic awareness training on children's ability to segment spoken words into their constituent phonemes immediately following training. The phoneme segmentation task consisted of 10 words from the pretest and seven new words. The 17 words were constructed from the 15 target sounds that children

encountered during training. The words were: *aid, eat, foe, nay, bean, bowl, cope, date, phase, gnome, seam, take, veal, blow, old, steak, peeks.* There were two VC, two CV, nine CVC, and one each of CCV, VCC, CCVC, CVCC words. Although children were not taught to segment words containing consonant clusters during either type of phonemic awareness instruction, four words containing consonant clusters were included in the one-day posttest segmentation task for the purpose of investigating transfer. The procedures for administering the posttest segmentation task were identical to those for the pretest.

The procedures used during the phoneme segmentation posttest task differed from the procedures used during the segmentation training. During the early segmentation training, children placed each letter or articulatory movement picture in order in a frame which specified the number of sounds that made up each word. During the review phase of segmentation training, children were required to determine the number of sounds in each word before selecting the appropriate letters or articulatory movement pictures. During the phoneme segmentation posttest tasks children were asked to listen to a word, segment the word into its individual sounds and select a blank tile for each sound. Children were given no information regarding the number of sounds in each word. The procedural differences between the segmentation training and the phoneme segmentation posttest task may explain children's poorer performance on the phoneme segmentation posttest task than on the developmental spelling task.

Two measures of the segmentation task were calculated: the number of words segmented correctly (17 maximum) and the number of individual sounds segmented correctly (49 maximum). Credit was given for consonant phonemes pronounced with a

schwa sound as long as the consonant was not followed by the vowel sound that was present in the actual word. The one-day posttest phoneme segmentation task had an alpha reliability coefficient of .88 computed from the measure of words segmented correctly.

Developmental spelling task. The purpose of the developmental spelling task was to compare the effects of the two types of phonemic awareness training on the children's ability to spell nonwords immediately following training. The developmental spelling task consisted of the same nine nonwords from the pretest plus three additional (VC, CV, and CVC) nonwords. None of the nonwords included in the one-day posttest was practiced during training. The 12 nonwords were constructed from the 15 target letter sounds children encountered during training. The nonwords were: *an, ef, ep, ol, ko, va, za, ze, bos, mef, pon, tad.* The spelling list consisted of three VC, three CV, and three CVC pseudowords, constructed from the 15 target sounds. The pseudowords were: *an, ep, ol, ko, va, ze, bos, mef, tad.* The procedures for administrating the developmental spelling posttest task were identical to those for the pretest.

Two measures of the developmental spelling task were calculated: the total number of nonwords spelled phonetically correct (12 maximum) and the total number of sounds represented phonetically correct (28 maximum). The one-day posttest developmental spelling task had an alpha reliability coefficient of .91 computed from the measure of nonwords represented correctly.

Sight word learning. The purpose of the sight word learning task was to compare the effects of the two types of phonemic awareness training on children's word learning ability immediately following training. The sight word learning task consisted of six words – three CV and three CVC - which children were taught to read. The words

were constructed from the 15 uppercase target letter sounds children encountered during training. None of the words was taught during the training sessions. One CV and one CVC word began with /b/, one CV and one CVC word began with /s/, and one CV and one CVC word began with /t/. Of the six words, one CV and one CVC word included the long /a/ sound, one CV and one CVC word included the long /e/ sound, and one CV and one CVC word included the long /o/ sound. The long /a/, /e/, and /o/ were the three vowel sounds children were taught during training. The words were: *bow, say, tea, beak, soap, tail*. Children were taught to read phonetic spellings of the words: BO (bow), SA (say), TE (tea), BEK (beak), SOP (soap), TAL (tail).

Each word was printed in uppercase letters on an index card. During the study trial, the experimenter presented the children with a word card and read a meaningful sentence containing the word. The experimenter then pointed to the word on the card and said "This says _____". The children were then asked to repeat the word. The procedure was repeated for each of the six words.

The study trial was followed by several test trials. The six words were presented in random order on each trial. The children were presented with a word card and given five seconds to read the word printed on the card. Children's word reading responses were recorded by noting whether they read the word within one second of seeing it, indicating that they were reading it from memory, or whether they took longer to read it, indicating they were applying a strategy to figure it out. If they were observed to sound out the word or its parts before reading it, this was noted. If the children provided the correct response, the experimenter confirmed this and moved on to the next card. If a child's response was incorrect, the experimenter read the word and had the child repeat it

before moving on to the next word card. The experimenter administered a minimum of five trials and a maximum of eight trials. If the children reached the criterion of three perfect successive trials before the 5th trial, the experimenter administered five trials. If the children did not reach the criterion of three perfect successive trials by the 5th trial, the experimenter continued until the criterion of three perfect successive trials was reached or for a maximum of eight trials.

Several measures of performance in the sight word learning task were calculated: the total number of correct responses produced within one second across five trials (30 maximum), the total number of correct responses across eight trials (48 maximum), and the total number of correct or incorrect responses that shared at least two sounds with the target word across eight trials (48 maximum). The latter score provided a measure of phonetic cue reading. If children completed fewer than eight trials, because they reached criterion, they were given credit for six correct responses on each of the uncompleted trials. The one-day posttest sight word learning task had an alpha reliability coefficient of .94 computed from the measure of the total words read correctly across the eight trials.

Sight word spelling recall task. The purpose of the spelling recall posttest was to assess the effects of phonemic awareness training on children's ability to recall letters in the spellings of the words just learned, immediately following training. The spelling task consisted of the six sight words taught in the previous task. The children were asked to use the letter tiles to spell the words that they learned to read by remembering the letters they saw in the words.

Two measures of spelling recall were calculated: the number of words spelled correctly as taught (6 maximum) and the number of letters recalled correctly as taught (15

maximum). The one-day posttest sight word spelling recall task had an alpha reliability coefficient of .89 calculated from the measure of words spelled correctly.

Nonword reading. The purpose of the pseudoword reading posttest was to assess the effect of the two types of phonemic awareness training on the children's ability to decode unfamiliar letter strings, immediately following training. The pseudoword reading task consisted of the nine pseudowords from the pretest. The words were: *af, eb, os, po, ta, ve, dem, nak, zol.* The procedures for administering the pseudoword reading task were identical to those in the pretest.

One measure of the pseudoword reading task was calculated: the total number of pseudowords read correctly (9 maximum). Credit was given for both long and short vowel pronunciations. The one-day posttest pseudoword reading task had an alpha reliability coefficient of .92 calculated from the measure of nonwords decoded correctly.

Nonword repetition task. The purpose of The Children's Test of Nonword Repetition (Gathercole & Baddeley, 1996) was to assess the effect of both types of phonemic awareness training on children's verbal short term memory, immediately following training. The same form and procedures of the CNRep administered during the pretest were administered during the one-day posttest.

Five measures of performance on the CNRep were calculated: the number of correct two-syllable repetitions (10 maximum), the number of correct three-syllable repetitions (10 maximum), the number of correct four-syllable repetitions (10 maximum), the number of correct five-syllable repetitions (10 maximum), and the total number of correct repetitions (40 maximum). The reliability reported in the manual is 0.77. The split half reliability calculated on the posttest scores was 0.91.

Letter-sound task. The purpose of the letter-sound task was to assess whether children who had participated in the two phonemic awareness training groups had successfully learned the letter-sound correspondences for the 15 target sounds taught during training and to confirm that children who had participated in the control group had not learned the letter-sound correspondences.

An index card containing the upper case alphabet letters representing the 15 target sounds, in mixed up order, was placed in front of the children. The 15 target letters were: A, B, D, E, F, K, L, M, N, O, P, S, T, V, Z. The children were told to point to each letter and to say the sound that the letter makes when it is in a word.

One measure was calculated from the letter-sound task: the number of letter-sound correspondences identified correctly (15 maximum).

Articulatory pictures task. The purpose of the articulatory pictures task was to assess whether children who had participated in the LPA group had learned the articulatory movement-sound correspondences for the 15 target sounds taught during training and to confirm that children who had participated in the LO and control groups had not learned the articulatory picture-sound correspondences.

The eight articulatory pictures were placed in front of the children in mixed up order. The experimenter said each of the 15 target sounds taught during training and asked the children to repeat each sound. Once the child had successfully repeated a sound, they were asked to point to the picture of the mouth that was saying that sound.

One measure was calculated from the articulatory pictures task: the number of articulatory picture-sound correspondences identified correctly (15 maximum).

Seven-Day Posttest

The tasks administered during the seven-day posttest session included a sight word memory task, a phoneme segmentation task (Uhry & Ehri, 1999), a developmental spelling task, a sight word learning task, and a sight word spelling recall task. The seven-day posttest was administered one week after the one-day posttest. The seven-day posttest session lasted approximately 30 minutes. The seven-day posttest measures were administered in the order presented below.

Sight word memory. The sight word memory task consisted of the six CV and CVC words taught during the one-day posttest. Each word was printed in uppercase letters on an index card. The child was presented with each word card and given five seconds to read the word. Children's word reading responses were recorded by noting whether they read the word within one second of seeing it, indicating that they were reading it from memory, or whether they took longer to read it, indicating they were applying a strategy to figure it out. If they were observed to sound out the word or its parts before reading it, this was noted. If the children provided a correct response, the experimenter confirmed they were correct and moved on to the next word card. If the children's response was incorrect, the experimenter read the word and had the children repeat it before moving on to the next word card. The procedure was repeated for each of the six words.

Several measures of performance in the sight word memory task were calculated: the total number of correct responses produced within one second (6 maximum), the total number of correct responses produced either within one second or longer (6 maximum), and the total number of correct or incorrect responses that share at least two sounds with

the target (6 maximum). The latter score provided a measure of phonetic cue reading. The seven-day posttest sight word memory task had an alpha reliability coefficient of .61 calculated from the measure of words read correctly.

Phoneme segmentation task. The phoneme segmentation task consisted of 14 words constructed from the 15 target sounds children encountered during training. The words were: *ate, oak, doe, see, dean, fees, foam, lobe, paid, vane, aches, plea, dotes, bleat.* There were two VC, two CV, six CVC, and one each of CCV, VCC, CCVC, CVCC words. The procedures for administering the test were identical to those from the pretest and one-day posttest.

Two measures of the segmentation task were calculated: the number of words segmented correctly (14 maximum) and the number of individual sounds segmented correctly (40 maximum). The seven-day posttest phoneme segmentation task had an alpha reliability coefficient of .87 calculated from the measure of words segmented correctly.

Developmental spelling task. The developmental spelling task consisted of the same 12 nonwords employed during the one-day posttest. There were four VC, four CV, and four CVC nonwords constructed from the 15 target letter sounds children encountered during training. The nonwords were: *an, ef, ep, ol, ko, va, ze, za, bos, mef, pon, tad*. The procedures for administering the task were identical to those from the pretest and the one-day posttest.

Two measures of the developmental spelling task were calculated: the number of words spelled phonetically (12 maximum) and the number of sounds represented phonetically (28 maximum). The seven-day posttest developmental spelling task had an

alpha reliability coefficient of .91 calculated from the measure of nonwords represented correctly.

Sight word learning. The sight word learning task consisted of six words – three CV and three CVC words- which children were taught to read. The words were developed from the 15 target letter sounds children encountered during training. One CV and one CVC word began with /k/, one CV and one CVC word began with /l/, and one CV and one CVC word began with /p/. Of the six words, one CV and one CVC word included the long /a/ sound, one CV and one CVC word included the long /e/ sound, and one CV and one CVC word included the long /o/ sound. The long /a/, /e/, and /o/ were the three vowel sounds children were taught during training. The words were: *key, low, pay, cave, leaf, pole*. Children were taught to read phonetic spellings of the words: KE (key), LO (low), PA (pay), KAV (cave), LEF (leaf), POL (pole). Each word was printed in uppercase letters on an index card. The procedures for administering the single study trial were identical to those used in the one-day posttest.

The study trial was followed by a series of test trials. The six words were presented in random order for each trial. The procedures for administering the test trials were identical to those from the one-day posttest. The experimenter administered a minimum of five trials and a maximum of eight trials. If the child did not reach the criterion of three perfect trials by the 5^{th} trial, the experimenter continued until the criterion of three perfect trials was reached or for a maximum of eight trials.

Several measures of performance in the sight word learning task were calculated: the total number of correct responses produced within one second across five trials (30 maximum), the total number of correct responses across eight trials (48 maximum), and

the total number of correct or incorrect responses that share at least two sounds with the target word across eight trials (48 maximum). The latter score provided a measure of phonetic cue reading. The seven-day posttest sight word learning task had an alpha reliability coefficient of .93 calculated from the measure of words read correctly across the eight trials.

Sight word spelling recall task. The sight word spelling recall task consisted of the six sight words taught during the previous sight word learning task. The children were told to use the letter tiles in order to spell the words that they had learned to read in the previous task. Children were told to remember the letters they saw in the words.

Two measures of the spelling sight words task were calculated: the number of words spelled correctly as taught (6 maximum) and the number of letters recalled correctly as taught (15 maximum). The seven-day posttest sight word spelling recall task had an alpha reliability coefficient of .91 calculated from the measure of words spelled correctly.

Design and Statistical Analyses

The experiment was a pretest-posttest control group design. The independent variable was phoneme segmentation training with three levels: letter manipulation only (LO), letter plus articulation (LPA), and no treatment control (C). Children were matched to form triplets, based on similar word-level scores on the segmentation, nonword/word reading, developmental spelling and vocabulary pretests, and members were randomly assigned to one of the three conditions. The intervention included one pretest session, four to nine LO and four to eleven LPA training sessions, a one-day posttest session and a seven-day posttest session. The pre- and posttest sessions were

approximately 30 minutes in length and the training sessions were approximately 20 minutes in length. The one-day posttest took place on the day after the last training session and the seven-day posttest took place one week later. The dependent measures were drawn from the one-day and seven-day posttests. Matched subjects were analyzed as independent observations rather than as repeated measures.

To verify that the three groups were comparable on the pretest measures prior to training, ANOVAs were used except when measures included excessive floor or ceiling effects. In these cases, binomial logistic regressions were conducted (see below). The three groups were found to differ significantly on a relevant pretest measuring phoneme segmentation ability despite the random assignment of participants to groups. As a result the pretest measure of number of phonemes segmented correctly was used as a covariate in the statistical analyses of posttest performance. Because the control group exhibited floor effects on many of the posttest measures, binomial logistic regression analyses were conducted (see below) to determine whether the control group differed significantly from either treatment group. To compare performance of the two treatment groups on outcomes, ANOVAs were employed on training session measures and ANCOVAs on posttest measures.

Treatment-control group comparisons were analyzed using a generalized linear model (GLM) conducted with SPSS on posttests where the same items were given to all subjects. This analysis was necessitated by the presence of excessive low scores which created substantial skew in the no-treatment control group. GLM does not require the assumption of normality in the distribution of scores. In addition, GLM allows the inclusion of a covariate which was necessitated by unequal performance of the three

groups on the phoneme-level segmentation pretest measure despite random assignment. The type of GLM model used was the binomial logistic regression (BLR) model (Agresti, 1996). With this model we examined whether the independent variable predicted a binomial outcome variable, in this case, the number of correct and incorrect responses on a fixed number of items. We used the model to test whether the log (odds) probability of correct responses of each of the two treatment groups differed statistically from the control group. "Odds" refers to the odds ratio, that is, the ratio of the odds of an event occurring in one group to the odds of it occurring in another group. Individual regression coefficients were compared to determine whether performance in the control condition treated as the baseline differed significantly from performance in each of the treatment conditions. In SPSS, the Hosmer-Lemeshow test assesses the goodness of fit for the model. Estimation procedures (i.e., robust covariance matrix and the Pearson scale Parameter method) were employed to address any lack of fit. The Wald chi-square statistic tested effects of conditions in the model.

Effect sizes were calculated based on mean performance of the groups on the posttests. To compare treatment and control groups, the difference between means was divided either by a pooled standard deviation if both standard deviations were similar or by the larger standard deviation of the treatment group. To compare the two treatment groups, the difference between means adjusted for the covariate was divided by an unadjusted pooled standard deviation followed by Hedges and Olkin (1985) adjustment for bias. Calculations were conducted using effect size calculator procedures, Center for Evaluation and Monitoring website, Durham University, UK.

Chapter 5

Results

Characteristics of Participants

Several pretest measures were used to form triplets whose members were assigned randomly to the letter plus articulation (LPA), letter manipulation only (LO), and control (C) groups. The pretests included the phoneme segmentation task (total words segmented correctly), the nonword reading task (total nonwords read correctly), the preprimer task (total words read correctly), the developmental spelling task (total nonwords represented phonetically), and the PPVT–4 (Dunn & Dunn, 2007) (standard score). The group means and percent zero scores for these measures are reported in Table 1.

Means were low across the pretest tasks used to assess children's ability to segment words into phonemes, to create phonetic spellings of nonwords, to decode nonwords, and to read words (See Table 1). For example, when asked to segment a list of words into their constituent phonemes, only one out of the 60 children who qualified for inclusion in the study was able to segment any words on the phoneme segmentation task and that child was able to segment only one word correctly. When asked to create phonetic spellings for a list of nonwords, only 5% of the children were able to represent all the sounds in any of the nonwords phonetically. When asked to decode a list of nonwords, 90% of the children were unable to correctly decode any of the nonwords. When asked to read a list of preprimer words, 92% of the children were unable to identify any of the words. The findings from the phoneme segmentation, developmental spelling,

and nonword/ word reading pretest tasks indicated that participants possessed little to no phonemic awareness or word reading ability prior to the start of training.

The final pretest measure used in order to form triplets was the PPVT- 4 (Dunn & Dunn, 2007). The PPVT- 4 is a measure of receptive vocabulary knowledge and was used in order to assess the children's level of English proficiency. Of the children who qualified for inclusion in the study, 72% demonstrated a standard score on the vocabulary measure that was one standard deviation or more above the mean for their age. Only one child demonstrated a standard score that was below the mean for their age and this child received a standard score of 99. These findings indicated that overall the children who qualified for inclusion in the study possessed higher than average English proficiency for their age.

Additional pretests were administered in order to assess children's level of letter name knowledge prior to training. In order to qualify for inclusion in the study, children were required to correctly identify the names of all of the 15 target letters, in upper case form, at least once across three tasks. Of the children who participated in the study, 77% correctly identified the names of all the target letters during the first task and all of the participants correctly identified the names of all 15 target letters across the first two tasks.

Also, the time required to name the 15 uppercase target letters during the first task was recorded for each child. As shown in Table 1, the groups differed significantly on this measure. Benjamini-Hochberg post hoc comparisons revealed that the control group took significantly more time to name the letters than the two treatment groups who did not differ.

Children were asked to name not only the 15 target letters but also 11 additional letters in both uppercase and lowercase. Because these letters were not used to spell words during the training, this measure was not used to form matched triplets. Mean scores are reported in Table 1. Results show that the groups differed significantly in their knowledge of the 26 uppercase letter names. As evident in Table 1, the LPA group demonstrated performance equal to that of the LO and Control groups while the LO group significantly outperformed the Control group. However, the groups did not differ significantly in naming the lowercase letters.

Two additional measures were drawn from the segmentation and spelling pretests to compare the three groups although these measures were not used to match triplets. One involved the number of sounds segmented correctly. The majority of children (66%) were able to identify at least one phoneme in words. As evident in Table 1, the groups differed significantly on this measure, with the LPA group performing equally to the LO and Control groups and the LO group outperforming the Control group. Another similar measure involved the number of phonemes spelled phonetically in the spelling task. The majority of the children (87%) were able to represent at least one of the sounds in the nonwords with letters. The three groups did not differ statistically on this measure (see Table 1).

Two other measures administered during the pretest, but not used to form triplets, were the name writing task and the Children's Test of Nonword Repetition (Gathercole & Baddeley, 1996). During the name writing task, children were given credit for attempts to represent the correct letters, in the correct order in their own names, even if they were unable to produce correctly formed letters. An analysis of scores demonstrated that 75%

of the children knew the correct letters, in the correct order, to spell their own name even if they had difficulty with the motor skills necessary to clearly write those letters.

The Children's Test of Nonword Repetition (Gathercole & Baddeley, 1996) was administered as a pretest in order to assess children's verbal working memory skill prior to the start of training. Children were asked to listen to a series of 40 two, three, and four syllable words and to repeat each word after they heard it. No significant differences were detected among the three groups on their level of verbal working memory skill prior to the start of training (see Table 1).

In order to qualify for inclusion in the study, children were required to be capable of functioning in Ehri's (2005) partial alphabetic phase of word reading. Children in the partial alphabetic phase of word reading possess limited phonemic awareness and little if any decoding skill. At this phase children remember how to read words by forming connections between a few of the letters in the word's spelling and some of the sounds in the word's pronunciation. In order to successfully employ this word reading strategy, children must possess at least a limited amount of letter knowledge. Findings from the various pretests indicated that the children who were included in the study were capable of functioning in the partial alphabetic phase of word reading prior to the start of training.

Although triplets were formed based on similar scores on some of the pretest measures prior to the beginning of training, it became apparent after the study ended that the treatment and control groups differed significantly on three other measures not used to match participants (see Table 1). To summarize, the groups differed significantly on the time required to name the 15 target letters, knowledge of the 26 uppercase letter names, and the number of phonemes segmented correctly during the phoneme

segmentation task. When children were asked to name the 26 uppercase letters and to segment words at the phonemic level mean performance of the LPA group equaled that of the LO and Control groups, while the LO group outperformed controls. On the measure of the time required to name the 15 target letters, the Control group performed significantly slower than the two treatment groups whose times did not differ. To take account of pretest differences in the analyses of training effects, the pretest phoneme segmentation measure of phonemes segmented correctly was used as a covariate in the binomial logistic regressions and ANCOVAs used to compare the groups on posttest measures.

Performance During Training

Children who participated in both the LO and the LPA conditions received phonemic segmentation training. Training for each child continued until that child had reached criterion on all aspects of the segmentation instruction. The total number of minutes spent in training was calculated for each child in both instructional conditions. ANOVAs revealed a significant difference between the two training groups for the number of minutes spent in training. As evident in Table 2, the LPA group spent significantly more time receiving training than did the LO group. This was due to the fact that children in the LO condition were required to learn only the associations between the 15 target letters and the sounds they represented whereas children in the LPA condition were required to learn these letter-sound associations as well as associations between the articulatory movement pictures and the sounds they depicted.

To examine whether longer training times explained why LPA-trained children outperformed LO-trained children on posttests, analyses of covariance were conducted

Table 2

Means and Standard Deviations during Training as a Function of Treatment

	Experimental Condition				ANOVA	
	LPA		LO		*F*-Statistic	Post hoc
Training Performance	*M*	*(SD)*	*M*	*(SD)*	*(df* =1,38*)*	
Minutes of Training	149. 0	(34.2)	111.8	(33.5)	12.14**	LPA>LO
Range	80 – 210 min.		65 – 195 min.			
Letter Segmentation[a]						
VC/CV Words	11.75	(3.6)	15.95	(6.1)	7.07*	LO>LPA
CVC Words	9.85	(2.5)	15.15	(5.7)	14.52**	LO>LPA
Articulation Segmentation[a]						
VC/CV Words	12.35	(4.8)	_ _ _		_ _ _	
CVC Words	13.60	(5.2)	_ _ _		_ _ _	
Review[a]	11.70	(2.9)	13.65	(4.5)	2.65n.s.	

Note. *p<.05; **p<.01; n.s. = not statistically significant. There were 20 participants in each condition.

[a] Number of words attempted in order to reach a criterion of eight successive words segmented correctly.

with total training time as the covariate, treatment group as the independent variable, and each of the posttests as the dependent measure. Results were negative. Training time contributed no significant effects in any of the analyses. Correlations between training time and the literacy posttests were low and non-significant, with *r*s ranging from -.01 to .24, all *p*s > .10. These findings rule out the possibility that greater training time explained the superior performance of the LPA group on the posttests.

The total numbers of segmentation attempts with letters required to reach criterion for VC/CV and CVC words were calculated for both of the training groups. During segmentation training for both word types, children were required to cycle through the word list until they reached a criterion of eight consecutive words segmented correctly. These eight consecutive, correctly segmented words were included in the measure of segmentation attempts to criterion for both word types. ANOVAs revealed a significant difference between the two groups for the number of segmentation attempts required to reach criterion for both VC/CV and CVC words. Comparison of means in Table 2 shows that the LPA group required significantly fewer attempts to reach criterion in segmenting both word types with letters than did the LO group. During segmentation training for both word types, LPA children were taught first to segment words with articulatory movement pictures and then to segment words with letters. It is likely that learning to segment first with articulatory pictures aided children in their subsequent attempts to segment words with letters.

A review task with CV/VC and CVC words presented in mixed order was administered at the end of segmentation training for both groups in an attempt to consolidate the skills taught during segmentation training. This task consisted of all of

the previously learned VC/CV and CVC words. Children were no longer told the number of phonemes in each word and were expected to determine this by themselves as they segmented them. Children in the LPA condition segmented using both letters and articulatory pictures whereas LO children segmented using letters only. The experimenter cycled through the word list until the children reached the criterion of eight consecutive words segmented correctly. ANOVAs revealed no significant difference between the two treatment groups in the number of segmentation attempts required to reach criterion on the review task (see Table 2). Having to segment with both articulatory movement pictures and letters did not increase the difficulty of the task for the LPA group compared to segmenting with letters only. These findings indicate that both treatment groups learned to segment words into phonemes equally well and did not differ in learning time on this final phase of training.

Posttest Performance

The main hypothesis of the study was that both forms of phonemic segmentation instruction would facilitate the acquisition of phonemic awareness and its transfer to word reading and spelling tasks compared to no training. In addition, it was hypothesized that combining letter-sound training with articulation training during segmentation instruction would benefit word learning more than letter training alone. Results are reported in Table 3, which shows the mean number of correct responses of the experimental and control groups on the posttests, test statistics of the binomial logistic regression and ANCOVA analyses that were applied to compare performance of the three groups, and effect sizes.

Table 3

Means, Standard Deviations, Test Statistics, Post Hoc Pairwise Tests, and Effect Sizes to Compare the Letter Plus Articulation (LPA), Letter Only (LO), and Control (C) Groups on One-Day and Seven-Day Posttests

	Experimental Condition						Test Statistic					
Posttest Measure	LPA		LO		Control		LPA vs. C		LO vs. C		LPA vs. LO	
	M	*(SD)*	*M*	*(SD)*	*M*	*(SD)*	Wald[a]	(Effect *d*)[b]	Wald[a]	(Effect *d*)[b]	*F*(1,37)[a]	(Effect *d*)[c]
One-Day Posttests												
Articulatory Pictures (15)[d]	14.35	(0.8)	1.95	(1.2)	1.30	(1.0)						
Phoneme Segmentation												
Words (17)	5.45	(3.9)	3.10	(2.5)	0.20	(0.6)	30.20**	(1.35)	16.49**	(1.16)	8.04*	(0.79)
% Zero	10%		25%		90%							
Phonemes (49)	26.70	(7.5)	22.50	(7.7)	4.85	(5.8)	72.31**	(2.91)	41.84**	(2.29)	4.58*	(0.62)
% Zero	0%		5%		40%							
Developmental Spelling												
Nonwords (12)	8.45	(3.1)	6.00	(2.8)	0.50	(1.1)	54.90**	(2.56)	32.38**	(1.96)	7.39**	(0.85)
% Zero	0%		5%		80%							
Phonemes (28)	24.30	(3.3)	21.15	(3.9)	7.15	(5.1)	96.83**	(5.20)	59.11**	(3.59)	7.77**	(0.88)
% Zero	0%		0%		10%							

Table 3 (Continued)

Means, Standard Deviations, Test Statistics, Post Hoc Pairwise Tests, and Effect Sizes to Compare the Letter Plus Articulation (LPA), Letter Only (LO), and Control (C) Groups on One-Day and Seven-Day Posttests

	Experimental Condition			Test Statistic		
Posttest Measure	LPA	LO	Control	LPA vs. C	LO vs. C	LPA vs. LO
	M (*SD*)	*M* (*SD*)	*M* (SD)	Wald[a] (Effect *d*)[b]	Wald[a] (Effect *d*)[b]	*F*(1,37)[a] (Effect *d*)[c]
Word Learning						
Total Read (48)	40.65 (5.1)	31.40 (10.4)	10.60 (8.1)	120.03** (5.89)	39.04** (2.00)	12.69** (1.12)
% Zero	0%	0%	15%			
Read Immediate (30)	11.79 (7.5)	7.80 (6.3)	2.40 (3.5)	24.51** (1.25)	11.04** (0.86)	3.22n.s. (0.57)
% Zero	10%	15%	60%			
Partial Words (48)	41.10 (6.0)	32.80 (10.4)	11.85 (7.8)	98.09** (4.88)	46.24** (2.98)	9.52** (4.46)
% Zero	0%	0%	5%			
Trials to Criteria (48)	5.85 (1.2)	7.20 (1.2)	_ _ _	_ _ _	_ _ _	11.37** (5.71)
Memory for Spellings						
Words (6)	5.00 (1.6)	4.15 (1.6)	0.70 (1.3)	32.28** (2.97)	26.73** (2.38)	2.67n.s. (0.52)
% Zero	5%	0%	65%			

Table 3 (Continued)

Means, Standard Deviations, Test Statistics, Post Hoc Pairwise Tests, and Effect Sizes to Compare the Letter Plus Articulation (LPA), Letter Only (LO), and Control (C) Groups on One-Day and Seven-Day Posttests

	Experimental Condition						Test Statistic					
Posttest Measure	LPA		LO		Control		LPA vs. C		LO vs. C		LPA vs. LO	
	M	*(SD)*	*M*	*(SD)*	*M*	(SD)	Wald[a]	(Effect *d*)[b]	Wald[a]	(Effect *d*)[b]	*F*(1,37)[a]	(Effect *d*)[c]
Memory for Spellings												
Phonemes (15)	13.55	(3.4)	12.70	(2.2)	6.00	(3.6)	17.37**	(2.16)	37.39**	(3.05)	0.93n.s.	(0.30)
% Zero	5%		0%		5%							
Nonword Reading (9)	3.00	(3.4)	0.80	(1.3)	0.00	(0.0)	_ _ _		_ _ _		W[a]:9.39**	(0.87)
% Zero	35%		65%		100%							
Nonword Repetition (40)	27.75	(5.0)	27.10	(8.2)	18.65	(5.8)	F:24.70**	(1.69)	F:11.19**	(1.03)	0.95n.s.	(0.10)
Seven-Day Posttests												
Phoneme Segmentation												
Words (14)	5.10	(3.5)	3.60	(2.3)	0.10	(0.3)	42.48**	(1.43)	31.13**	(1.52)	4.02*	(0.58)
% Zero	20%		15%		90%							
Phonemes (40)	22.80	(6.8)	20.20	(6.9)	4.50	(4.6)	76.73**	(2.69)	50.46**	(2.27)	2.35n.s.	(0.45)
% Zero	0%		0%		40%							

Table 3 (Continued)

Means, standard Deviations, Test Statistics, Post Hoc Pairwise Tests, and Effect Sizes to Compare the Letter Plus Articulation (LPA), Letter Only (LO), and Control (C) Groups on One-Day and Seven-Day Posttests

	Experimental Condition			Test Statistic					
Posttest Measure	LPA		LO		Control		LPA vs. C		LO vs. C		LPA vs. LO	
	M	*(SD)*	*M*	*(SD)*	*M*	(SD)	Wald[a]	(Effect *d*)[b]	Wald[a]	(Effect *d*)[b]	*F*(1,37)[a]	(Effect *d*)[c]
Developmental Spelling												
Nonwords (12)	7.10	(3.2)	6.20	(3.6)	0.40	(1.0)	35.98**	(2.09)	27.52**	(1.61)	0.98n.s.	(0.30)
% Zero	0%		0%		85%							
Phonemes (28)	22.75	(3.8)	21.30	(4.6)	7.20	(4.3)	100.05**	(4.09)	63.14**	(3.17)	1.63n.s.	(0.39)
% Zero	0%		0%		0%							
Word Learning												
Read from Day 1 (6)	4.25	(1.3)	2.45	(1.6)	0.80	(1.1)	44.43**	(2.88)	10.15**	(1.22)	15.03**	(1.22)
% Zero	0%		15%		55%							
Total Read (48)	40.45	(5.3)	30.40	(9.9)	12.70	(12.2)	65.12**	(5.23)	18.61**	(1.79)	16.37**	(1.27)
% Zero	0%		0%		5%							
Read Immediate (30)	12.40	(7.3)	9.10	(7.5)	3.65	(4.8)	18.79**	(1.20)	7.55**	(0.73)	1.76n.s.	(0.42)
% Zero	10%		15%		45%							

Table 3 (Continued)

Means, Standard Deviations, Test Statistics, Post Hoc Pairwise Tests, and Effect Sizes to Compare the Letter Plus Articulation (LPA), Letter Only (LO), and Control (C) Groups on One-Day and Seven-Day Posttests

	Experimental Condition					Test Statistic					
Posttest Measure	LPA		LO		Control	LPA vs. C		LO vs. C		LPA vs. LO	
	M	*(SD)*	*M*	*(SD)*	*M* (SD)	Wald[a]	(Effect *d*)[b]	Wald[a]	(Effect *d*)[b]	*F*(1,37)[a]	(Effect *d*)[c]
Word Learning											
Partial Word (48)	40.75	(5.5)	32.60	(9.7)	13.75 (12.4)	60.74**	(4.91)	23.57**	(1.94)	10.66**	(3.82)
% Zero	0%		0%		5%						
Trials to Criteria (48)	6.10	(1.3)	7.15	(1.3)	_ _ _	_ _ _		_ _ _		7.38*	(4.27)
Memory for Spellings											
Word (6)	5.00	(1.3)	4.55	(1.6)	0.90 (1.8)	28.43**	(2.63)	20.73**	(2.09)	0.96n.s.	(0.31)
% Zero	0%		0%		65%						
Phonemes (15)	13.85	(1.5)	13.20	(2.1)	5.70 (3.2)	62.27**	(5.43)	50.30**	(3.57)	1.21n.s.	(0.35)
% Zero	5%		0%		5%						

Note. There were 20 children in each condition. Means are unadjusted for the covariate. *$p<.05$; **$p<.01$; n.s. = not statistically significant.

[a] For Binomial Logistic Regression analyses, Wald Chi Square Test Statistics are reported to compare each of the treatment groups to the control group. For ANCOVAs to compare the two treatment groups, *F*-values are reported except where W indicates a Wald statistic.

[b] Effect sizes reflect the difference between *M* (Treatment) and *M* (Control) divided by *SD* (Treatment), or divided by pooled *SD* if *SD* (Treatment) and *SD* (Control) were similar.

Table 3 (Continued)

Means, Standard Deviations, Test Statistics, Post Hoc Pairwise Tests, and Effect Sizes to Compare the Letter Plus Articulation (LPA), Letter Only (LO), and Control (C) Groups on One-Day and Seven-Day Posttests

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[c] Effect sizes reflect the difference between *M* (LPA) and *M* (LO) adjusted for covariate divided by unadjusted pooled *SD* followed by Hedges and Olkin (1985) adjustment for bias. Calculations were conducted using effect size calculator procedures, Center for Evaluation and Monitoring website, Durham University, UK.

[d] Chance- level performance on this 8-choice picture recognition test was 1.88. The highest score in the LO and C groups was 4 correct whereas the lowest score in the LPA group was 13 correct.

Letter and articulatory knowledge. During the posttest given one-day after training, the letter–sound knowledge of the three groups was assessed in order to determine whether children who participated in the two instructional conditions had successfully learned the letter-sound correspondences for the 15 target letters which were taught during training. An analysis of the group means demonstrated that children in both treatment groups succeeded in learning the letter–sound correspondences for the 15 target letters (LO mean = 14.95 and LPA mean = 15.00) and that both treatment groups were able to say the sounds of more target letters than the control group (control mean = 7.50). All of the children in the LPA group and 19 of the 20 children in the LO group received perfect scores on the posttest measure assessing letter-sound knowledge. In contrast, only one of the children in the control group received a perfect score on the measure. These findings indicate that both treatments were effective in teaching children the letter-sound correspondences.

During the one-day posttest session, memory for the articulatory picture-sound associations was assessed in order to determine whether children in the LPA group had succeeded in learning the 15 articulatory picture–sound correspondences taught during training and that children in the other two groups had not acquired this knowledge. An analysis of the group means demonstrated that children in the LPA group succeeded in learning the articulatory picture–sound correspondences for the 15 target letters (LPA mean = 14.35) and that LPA children were able to make more associations between articulatory pictures and sounds than the LO (mean = 1.95) and control (mean = 1.30) groups (see Table 3). Every child in the LPA group demonstrated knowledge of at least 14 articulatory picture-sound associations. In contrast, no child in the LO or control

group demonstrated recognition of more than four of the articulatory picture sound-associations. By chance, students could get $1/8^{th}$ of the 15 items correct, or 1.88, on this multiple choice task. From the means in Table 3, it is apparent that the LO and control group performed on average no higher than chance, indicating that they were guessing.

Phoneme segmentation. It was hypothesized that both types of phonemic awareness instruction would facilitate performance on the one- and seven-day posttests assessing phoneme segmentation ability compared to no training. Binomial logistic regressions were computed to compare the performance of each treatment group to the control group on the measures of words segmented and individual phonemes in words segmented correctly. Wald chi square tests revealed that the log(odds) probability of correct responses was significantly greater for the treatment groups than for the control group at both the word and phoneme level across both posttests (see Table 3). Ninety percent of the control children were unable to segment any words correctly across both posttests.

ANCOVAs were computed to compare the performance of the LPA and LO groups on the posttest phoneme segmentation measures. The results indicated that children in the LPA condition segmented significantly more words than children in the LO condition on both the one- and seven-day posttests. Children in the LPA condition segmented significantly more of the individual phonemes in words than children in the LO condition on the one-day posttest but the two groups did not differ on the seven-day posttest (see Table 3). Effect sizes (*d*) were 0.79 (one-day) and 0.58 (seven-day) for the word level measure indicating that LPA training was more effective than LO training for increasing children's phonemic segmentation ability (see Table 3).

Children in both instructional conditions were trained to segment words to criterion. It was hypothesized that this would enable both groups to master the skill, so no differences would be detected between the two treatment groups on the phoneme segmentation posttests. However, these results indicate that children in the LPA condition correctly segmented significantly more words at both test points and more sounds on the one-day posttest than children in the LO condition. This was despite the fact that the two groups did not differ in their ability to segment words on the review task at the end of training. These findings do not support the prediction of no difference between the two treatment groups. Rather the findings indicate an advantage of LPA training over LO training in teaching children to segment whole words into their constituent phonemes, and this advantage persisted up to a week later. However, this advantage was weaker when measured at the level of the individual phoneme.

Neither instructional condition included training in how to segment words containing consonant clusters. To investigate whether training would transfer and enable children to segment consonant clusters, four words containing eight consonant clusters were included in the phoneme segmentation one- and seven-day posttests. Inspection of students' scores revealed little if any success. None of the control children segmented any consonant clusters correctly on either test. There were only a few children in the training groups who segmented any clusters, with most scores showing only one correct: on the one-day posttest, three LO children and five LPA children out of 20 in each group; on the seven-day posttest, four LO children and six LPA children. These findings indicate that segmentation training did not produce much transfer to words whose phonemic structure was not practiced.

In summary, analyses of the findings revealed that both instructional treatments were effective for increasing children's ability to segment words into their constituent phonemes. In addition, articulation training provided an added benefit over letter training during phoneme segmentation instruction, with children in the LPA condition segmenting significantly more words on both the one- and seven-day posttests and more individual phonemes in words on the one-day posttest than children in the LO condition.

Although training was effective in teaching phonemic segmentation, children's scores on the posttests were surprisingly low. The percentages of words segmented correctly were 32% (one-day) and 36% (seven-day) for the LPA group and 18% (one-day) and 26% (seven-day) for the LO group. One possible reason is that the phoneme segmentation posttest was structured differently from the training tasks. There were not boxes to fill and letters to fill them. Rather blank markers were used to distinguish segments.

Developmental spelling. It was hypothesized that both types of phonemic awareness instruction would facilitate performance on the posttests assessing developmental spelling ability compared to no training. Binomial logistic regressions were computed to compare the performance of each treatment group to the control group on two measures, number of nonwords represented phonetically with letters and number of individual phonemes within nonwords represented phonetically with letters. Wald chi square tests revealed that the log(odds) probability of correct responses was significantly greater for the two treatment groups than for the control group at both the nonword and phoneme level across both posttests (see Table 3). Eighty percent of controls on the one-

day posttest and 85% of controls on the seven-day posttest were unable to spell any of the nonwords phonetically.

ANCOVAs were computed to compare the performance of the LPA group with the LO group on the developmental spelling posttest measures. Results indicated that children in the LPA condition spelled significantly more nonwords phonetically and represented significantly more of the individual sounds in nonwords with letters on the one-day posttest than children in the LO condition. However, on the seven-day posttest, the difference between the two treatment groups fell short of significance on both the word and phoneme measures (see Table 3). The effect size (*d*) for the one-day posttest word level measure was 0.85 and for the one-day posttest phoneme level measure was 0.88 indicating that LPA training was more effective than LO training for increasing children's developmental spelling ability immediately following training.

In summary, analyses of the findings revealed that both instructional treatments were effective for increasing children's ability to create phonetic spellings for nonwords. In addition, articulation training provided a limited benefit over letter training during phoneme segmentation instruction immediately following training. Children in the LPA condition created significantly more phonetic spellings for nonwords and represented significantly more individual phonemes in nonwords with letters on the one-day posttest than children in the LO condition. However, this advantage did not persist over time.

Sight word learning. During the sight word learning transfer task, children were asked to read a list of phonetically spelled words over a series of trials. Both the one- and seven-day sight word learning posttests involved a different set of six words: three CV and three CVC. It was hypothesized that both types of phonemic awareness instruction

would facilitate performance on the sight word learning posttests compared to no training. Binomial logistic regressions were computed to compare the performance of each treatment group to the control group on the measure of words read correctly across the 8 test trials for the one- and seven-day posttests. Wald chi square tests revealed that the log(odds) probability of correct responses was significantly greater for the two training groups than for the control group on the measure across both posttests (see Table 3).

It was hypothesized that articulation training would provide an added benefit over letter training during segmentation instruction for children's word learning ability. ANCOVAs were computed to compare the performance of the LPA group with the LO group on the sight word learning measure of words read correctly across 8 test trials. Results indicated that children in the LPA group read significantly more words correctly summed across the eight test trials administered during both posttests than did children in the LO group. During the one-day posttest, LPA children read 85% of the words correctly whereas LO children read 65% of the words correctly. During the seven-day posttest, LPA children again read 85% of the words correctly whereas LO children read 63% of the words correctly. Effect size (*d)* was 1.12 (one-day) and 1.27 (seven-day) for the measure of words read, indicating that combining articulation training with letter training during phoneme segmentation instruction was more effective than letter training alone for increasing children's sight word learning ability.

During the sight word learning tasks, children were taught to read six words to a criterion of three perfect consecutive trials. If a child reached criterion before the fifth learning trial, the experimenter administered a total of five learning trials. If a child did

not reach criterion by the fifth trial, the experimenter continued until the child reached criterion or a maximum of eight trials. ANCOVAs were conducted to compare the performance of the LPA group with the LO group. The control group was dropped because none of the control children reached criterion on the one-day posttest and only two of the control children did on the seven-day posttest. As evident in Table 3, results revealed that the LPA group reached criterion in significantly fewer trials than the LO group on both the one- and seven-day posttests. These findings provide additional support for the hypothesis that training with both articulation and letters facilitates sight word learning.

Eight (Trial) x three (Condition) mixed model ANOVAs were conducted to examine children's performance over the eight sight word learning trials during the one- and seven-day posttests. The analysis conducted on the one-day sight word learning posttest revealed that the main effects for Trial, $F(7,399) = 64.71$, $p<.01$ and Condition, $F(2,57) = 71.40$, $p<.01$ were significant. A significant interaction of Trial x Condition was also attained, $F(14,399) = 9.22$, $p<.01$. As evident in Figure 2, the LPA condition demonstrated the largest increase in word reading scores across the 8 trials (i.e., mean gain of 3.75 words) followed by the LO condition (i.e., mean gain of 3.40 words). The word reading scores for the control condition did not increase much across the learning trials (i.e., mean gain of 0.90 words).

The analysis conducted on the seven-day sight word learning posttest revealed that the main effects for Trial, $F(7,399) = 72.21$, $p<.01$ and Condition, $F(2,57) = 43.11$, $p<.01$ were significant. A significant interaction of Trial x Condition was also attained, $F(14,399) = 4.08$, $p<.01$. As evident in Figure 3, the LPA condition demonstrated the

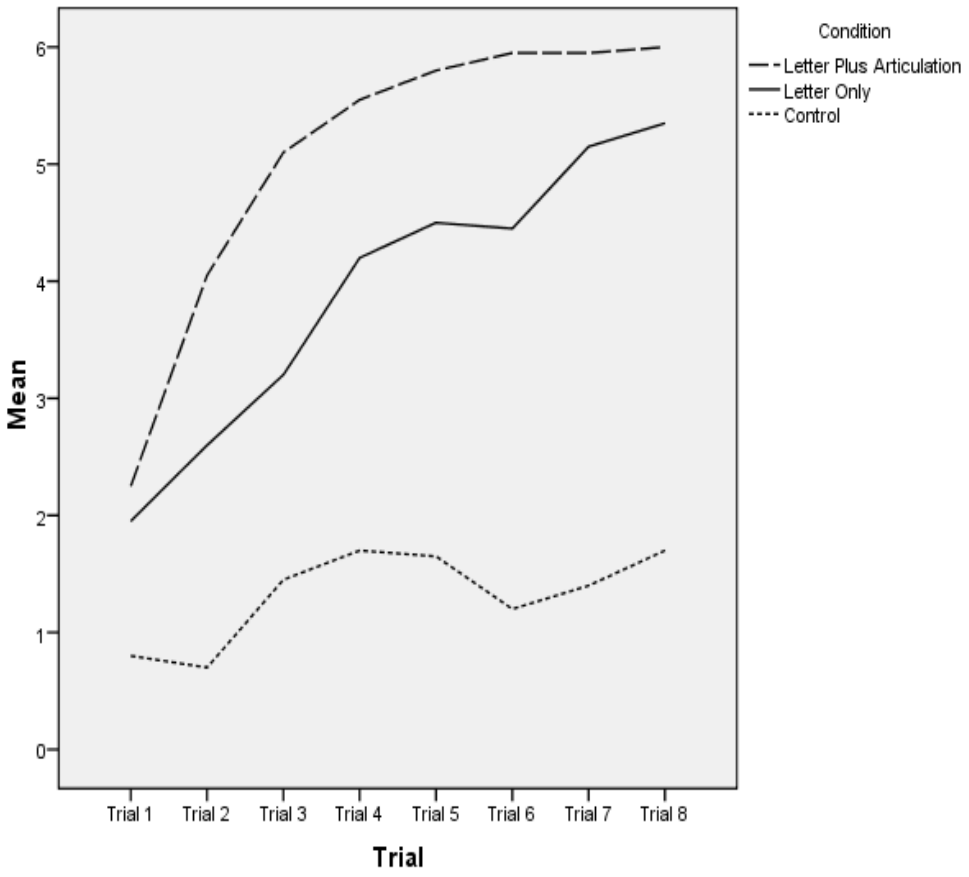


Figure 3. Mean number of words read correctly on the eight learning trials by LPA, LO and Control groups as a function of condition on the one-day sight word learning posttest.

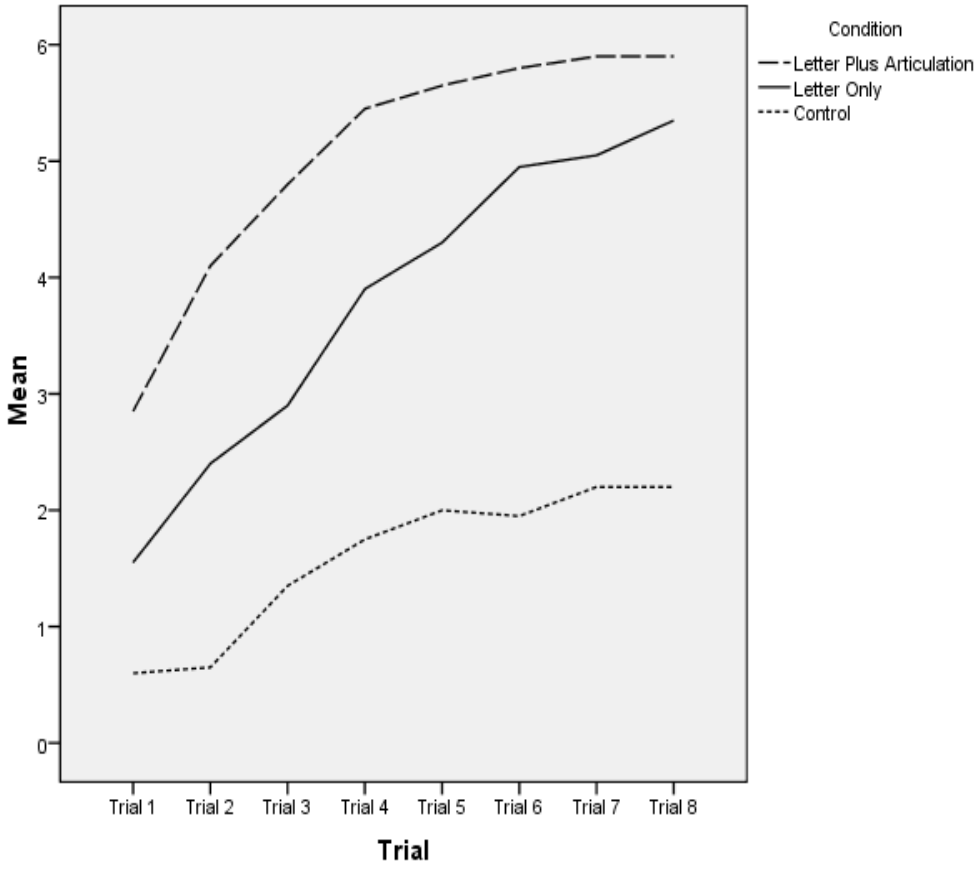


Figure 4. Mean number of words read correctly on the eight learning trials by LPA, LO, and control groups as a function of condition on the seven-day sight word learning posttest.

largest increase in word reading scores across the 8 trials (i.e., mean gain of 3.05 words) followed by the LO condition (i.e., mean gain of 3.8 words). The word reading scores for the control condition did not increase much across the learning trials (i.e., mean gain of 1.6 words).

Children's use of various word reading strategies during the sight word learning posttests was also examined. The numbers of children in each condition who used each strategy at least one time across the first five sight word learning trials was calculated. The first five learning trials were examined because all of the children completed these trials. As Evident in Table 4, children from the LO and control groups attempted to use every strategy and children from the LPA group attempted to use every strategy except for repeating the same word over and over. During both posttests more LO and LPA children attempted to use word reading strategies which employed their letter knowledge and segmentation skills than controls.

Following up on findings of Castiglioni-Spalten and Ehri (2003), the effect of phonemic awareness instruction on children's ability to use partial letter-sound cues during word reading was examined. The number of responses that shared at least two sounds with the written word was counted. Children were given credit for two and three phoneme words that were read correctly plus CVC words that were read incorrectly but that shared at least two sounds with the written word. For example, credit was given for misreading "Bek" as "Be" or "Bake". Binomial logistic regressions were computed to compare the performance of the two treatment groups with the control group on the measure of partial words across both posttests. As evident in Table 3, Wald chi square tests revealed that the log(odds) probability of correct responses was significantly greater

Table 4

Numbers of Children in Each Treatment Condition Who Used Each Strategy at Least One Time Across the First Five Sight Word Learning Trials

	Experimental Conditions		
Word Reading Strategy	Control	LO	LPA
One-Day Sight Word Learning Posttest			
Guessed Unrelated Word	17	15	10
Repeated Same Word across Several Different Target Words	6	5	0
Named Letters in Word	8	9	3
Sounded Out One or More Letter-Sounds	9	19	19
Sounded Out and Blended Letters in Word	7	15	15
Read Immediate and Correct	10	14	16
Seven-Day Sight Word Learning Posttest			
Guessed Unrelated Word	17	12	5
Repeated Same Word across Several Different Target Words	6	8	0
Named Letters in Word	10	7	4
Sounded Out One or More Letter-Sounds	10	18	18
Sounded Out and Blended Letters in Word	4	13	16
Read Immediate and Correct	12	16	17

Note. There were 20 children in each condition

for the two treatment groups than for the control group on the measure across both posttests (see Table 3). In addition, ANCOVAs revealed that children in the LPA condition significantly outperformed children in the LO condition on the measure at both test points. These findings differ somewhat from results of Castiglioni-Spalten and Ehri (2003) who found that children who received articulatory segmentation instruction outperformed controls whereas children who received phoneme segmentation instruction without articulatory pictures did not differ from controls on the measure of words sharing at least two sounds with the written word. It is interesting to note that relaxing the scoring criteria did not raise scores by much. As evident in Table 3, this increased scores by only half to a full word. In other words, children were not guessing the words using partial letters or using partial letters to remember how to read the words. They either read the words correctly or missed by more than two letters. This differs from the 2003 study where this partial measure increased scores in the articulation group substantially.

During the one- and seven-day word learning tasks, words were scored as being read immediately or after a pause. This was done in order to assess whether children were reading the words by decoding or by sight. It was reasoned that words that were read immediately when seen were read from memory by sight, and words that were read after a pause were supported by a decoding strategy. It was hypothesized that both types of phonemic awareness instruction would strengthen children's ability to make connections between letters in a word's spelling and sounds in the word's pronunciation during word learning, and this would lead to more words being read by sight when compared to the word learning of controls. In addition it was hypothesized that children in the LPA condition would read more words by sight during the word learning tasks than

children in the LO condition. The measure of immediate word reading was limited to the first five trials because several children reached criterion at this point. Because they did not complete additional trials, it was not possible to assess whether they read words immediately or after a pause.

Binomial logistic regressions were calculated to compare the performance of the two treatment groups with the control group on the measure of words read immediately and correctly across both posttests. Wald chi square tests revealed that the log(odds) probability of correct responses was significantly greater for the two treatment groups than for the control group on the measure across both posttests (see Table 3). ANCOVAS were calculated to compare the performance of the LPA group with the LO group on the measure at both test points. Results revealed no significant difference between the two treatment groups for the number of words read immediately and correctly, across the first five learning trials, during both posttests.

The reliability of the examiner's scoring for the measures of words read immediately and words read after a pause was assessed during the study. A second tester was trained to observe and record children's word reading performance. The observer was a former preschool teacher who was unknown to the children participating in the study. Each child was introduced to the observer and was told that the observer was a friend of the examiner's and was visiting for the day. All of the children appeared comfortable with the presence of the observer and ignored her once the posttesting session had begun. The observer sat behind the child in a corner of the classroom where she had a view of the word cards as they were presented to the child. The observer scored the responses of 20 children completing the one-day word learning posttest. The

observer and examiner data sheets were compared on the measures of the number of words read immediately and correctly and the number of words read correctly after a pause and were found to be in 99% agreement.

At the beginning of the seven-day posttest, children were asked to remember how to read the six words that were taught during the one-day posttest. It was hypothesized that both types of phonemic awareness instruction would facilitate memory for these words compared to no training, and that LPA training would facilitate performance compared to LO training. Binomial logistic regressions were computed to compare the performance of the two treatment groups with the control group on the measure of children's ability to remember how to read the previously learned words. Wald chi square tests revealed that the log(odds) probability of correct responses was significantly greater for the two treatment groups than for the control group on the measure (see Table 3). ANCOVAs were computed to compare the performance of the LPA group with the LO group on the measure. Results revealed that children in the LPA group remembered significantly more of the previously learned words than children in the LO group after a week's delay (see Table 3).

After both the one- and seven-day word learning posttests, children were asked to recall the spellings of the words they had learned to read. It was hypothesized that both types of phonemic awareness training would facilitate spelling performance compared to no training, and that LPA training would facilitate performance more than LO training. Binomial logistic regressions were computed to compare the performance of the two treatment groups with the control group on the posttest spelling recall measures of sight words spelled correctly as learned and individual phonemes represented with the correct

letters across both posttests. Wald chi square tests revealed that the log(odds) probability of correct responses was significantly greater for the two treatment groups than for the control group on both measures at both test points (see Table 3). ANCOVAs were computed to compare the performance of the LPA group with the LO group on the two spelling recall measures. Results revealed no significant difference between the two treatment groups for the number of words spelled correctly or the number of the individual sounds in words represented with letters.

To summarize, findings from the one- and seven-day word learning posttests revealed that both instructional conditions strengthened children's ability to form in memory connections between letters in spellings and sounds in pronunciations and store them in memory to facilitate word reading and spelling. During both the one- and seven-day posttests, children in both instructional conditions demonstrated higher scores across all of the word learning measures than children in the no treatment condition. During the one-day posttest, the LPA group outperformed the LO group on the measures of words read, partial words read, and trials to criteria. During the seven-day posttest, the LPA group outperformed the LO group on the measures of words read, partial words read, trials to criteria, and words remembered from the one-day posttest. No significant difference was found between the two treatment groups on the measure of words read immediately and the two sight word spelling recall measures across both posttests.

Nonword reading. During the nonword reading transfer task given one day after training ended, children were asked to decode nine nonwords: three VC, three CV, and three CVC. Credit was given for the use of both long and short vowel pronunciations during children's attempts to read the nonwords. It was hypothesized that neither type of

phonemic awareness instruction would facilitate performance in this task compared to no training. The lack of transfer was expected to occur because neither type of phonemic awareness training provided explicit instruction on how to blend sounds into pronunciations, children were unable to decode nonwords on the pretest, and their preschool curriculum did not include reading instruction.

Binomial logistic regressions were computed to compare performance of the LPA group with the LO group on the one-day posttest measure of nonwords read. The control group was dropped as none of the children read any nonwords correctly on the one-day posttest. As evident in Table 3, wald chi square tests revealed that the log(odds) probability of correct responses was significantly greater for the LPA group than for the LO group. Inspection of individual scores revealed that whereas no LO child read more than 4 nonwords correctly, there were six LPA children who decoded between 5 and 9 nonwords correctly (maximum score was nine). This indicates that LPA training enabled some children to improve dramatically in their ability to read nonwords. Because the nonword decoding task followed the word learning task in which children practiced reading real words spelled with the trained letters, perhaps some of the LPA children were helped in figuring out the decoding process. Table 4 reveals that several children in the two treatment groups attempted to sound out and blend letters as they learned to read words over trials, so this procedure was practiced during this task.

CNRep – nonword repetition. On the transfer task of nonword repetition (Gathercole & Baddeley, 1996), children were asked to listen to the pronunciations of 40 words and immediately repeat each after it was heard. The list included 10 two syllable words, 10 three syllable words, 10 four syllable words and 10 five syllable words. It was

hypothesized that both types of phonemic awareness training would facilitate children's performance on the nonword repetition task compared to no training, and that LPA training would facilitate performance more than LO training.

ANCOVAs were computed to assess the effects of training on children's nonword repetition scores. As evident in Table 3, results revealed that the children in both treatment groups repeated significantly more nonwords correctly than children in the control group. However, the results showed no significant difference between the LPA group and the LO group on the measure. Comparison of pretest to posttest performance with paired-sample *t*-tests revealed that mean scores rose significantly in each of the treatment groups but fell significantly in the control group: $t(19) = 2.63$ (LPA), and $t(19)=2.65$ (LO), both ps $< .02$; $t(19) = -3.17$ (C), $p < .01$. These findings indicate that superior performance of the treatment groups on the posttest did not result simply from depressed scores of the control group.

In summary, analysis of the findings revealed that both treatment groups facilitated children's ability to repeat nonwords. Children in the LPA and LO groups performed significantly better on the nonword repetition posttest than children who received no training. However, the performance of the two treatment groups did not differ from one another.

Correlation and Regression Analyses. To examine relationships among the measures, Pearson correlations were calculated on children's scores on selected pretests and posttests where there was sufficient variability. Values are presented in Table 5. Results reveal that of the various pretest measures, the one assessing children's ability to spell the phonemes in nonwords was significantly correlated with the greatest number of

Table 5

Correlations between Pretests and Posttests

Tasks	1	2	3	4	5	6	7	8	9	*M*	*SD*
Pretest											
1. LC Letter Name										17.75	3.9
2. Seg Phonemes	.15									3.78	4.0
3. Spell Phonemes	.33**	.32*								5.62	3.6
4. PPVT-4	-.05	-.15	.11							118.87	6.9
5. Nonword Rep	.39**	.01	.26*	.07						24.02	7.3
One-Day Posttest											
6. Seg Phonemes	.19	.47**	.25	.04	.17					18.02	11.8
7. Spell Phonemes	.10	.32*	.27*	.04	.19	.89**				17.53	8.6
8. Sight Word Learn	.20	.25	.33*	.05	.27*	.79**	.91**			27.55	15.0
9. Nonword Rep	.35**	.19	.28*	.10	.67**	.51**	.61**	.61**		24.50	7.6
10. Gain Non Rep	-.03	.22	.05	.05	-.35**	.44**	.54**	.44**	.46**	0.48	6.1

Note. LC = lowercase letters; *$p < .05$; ** $p < .01$

other pretests including letter name knowledge, phoneme segmentation and nonword repetition. In contrast, the PPVT vocabulary test showed very low correlations with all other measures. The three posttests assessing literacy training and transfer were highly correlated, with *r*s ranging from .79 to .91, indicating that much of the variance in these tasks was shared and that performance in the sight word learning task was heavily dependent on phoneme segmentation and developmental spelling abilities.

Of special interest were relationships between the nonword repetition task, taken as a measure of phonological memory, and performance in the literacy pretests and posttests. From the correlations in Table 5, it is apparent that nonword repetition scores on the pretest were significantly correlated with two pretests involving letter knowledge, lowercase letter names and the spelling of phonemes. Nonword repetition scores on the posttest were also significantly correlated with these two pretest measures as well as the phoneme segmentation, spelling, and sight word learning posttests. This indicates that alphabetic skills are strongly related to nonword repetition ability.

In order to examine whether literacy skill explained significant variance in nonword repetition skill, hierarchical regression analyses were conducted. Results are reported in Table 6. In these analyses, children's entry level ability to repeat nonwords was entered first to eliminate pretest differences. In the first analysis, phoneme segmentation was entered followed by spelling. In the second analysis, these predictors were entered in the reverse order. From the results in Table 6, it is apparent that spelling ability when entered ahead of phoneme segmentation explained all of the unique variance, although it should be noted that the two predictors shared substantial variance. When the nonword repetition pretest was entered after the spelling posttest, it still explained significant

Table 6

Hierarchical Regression Analyses to Predict Gains in Nonword Repetition Task from Pretest to Posttest

Predictors	r^2	*B*	*SE*	Beta	*F*-Change
1 Pretest: Nonword Repetition	.13	-.40	.08	-.47	8.33**
2. Posttest: Phoneme Segmentation: Phonemes	.38	-.09	.11	-.18	23.84**
3. Posttest: Developmental Spelling: Phonemes	.51	.55	.15	.78	14.34**
1. Pretest: Nonword Repetition	.13	-.40	.08	-.47	8.33**
2. Posttest: Developmental Spelling: Phonemes	.50	.55	.15	.78	43.21**
3. Posttest: Phoneme Segmentation: Phonemes	.51	-.09	.11	-.18	0.74ns
1. Posttest: Developmental Spelling: Phonemes	.29	.44	.07	.63	23.31**
2. Pretest: Nonword Repetition	.50	-.40	.08	-.47	24.75**
1. Pretest: Nonword Repetition	.13	-.34	.11	-.40	8.33**
2. Pretest: Lowercase Letter Names	.14	.20	.21	.13	0.91ns
1. Pretest: Nonword Repetition	.13	-.30	.10	-.36	8.33**
2. Pretest: Phoneme Segmentation: Phonemes	.18	.34	.18	.23	3.52ns
1. Pretest: Nonword Repetition	.13	-.33	.11	-.39	8.33**
2. Pretest: Developmental Spelling: Phonemes	.15	.25	.21	.15	1.36ns

Note. ** $p < .0$

unique variance, indicating that both the pre-existing and the trained capabilities contributed to the gain in nonword repetition from pretest to posttest. In additional analyses, other pretests were entered to determine whether each explained any additional unique variance not explained by pretest nonword repetition. As evident in Table 6, none did. From these results, we concluded that the training provided in spelling, that is, teaching children to spell phonemes with letters served to improve children's phonological memory. In the earlier ANCOVA analysis, it was found that the two treatment groups did not differ in the advantage that training provided in repeating nonwords, confirming that letter-sound spelling was the important instructional component that boosted nonword repetition skill.

Chapter 6

Discussion

Summary of Results

The purpose of this study was to compare the effectiveness of two types of phonemic awareness instruction with beginning readers. Children in the LO condition received instruction in letter sound correspondences and their use of these to segment words into phonemes. Children in the LPA condition received the same phoneme segmentation and letter-sound instruction as well as instruction in articulatory picture-sound correspondences and the use of these to segment words into phonemes. Posttests were administered one and seven days after training ended. The posttest measures assessed children's letter-sound knowledge, ability to segment words into phonemes, to create phonetic spellings of nonwords, to decode nonwords, to learn to read a list of phonetically spelled words, to recall the spelling of the words they read, and to repeat spoken nonwords.

The letter-sound, phoneme segmentation and developmental spelling posttests were administered to assess whether children had successfully acquired the skills taught during both types of segmentation training. Results demonstrated that both types of phonemic awareness training were effective. Both the LO and the LPA group outperformed the control group on the posttests assessing phonemic segmentation and developmental spelling as well as letter-sound correspondences. Effect sizes were calculated comparing each training group to the control group and the LPA group to the LO group. The effect sizes were evaluated based Cohen's (1988) rule of thumb in which effect sizes of 0.80 and above are considered large, 0.50 moderate, and 0.20 small.

Results are reported in Table 3. Effect sizes comparing the training groups to the control group on the phonemic segmentation and developmental spelling posttests were very large. These findings indicate that both types of training were effective for teaching phoneme segmentation and spelling skills to beginning readers.

Another question of interest was whether articulation training would provide an added benefit to phonemic awareness training beyond that of letter training alone. Children in the LPA group significantly outperformed children in the LO group on the phoneme segmentation posttests and effect sizes ranged from .45 to .79 (see Table 3). These results provide support for the added benefit of articulation training over letter training for increasing children's phoneme segmentation ability. In contrast, the results for the developmental spelling posttests provided only partial support for the advantage of articulation training. Children who received LPA training outperformed children who received LO training on the developmental spelling posttest immediately following training and effect sizes were .85 and .88. However, the advantage of LPA training was not evident one week after training ended. The preschool children who participated in the study were prereaders who possessed little to no segmentation or spelling skill prior to training. The large effects of training may have occurred because the LO and LPA children had much room for improvement in their segmentation and spelling ability and because controls received no concurrent classroom literacy instruction.

The sight word learning, sight word memory, sight word spelling recall, and nonword decoding posttests were administered to assess whether both types of segmentation training transferred to literacy skills not explicitly taught during training. Both the LO and the LPA groups outperformed the control group on all of the posttests

assessing transfer to children's literacy skills. Effect sizes comparing the treatment groups to the control group were very large indicating that both types of training effectively transferred to the literacy skills of beginning readers. The LPA group outperformed the LO group on the nonword reading and sight word learning posttests both immediately following training and one week later. There was no difference in the performance of the two groups on either of the sight word spelling recall posttests. Effect sizes comparing the LPA group to the LO group ranged from 0.42 to 5.71 across the posttests assessing transfer (see Tables 3). These findings indicate that segmentation instruction involving both articulation and letter training facilitates transfer to the literacy skills of beginning readers more effectively than segmentation instruction involving letters only.

The nonword repetition posttest was administered one day after training to assess whether both types of segmentation training transferred to the phonological memory skill of beginning readers. Both the LO and the LPA group outperformed the control group on the nonword repetition posttest. Both effect sizes were large (see Table 3). However, no difference was found between the two treatment groups in their ability to repeat nonwords. The findings demonstrated that both types of training were effective for increasing children's nonword repetition ability but that articulation training added no benefit when combined with letter training. This suggests that the letter training provided to both training groups was likely the instructional ingredient that was most instrumental in facilitating transfer to children's phonological memory skill.

Acquisition of Phonemic Awareness

The present study was a replication and extension of a study conducted by Castiglioni-Spalten and Ehri (2003) comparing segmentation training with versus without attention to articulatory movements. Letters were not part of the training in the 2003 study whereas letters were involved in training in the present study. Results of both studies found that both types of training were effective for increasing the segmentation skill of kindergartners compared to the no treatment control group. However, in contrast to the 2003 study, training with articulation was more effective for increasing segmentation skill than training without articulation in the present study.

Both LO and LPA instruction resulted in increased segmentation skill despite the limited amount of time spent in training. Children in the LO group received an average of 111.8 minutes of training and children in the LPA group received an average of 149 minutes of training. The Castiglioni-Spalten and Ehri (2003) study demonstrated increased segmentation skill for kindergartners who received only 60 to 120 minutes of segmentation training. The amount of time spent in training was increased from the earlier study in an effort to help preschoolers achieve mastery levels of segmentation skill. However, although trained children in the present study demonstrated significant increases in segmentation skill they failed to achieve mastery levels on the posttests.

While the time spent in training was greater than that in the Castiglioni-Spalten and Ehri (2003) study, training time was still substantially less than that reported in previous intervention studies investigating phonemic awareness skill. For example, children who participated in the Santoro et al. (2006) study received 108, 30 minute small group training sessions over seven months. Children in the Hatcher et al. (1994) study

participated in forty, 30 minute sessions over 20 weeks. The results of both the present study and the Castiglioni-Spalten and Ehri (2003) study demonstrated that it is not necessary to spend large amounts of time on phonemic awareness instruction in order to increase children's segmentation skill. However, more training time may be required in order for children to fully master the ability to segment words into phonemes.

Castiglioni-Spalten and Ehri (2003) observed that the kindergartners in their study found the segmentation training involving articulatory movements to be more engaging than the segmentation training involving blocks. During the present study, children appeared to have greater difficulty learning the articulatory movement picture-sound correspondences than the letter-sound correspondences. However, little difference was observed in the level of enthusiasm displayed by children across the two instructional conditions. All of the children were eager to attend training sessions. Children who were not selected for a particular session would frequently request to be selected for the next session. At the end of the day children would ask when the examiner would be coming back. Children in the LPA condition enjoyed using the mirror and examining their mouth movements during training. Children from both treatment groups were eager to work with the letters and to learn the letter-sound correspondences.

One indicator of children's level of engagement, with both types of segmentation training, was that very little off task behavior was observed during training. The children who participated in the study were very young and it was expected that they might have difficulty concentrating from time to time. However, when children became distracted it was easy to direct their attention back to the current task. In sum, children appeared

enthusiastic about participating in the training and demonstrated great pride in learning to segment words whether they used articulatory movement pictures or letters.

Both instructional conditions were successful in teaching children to segment words into their constituent phonemes, with LPA training more effective than LO training. However, none of the children in either training condition was able to segment all of the words correctly on either posttest. During the one-day posttest, the LO group was able to segment only 18% of the words and 46% of the sounds correctly and the LPA group was able to segment only 32% of the words and 54% of the sounds correctly. During the seven-day posttest, the LO group was able to segment only 26% of the words and 51% of the sounds correctly and the LPA group was able to segment only 36% of the words and 58% of the sounds correctly. This occurred despite the fact that all the children in both training conditions successfully reached criterion on all aspects of training. The findings indicated that both types of segmentation training had a greater impact on children's ability to partially segment words into some of their individual phonemes than on their ability to fully analyze words into all their individual phonemes.

Children who participated in the present study demonstrated little to no transfer from either type of segmentation training to words which included consonant clusters. During the one-day posttest, only 25% of the children who received LPA training and 15% of the children who received LO training were able to segment at least one consonant cluster correctly. During the seven-day posttest, only 30% of the children who received LPA training and 20% of the children who received LO training were able to segment at least one set of consonant cluster sounds correctly. This finding is not

surprising considering that neither type of segmentation training involved words containing consonant clusters.

Castiglioni-Spalten and Ehri (2003) included words containing consonant clusters in both types of segmentation taught in their study. Forty percent of the students failed to reach criterion on the segmentation exit task administered at the end of training. The researchers suggested that this was due to difficulties children encountered while attempting to segment consonant clusters. Children within their study failed to demonstrate mastery levels of performance on consonant cluster words during the posttest segmentation tasks despite receiving training with consonant cluster words. During the one-day posttest segmentation task, 33% of the children who received segmentation training involving articulatory movements and 47% of the children who received segmentation training involving blocks were able to segment at least one consonant cluster word correctly. During the seven-day posttest segmentation task, 62% of the children who received segmentation training involving articulatory movements and 57% of the children who received segmentation training involving blocks were able to segment at least one consonant cluster word correctly. As evident above, a greater percentage of trained children from the Castiglioni-Spalten and Ehri (2003) study were able to segment at least one consonant cluster word correctly during the posttests than trained children in the present study. This finding indicates that direct instruction in consonant cluster segmentation may have had a slight beneficial effect on children's ability to segment consonant clusters even though the skill was just beginning to develop.

The present study taught segmentation to preschoolers and the Castiglioni-Spalten and Ehri (2003) study taught segmentation to kindergartners. The children in

both studies were very young and had received little formal education. Words containing consonant clusters were the most difficult words for these children to segment. It is possible that the ability to segment consonant clusters into their constituent phonemes may require more experience in segmenting the sounds in words across a wider range of contexts than could be provided within the scope of either study.

One reason children from the present study were unable to correctly segment all of the words from the segmentation posttests following training may be due to differences between procedures used during segmentation training and procedures in the posttest segmentation tasks. During segmentation training children were asked to listen to a word, segment the word into its component parts and match each sound in the word to its corresponding letter or articulatory picture. During the instructional phase of segmentation training, children placed each letter or articulatory picture in order in a frame which specified how many phonemes made up each word. During the review phase of segmentation training, children were required to determine the number of phonemes in each word before selecting the appropriate letters or articulatory pictures. In contrast, during the one-day and seven-day segmentation posttests, children were asked to listen to a word, segment the word into its component parts, and select a blank tile for each sound. Children were given no information regarding the number of phonemes in each word. Children from the two training conditions may have had some difficulty transferring the segmentation skills acquired during training to the novel more abstract segmentation posttest. The ability to transfer segmentation skill across word types and tasks may require better instructions, or a longer period of more varied phonemic awareness tasks than were provided in the present study.

While both types of segmentation training were effective for increasing children's phoneme segmentation skill, children who received LPA training were able to segment more words correct both immediately and seven days after training ended than children who received LO training. One explanation for the advantage of LPA over LO training may involve differences in the training procedures administered within the two conditions. During training LPA children were taught to segment words with both mouth pictures and letters. In contrast, LO children were taught to segment words only with letters. To render procedures more equivalent across the two conditions, steps were taken to equate the number of times that children segmented individual words. During training, LO children segmented each word twice in a row using letters within a session whereas LPA children segmented each word twice but in different sessions, once within a session with mouth pictures and once within a session with letters. Superior segmentation performance in the LPA condition may have resulted from this procedure involving distributed practice.

The favored explanation for the benefits of LO and LPA training and for the advantage of LPA over LO training in improving children's phonemic awareness centers on the enhanced nature and accessibility of the phonological representations fostered by each type of training. Both types of training are thought to have supported the development of a phonological representation system that is more segmental and phonemic in nature. Teaching segmentation with letters served to create concrete referents for phonemes that otherwise are ephemeral and disappear as soon as they are spoken or heard in speech. Letters enabled children to conceptualize and distinguish among phonemes in words, to hold them in mind after their acoustic features had

dissipated, and to treat them as objects capable of being manipulated. The phonemes in words became linked in memory to the alphabet letters that represented them and in doing so became part of the child's phonological representation system.

Adding articulatory movement pictures to segmentation training served to enhance the distinctiveness among phonemes by drawing attention to those features that make them distinctive, that is, differences in mouth positions and movements. Also articulatory movement pictures provided an additional concrete basis for holding onto phonemes in order to analyze and manipulate them. The pictures not only provided concrete markers but also taught children to use their own mouths as a concrete basis for monitoring and distinguishing among phonemes. In addition, mouth pictures may have helped to form more secure connections between letters and sounds in memory. The sounds in words became linked in memory to the articulatory movements used to create them and became part of the child's phonological representation system.

Acquisition of Developmental Spelling Ability

One major issue of interest within the present study involved the effect that both types of phoneme segmentation instruction had on the developmental spelling ability of beginning readers. Developmental spelling involves the creation of phonemically accurate word spellings as opposed to the production of conventionally correct word spellings. In order to successfully create phonemic word spellings, children must be able to segment words into their individual phonemes, to determine which alphabet letter represents each phoneme, and to arrange letters in the appropriate order to reflect the sequence of phonemes in speech.

Castiglioni-Spalten and Ehri (2003) also examined the effects of segmentation training on the phonemic spelling ability of kindergartners, but this was a transfer task for them because letters were not part of training. The results of their study demonstrated that both types of training were equally effective for increasing children's spelling skill. Similarly in the present study, even though letters were part of training, results demonstrated that both types of training were equally effective for increasing the spelling skill of preschoolers over the long run. LPA training was more effective than LO training for increasing spelling skill immediately following training, but the advantage did not last.

The finding that both types of segmentation training provided during the present study had a positive effect on the developmental spelling ability of preschoolers was particularly significant because spelling instruction was not part of the literacy curriculum for either of the preschools that participated in the study. The children who qualified for participation in the study had received no formal spelling instruction, either developmental or conventional, prior to receiving segmentation training. Their lack of familiarity with the concept of creating phonemic word spellings was reflected in their low scores on the developmental spelling pretest task. Children were able to represent few if any nonwords and they analyzed only 27% of the phonemes in nonwords on the spelling pretest. In contrast, on the one-day posttest, the LO group accurately represented on average 69% of the words and 76% of the phonemes, and the LPA group accurately represented 70% of the words and 87% of the phonemes in words. On the seven-day posttest, the LO group accurately represented on average 52% of the words and 76% of the phonemes, and the LPA group accurately represented 59% of the words and 81% of

the phonemes. These findings demonstrated that the children from both training groups had effectively learned the spelling skills taught during segmentation training. They had almost reached a mastery level based on a criterion of 80% correct on the posttests despite the fact that they were very young nonreaders.

Findings from the developmental spelling posttests indicated that both types of segmentation training had greater impact on children's ability to phonemically represent partial phonemes in nonwords than on their ability to create full phonemic representations of nonwords. An examination of children's responses during the pretest demonstrated that children were not creating full phonemic spellings for nonwords prior to training. While children were able to represent a few of the phonemes in nonwords correctly prior to training, most letters tended to have little or no connection to the actual sound structure of the nonword pronunciations. This indicates that these children were still pre-alphabetic but ready to transition to the partial alphabetic phase of word spelling prior to training. According to Ehri (1997), children in the pre-alphabetic phase may possess some letter knowledge they can use to spell. However, there is little relationship between the letters in the spellings they create and the sounds in pronunciations. Once children acquire some phonemic awareness and letter knowledge they can move into the partial alphabetic phase of word spelling and are capable of processing a few of the letter-sound correspondences in words during spelling tasks.

Results show that both forms of segmentation training facilitated children's movement into Ehri's (1997) partial alphabetic phase of word spelling. Prior to training, children demonstrated knowledge of letter names and a limited ability to use this knowledge to match letters to the phonemes in words. Following training, children from

both training groups demonstrated letter-sound knowledge and an increased ability to segment words into phonemes and to match the appropriate letters to the phonemes in words.

The level of performance on the developmental spelling posttests was greater than the level of performance on the phoneme segmentation posttests for both treatment groups (ie., *M* = 58% spelling vs 33% segmentation). This may be due to the fact that procedures for the developmental spelling posttest were more similar to procedures for the review section of segmentation training and involved the use of letters in order to mark the phonemes in words. In contrast, the procedures for the phoneme segmentation posttest were different from those employed during training, with blank tiles rather than letters to mark the phonemes in words. Children from both treatment groups may have found it difficult to transfer the concrete phoneme segmentation skills acquired during training to the more abstract phoneme segmentation posttest.

The no treatment control group demonstrated a slight increase in the number of words and the number of phonemes spelled from the pre- to the posttest. On the developmental spelling pretest the control group was able to spell few if any words and only 23% of the phonemes correctly. In contrast, on the one-day posttest, the control group spelled 10 words and 26% of the phonemes correctly, and on the seven-day posttest, controls spelled eight words and 26% of the phonemes correctly. It is possible that this slight increase in performance could be explained through the practice effects of taking the spelling pre- and posttests and through children's general development during the approximately 40 day period between pretest and posttest.

In order to create complete word spellings children must be able to segment words into their individual phonemes, determine which alphabet letter represents each phoneme and arrange the correct letters in the appropriate order. This is a complicated process that can place a significant load on the phonological memory capacity of young children. Both types of segmentation training provided in the current study were effective for increasing children's developmental spelling skill. The positive effect that segmentation training had on children's spelling ability may be due to the nature of the phonological representation system that was fostered by the training. As discussed previously, both types of segmentation training may have provided children with concrete representations in which the phonemes in words were linked in memory with either the letters that represent them or the articulatory movements that create them. The two types of segmentation instruction may have provided children with a more elaborate phonological representation system that supported their attempts to create phonetic spellings of nonwords.

Acquisition of word reading ability

Another major issue of interest was the effect that both types of segmentation training exerted on preschooler's word reading ability. Children's ability to learn to read a set of phonemically spelled words over a series of trials was assessed both one and seven days following training. The sight word learning task was followed by a sight word spelling recall task assessing children's ability to remember the spellings of the words they had learned to read. Children's ability to remember how to read words learned during the one-day posttest was assessed seven-days later. Children's ability to decode nonwords was assessed one day after training ended.

Sight word learning ability. In the present study both training conditions exerted a strong positive influence on children's sight word learning ability. Trained children outperformed controls on all of the sight word learning and spelling recall posttests. Moreover, LPA children outperformed LO children on the sight word learning posttests. However, the two treatment groups did not differ in their performance on the sight word spelling recall posttests. In contrast, Castiglioni-Spalten and Ehri (2003) found that phonemic awareness training exerted little effect on children's ability to learn to read a list of words over a series of trials when correctly read words were scored. Differences across the two studies may be due to the nature of the segmentation training provided within each study. Training in the present study included instruction in letter-sound correspondences and the use of alphabet letters in order to represent the phonemes in words. In contrast, the segmentation training provided in the Castiglioni-Spalten and Ehri (2003) study involved the use of either articulatory movement pictures or blocks in order to mark the phonemes in words. No letter training was included. Previous intervention studies have demonstrated that phonemic awareness training exerts the strongest positive effect on the literacy skills of beginning readers if it is provided as part of formal reading instruction (Hatcher et al., 1994). The inclusion of letter training in the present study may have made the connection between the letters in the word spellings and the sounds in word pronunciations more explicit for children during the reading and spelling posttest tasks.

In the 2003 study, the sight word learning task proved difficult because the words all began with the same letter causing children to mix up the words based on partial cues. Castiglioni-Spalten and Ehri (2003) examined children's use of partial letter cues during

word learning by giving children credit for words sharing at least two grapheme-phoneme relations with the written words. This scoring procedure resulted in a significant effect of articulation training.

One purpose of the present study was to investigate whether simplifying the word learning task and adding letters to the segmentation training would result in greater effects on children's ability to remember how to read words over a series of trials. The same task was used but the words had fewer letters and the initial letters were not all the same. The incorporation of letters into the articulation segmentation training and the use of a better designed word learning task resulted in more pronounced training and articulation effects. Both training groups out performed controls and the LPA group outperformed the LO group on the measure of words read correctly. Giving children credit for the use of partial letter cues during word learning did not result in significant increases in group means over the word reading measure. The findings clearly demonstrate that children were not relying on partial letter cues in order to remember how to read words. The addition of letters to segmentation training facilitated children's ability to fully analyze the letter-sound connections in words and to use these connections to remember how to read words and articulation training provided a special advantage over letter training.

All of the children in the present study were observed using a variety of strategies in order to read words during the word learning test trials (see Table 4). Children's strategies use across the first five trials was examined because all of the children completed these trials. Children in the control group tended to employ strategies that resulted in fewer correct word readings than those employed by trained children (see

Figures 2 and 3). Strategies used by controls included counting letters in word spellings, naming letters in word spellings, guessing unrelated words, repeating the same word across several different target words, and repeating the previous word.

Trained children employed word reading strategies which resulted in increased numbers of correct responses with each successive trial (see Figures 2 and 3). This occurred because children who received segmentation training were more apt to employ word reading strategies that made use of their letter knowledge and segmentation skills even though the connection between these skills and word learning was not made explicit during the sight word learning task. These strategies include the use of partial letter cues, sounding out of letters in word spellings and blending of letter sounds during word reading.

All of the children in both treatment groups utilized more than one strategy across the first five trials. Children from both treatment groups demonstrated a tendency to progress from less effective to more sophisticated strategies. For example, several LPA children moved from random guessing, to use of partial letter cues, to sounding out without blending, to sounding out and blending, to reading words by sight. Several LO children moved from naming letters in word spellings, to sounding out a few letters in word spellings, to sounding out all the letters in spellings without blending, to sounding out and blending. The majority of children combined strategy use across trials with one strategy being phased out as another was being adopted.

Consistent, reliable word reading is dependent on the development of a strategy for sounding out the letters in a word's spelling and then blending these sounds together to produce the correct word pronunciation. Despite the fact that the strategy of sounding

out and blending was not explicitly taught during the study, some children from all of the groups demonstrated this skill. More trained children than controls successfully used the sounding out and blending strategy at least once during the first five trials. During the one-day posttest, 75% of the LO and LPA children used the strategy at least once compared to 35% of the control children.

The nature of the feedback provided to children during the word learning test trials combined with the skills acquired during training may have guided the development of the sounding out and blending strategy. Each time a child misread a word during the test trials the examiner would show the child the word card and provide them with the correct word pronunciation. Children were given no information on possible strategies that could aid them during future attempts at reading the word. With each word reading attempt, children may have developed the understanding that the sounds they heard in pronunciations corresponded to the letters they saw in spellings. This realization could have led them to the discovery of the sounding out strategy. In addition, children from the LPA group reached criterion in significantly fewer trials than LO children across both posttests. This indicates that LPA children developed the ability to blend the sounds they recognized in word spellings into pronunciations earlier during word learning than LO children. It is possible that the articulation training provided to the LPA group may have facilitated the development of blending skill by drawing children's attention to the flow of their articulatory movements as they combine the sounds in words.

According to Ehri (1994), unfamiliar words can be read by prediction, analogy or decoding while familiar words are read from memory. Decoding an unfamiliar word involves sounding out each letter in the word's spelling and then blending the sounds to

produce a recognizable word. When an unfamiliar word is successfully decoded, the reader has fully analyzed the relationship between all the letters in the word's spelling and the sounds in the word's pronunciation. An unfamiliar word becomes familiar and capable of being read from memory after it is successfully decoded over several different occasions. According to the connectionist view of word learning proposed by Ehri (2005) and others, remembering how to read familiar words involves making connections between the letters in spellings and the sounds in pronunciations. These connections are then stored in memory along with the word's meaning. When a familiar word is subsequently encountered during reading, that word's pronunciation, spelling and meaning can be automatically retrieved from lexical memory.

In order to examine whether children in the study were reading words by decoding or from memory, a measure of the number of words read immediately and correctly was calculated based on children's performance across the first five trials. Words that were read immediately and correctly were assumed to be read from memory. Words that were read correctly after a pause were assumed to be decoded. The results show that trained children read more words immediately and correctly across the first five trials than children who received no treatment. The two treatment groups demonstrated similar performance on the measure.

However, there is a problem with the original assumption that words read immediately and correctly were being read from memory and that words read correctly after a pause were being read by decoding. An analysis of children's behaviors during the word learning trials shows that not all of the words read correctly after a pause were read as the result of a successful decoding attempt. Some of these words were the result

of children sounding out only a few of the letters in the word's spelling and combining the partial letter cues with their memory for words on the word list. For some words read correctly after a pause, children gave no outward indication of the strategy that was being used in order to read the words. This was particularly true during the last three trials for the children who reached criterion on the task. It is possible that the children knew the word as soon as they saw it but paused in order to double check the word in memory.

The sight word spelling recall posttest was administered immediately following both the one- and seven-day word learning posttests. During this posttest, children were asked to remember the spellings of the words they had just learned to read. Results showed that trained children remembered how to spell more of the previous words correctly than controls. However, the LPA and LO groups demonstrated similar performance on the measure. These findings indicate that by the end of the learning trials, both types of segmentation training had facilitated children's ability to form connections between the letters in word spellings and the sounds in word pronunciations.

While the effects of articulatory segmentation training were substantial in the word learning tasks they were more limited or nonexistent in the spelling tasks. Castiglioni-Spalten and Ehri (2003) reported the same results in their study. They suggest a possible explanation involving the difference between implicit automatic attachment of graphemes to phonemes within words during word learning versus explicit deliberate accessing of phonemes and linking them to graphemes during a spelling task. When children practiced reading words, no attention was directed at phonemic awareness or grapheme-phoneme mappings so connections were activated "out of awareness" and hence benefited from better articulated phonemic representations. In contrast, when

children spelled words, they focused on and searched for the phoneme segments in order to select letters. Moreover, both groups were taught to spell phonemes with letters in this way, hence limiting the presence of spelling differences between the groups.

We expected that superior word learning would be accompanied by superior spelling of the words that were read. However, the LPA group did not remember the spellings of the words any better than the LO group. One possible explanation is that rather than accessing their memory for letters in the words, both groups simply "invented" spellings as they were taught to do during segmentation training. To pursue this, we took as a measure of invented spelling children's scores on the nonword spelling (NSp) posttest and examined whether this measure was more highly correlated with their spelling accuracy scores on the words they had learned to read (WSp) than on their word reading scores over trials (WRe). The analysis was limited to trained children (N=40). Results of t-tests confirmed that the difference between correlations was significant. On the immediate posttests, r (WSp:NSp) = 0.68 vs. r (WSp:WRe) = 0.49, $t(37) = 1.99$, $p<.05$ one-tailed; on the delayed posttests, r (WSp:NSp) = 0.70 vs. r (WSp:WRe) = 0.42, $t(37) = 2.62$, $p<.01$. These findings suggest that memory for letters in words contributed less to the way children spelled words they had learned to read than invented spelling procedures. This may explain why articulation training did not enhance performance in this task.

The present study supports findings from previous studies that have demonstrated the positive impact that word reading has on children's word spelling (Ehri, 1997). Previous studies have found effects of word reading on word spelling with older children. For example, Conrad (2008) demonstrated effects with second graders and Share (2004)

with third graders but not first graders. The present study extended results down to preschoolers and demonstrated that learning to read words aided them in spelling the words.

The sight word memory posttest was administered seven days after training ended to assess children's ability to remember how to read previously learned words. Trained children remembered how to read more of the previously learned words than controls and LPA children read more words than LO children. None of the control children were able to read all of the words from the previous word list correctly while five LPA children and one LO child were able to read all six words correctly.

According to the connectionist view (Ehri, 2005), words that are fully analyzed during the word learning trials should be secured in memory by connections that are made between sounds and letters in the words. The pronunciations for these word spellings should be automatically accessed in memory during future reading attempts. Alternatively, if children discover how to sound out and blend words during the learning trials they should be able to decode any words not stored in memory. Results indicated that both types of training, particularly LPA training, had a positive effect on both types of word reading abilities.

Decoding ability. During the nonword decoding posttest, given one day after training, children were asked to read a set of VC/CV and CVC nonwords. Children's performance on this posttest was generally poor across the three groups, indicating that most children encountered difficulties decoding nonwords. Children in the control group were unable to decode any nonwords, and children receiving LO training decoded few if

any nonwords. In contrast, children receiving LPA instruction decoded some nonwords, significantly more than LO children.

Effects of segmentation training differed on the two posttests requiring children to read words and nonwords. Both types of segmentation training enhanced children's word learning ability, with LPA training facilitating word learning more than LO training. However, LPA training increased the nonword decoding skill of some children whereas LO training did not. This may have resulted from differences in the nature of the two tasks. During the nonword decoding posttest, children were given only one chance to read each nonword on the list without any corrective feedback. During the word learning posttest, children had eight chances to read each word across trials. Each time a child misread a word the examiner displayed the word's spelling and provided the correct pronunciation. The multiple word reading attempts and the feedback provided in the latter task may have aided children in using their letter-sound knowledge and segmentation skill to develop effective word reading strategies. However, this does not explain why LPA children were able to decode significantly more nonwords than LO children.

It is not surprising that trained children had difficulty decoding nonwords considering that neither type of segmentation training involved instruction in how to blend individual phonemes into word pronunciations. It is interesting that although LPA children had difficulty decoding nonwords, they significantly outperformed LO children. One possible explanation for the increased nonword decoding ability demonstrated by LPA children can be found in the strategies they were observed to use during the word learning posttests. Both LO and LPA children sounded out the letters in word spellings

and blended the sounds into word pronunciations during word learning. However, LPA children developed the decoding strategy earlier and used the strategy more effectively than LO children as suggested by the fact that LPA children reached criterion on the task in significantly fewer trials than LO children. It is possible that the articulatory training aided LPA children in the discovery of the blending process by making the relationship between the articulatory gestures used to create sounds and the letters that represent sounds more apparent. The nonword decoding posttest followed the sight word learning posttest. Some children from both treatment groups were observed attempting to use the decoding strategy during the nonword decoding posttest. However, LPA children were more successful at transferring this strategy from the word learning to the nonword decoding posttest.

Implications for phase theory. An issue of interest within the present study involved the effect both types of segmentation training would have on children's position within Ehri's (2005) phases of word reading. Ehri (2005) proposed that children pass through four phases of word reading on the way to developing sight word reading ability. Each phase is characterized by the extent of alphabetic knowledge available for children to use during word reading. The phases are pre-alphabetic, partial alphabetic, full alphabetic, and consolidated alphabetic.

Children selected for participation in the study were capable of functioning in the early partial alphabetic phase of word reading prior to the start of training. Children move from the pre-alphabetic to the partial alphabetic phase when they acquire some alphabetic knowledge that they can use during word reading. Partial alphabetic readers make connections between a few of the letters in word spellings and some of the sounds

in word pronunciations during word reading attempts. They are unable to make connections between all of the letters and sounds in words because they possess limited alphabetic knowledge and limited phoneme segmentation ability.

Pretests showed that all of the children possessed sufficient letter knowledge prior to the start of training. Every child was able to name the 15 uppercase target letters used during training and at least 20 of the 26 uppercase letters of the alphabet. In addition, the children demonstrated limited phonemic segmentation ability at the time of pretesting. All of the children demonstrated difficulty in segmenting words during the pretest with 100% of the control and LO children and 95% of the LPA children receiving zero scores (see Table 1). The children demonstrated some ability to use their limited alphabetic knowledge while attempting to spell nonwords. The majority of children were unable to spell any words correctly with 95% of the control children, 100% of the LO children and 90% of the LPA children receiving zero scores. However, the group means showed that children were able to represent a few of the phonemes in words correctly (see Table 1).

Results showed that control children were still functioning in the early partial alphabetic phase of word reading at the time of posttesting. During the one-day posttest, only one of the 20 controls knew all 15 of the letter-sound correspondences taught to the experimental groups during segmentation training. The remaining 19 controls demonstrated knowledge of at least one but no more than 13 of the letter-sound correspondences. In addition, controls continued to demonstrate little to no phonemic segmentation ability at the time of the posttests with 90 % of controls unable to segment any words correctly (see Table 3).

Controls demonstrated limited ability to use their alphabetic knowledge to read and spell words. On the one-day developmental spelling posttest, 80% of controls were unable to spell any nonwords correctly but 90% were able to represent at least one phoneme correctly. On the seven-day developmental spelling posttest, 85% of controls were unable to spell any nonwords correctly but 100% were able to represent at least one phoneme correctly (see Table 3). During both sight word learning posttests, the control group means were low for the number of words read correctly but only 5% of controls received zero scores when the children were given credit for the use of partial letter cues during word reading attempts (see Table 3).

In contrast, posttest results demonstrated that both types of segmentation training strengthened children's position as partial alphabetic readers and that LPA training was more effective than LO training. Both training groups demonstrated increased phoneme segmentation ability from pretest to posttest with LPA children demonstrating greater increases than LO children (see Tables 1 and 3). During the one-day posttest, 75% of LO children and 90% of LPA children were able to segment at least one word correctly. During the seven-day segmentation posttest, 85% of LO children and 80% of LPA children were able to segment at least one word correctly. In addition, the means for both training groups increased from pretest to posttest for the number of phonemes segmented correctly (see Table 3).

The LO and LPA groups demonstrated the ability to use their alphabetic knowledge to read and spell words during both posttests. Both treatment groups demonstrated increased phonemic spelling ability from pretest to posttest with LPA training being more effective than LO training. During the one-day posttest, 95% of the

LO children and 100% of the LPA children spelled at least one nonword. During the seven-day posttest, all of the children from both treatment groups spelled at least one nonword. In addition, the means for both groups increased from the pretest to the posttests on the number of phonemes represented correctly (see Table 3). During both sight word learning posttests, all of the children in both treatment groups were able to read at least one word correctly and the means for both groups were high (see Table 3 and Figures 2 and 3).

While both types of segmentation training strengthened children's position as partial alphabetic readers neither type of training was able to move children into the full alphabetic phase. During the full alphabetic phase of word reading children are able to use their more complete alphabet knowledge combined with the ability to fully segment word pronunciations to remember how to read words. At this phase children secure words in memory based on connections between all of the letters in written words and all of the phonemes in word pronunciations.

While trained children demonstrated knowledge of the 15 letter-sound correspondences they were taught there are still many letter-sound correspondences left for them to learn. During training children were taught to fully analyze the phonemes in spoken words during spelling attempts. However, trained children were unable to create fully phonemic spellings for all of the nonwords during the posttests. Trained children were observed attempting to analyze the letter-sound correspondences in words during word reading attempts. However, an analysis of children's strategy use showed that trained children did not fully analyze words on a consistent basis during word reading (see Table 3). While more LPA than LO children demonstrated decoding skill the

number of nonwords successfully decoded by both groups was generally low (see Table 3).

All of the children who participated in the study were very young prereaders who had received no formal phonemic awareness, reading, or spelling instruction prior to the start of training. These children possessed minimal phoneme segmentation, word reading and spelling ability at the time of pretesting. In fact, this was a requirement for inclusion in the study. It is encouraging how easy it is to strengthen their position in the partial alphabetic phase and to provide them with the foundation necessary to move into the full alphabetic phase.

Acquisition of Nonword Repetition Ability

Although the major focus of the study involved the transfer of phonemic segmentation training to the word reading and spelling abilities of preschoolers, the effect of both types of segmentation training on the phonological memory of preschoolers was also investigated. Phonological memory is a phonological processing skill which involves the ability to represent sound-based information in working memory for storage during processing. The existence of a relationship between young children's phonological awareness and phonological memory has both theoretical and experimental support.

Phonological awareness encompasses a number of tasks all of which require the ability to attend to and manipulate the phonemes in words. Examples of phonological awareness tasks include deciding if two words rhyme, blending individual phonemes to form word pronunciations, and segmenting a word pronunciation into its constituent phonemes. All of these tasks require that words and the phonemes that make up these

words be held in working memory while the appropriate operations are performed on them. In this way, children's phonological memory capacity is related to their ability to perform phonological awareness tasks.

Longitudinal and correlational studies have examined the latent phonological processing abilities of preschool children and the relations of these phonological abilities to emergent literacy skills (Anthony, Williams, McDonald, Corbitt-Shindler, Carlson, & Francis, 2006; Anthony, Williams, McDonald, & Francis, 2007; Wagner, Balthazor, Hurley, Morgan, Rashotte, Shaner, et al., 1987). All of these studies identified phonological awareness and phonological memory as being separate from general cognitive ability. Wagner et al. (1987) found that phonological awareness and phonological memory represented a single factor for English speaking 4 and 5 year olds in their studies. In contrast, Anthony et al (2006) examined the phonological awareness and phonological memory of Spanish speaking 3, 4, & 5 year old American children. After controlling for general cognitive ability, the examiners identified Spanish phonological awareness and Spanish phonological memory as separate factors uniquely related to the children's early literacy skills. Anthony et al. (2007) also examined the phonological awareness and phonological memory of English speaking 3, 4, & 5 year old children. After controlling for general cognitive ability, the examiners identified phonemic awareness and phonological memory as separate but correlated abilities regardless of skill level. Despite the contradictory nature of these findings, they support the existence of a relationship between young children's phonological awareness and phonological memory. However, these findings do not examine the exact nature of this relationship. This is an issue that was investigated in the present study.

The Children's Test of Nonword Repetition (Gathercole & Baddeley, 1996) was administered during the present study in order to assess preschooler's phonological memory capacity. The CNRep assesses phonological memory capacity by tapping the underlying phonological representations that are available for memorial processing (Gathercole & Baddeley, 1996). During the nonword repetition task, children were asked to repeat a series of 2, 3, 4, and 5 syllable nonwords.

According to Gathercole (2006), the ability to create accurate spoken repetitions of nonwords depends on the phonological working memory capacity of the individual child. The constituent phonemes that make up a nonword must be stored in working memory during repetition attempts. This ability to store phonemic information in working memory during processing is influenced, in part, by the quality and durability of the phonological representations possessed by the child. These phonological representations are the building blocks used to reconstruct an accurate spoken match for the previously heard nonword pronunciation. The possible impact of children's graphophonemic skills for improving children's phonological memory has been neglected within Gathercole's (2006) theory.

It was anticipated that both types of segmentation training would have a positive influence on children's nonword repetition ability through their impact on children's phonological representation systems. Both types of training may foster a more segmental understanding of the sound structure of words and may link the phonemes in words to the corresponding alphabet letters. The enhanced phonological representation system would in turn support the working memory processes involved in the nonword repetition posttest. In fact, results of the nonword repetition posttest demonstrated that children

who received both types of segmentation training were able to accurately repeat significantly more nonwords than controls on the posttest but the groups did not differ on the pretest.

In addition, it was anticipated that LPA training would enhance children's phonological representation system above LO training by linking the phonemes in words to both the corresponding alphabet letters and articulatory movements. In turn, this more elaborate phonological representation system would provide even greater support to the working memory processes. Based on this hypothesis, LPA children should have been able to repeat more nonwords correctly during the posttest than LO children. However, no difference was found in the performance of the two treatment groups suggesting that LO and LPA training exerted equal effects on preschooler's nonword repetition skill.

Findings of the regression analyses showed that performance on the developmental spelling posttest explained the most variance in gains in nonword repetition from pretest to posttest after taking account of pretest nonword repetition performance (see Table 6). In addition, naming lowercase letters and developmental spelling were the only pretests that correlated significantly with the nonword repetition pretest. These analyses taken together with the finding of no difference in the performance of the two treatment groups suggest that teaching children to represent phonemes with letters was the most important form of enrichment to the phonological representational system that facilitated children's ability to repeat nonwords.

One possible explanation is that as children learn to spell, the letter-sound connections in words may become integrated into the phonological representation system. This amplifies phonemes and prolongs their duration in memory when words are

heard and hence the ability to repeat nonwords is enhanced. Rosenthal and Ehri (2008) found the orthographic knowledge of school age children to be strongly correlated with their memory for spoken words. This was true whether the children were exposed to the written form of the word or not during word learning. During the present study, children were taught to create phonemic spellings for nonwords rather than to produce conventionally correct spellings. Training children to create phonemic nonword spellings provides them with the most basic level of orthographic knowledge, specifically, the understanding that words are made up of individual phonemes and that each phoneme can be represented by a specific alphabet letter. Children's scores on the one-day developmental spelling posttest were strongly and positively correlated with children's scores on the nonword repetition posttest (see Table 5). This finding adds support to the Ropsenthal and Ehri (2008) finding that a relationship exists between children's orthographic knowledge and phonological memory.

The correlations in Table 5 show that children's scores on the nonword repetition posttest significantly correlated with their scores on the sight word learning posttest. The present experimental study provides support for the findings of previous studies which demonstrated high positive correlations between children's phonological memory capacity and reading achievement. Previous studies have found that good readers tended to have better phonological working memories for words than poor readers (Rapala & Brady, 1990; Rohl & Pratt, 1995; Snowling Goulandris, Bowby, & Howell, 1986; Stone & Brady, 1995). These findings have led to the assumption that phonological working memory is a contributor to children's reading achievement.

While the present findings support the existence of a significant relationship between children's literacy development and phonological memory, they indicate that the relationship may actually run in the other direction. In fact, the findings show that the spelling training provided to the children in both instructional conditions contributed to children's phonological memory. Teaching children to represent the phonemes in words with alphabet letters effectively increased children's ability to repeat nonwords.

Strengths and Limitations

The present study examined the effects of providing beginning readers with phonemic awareness instruction involving either letter manipulation only or letter manipulation plus articulation training. The results demonstrated that both types of segmentation training benefitted phoneme segmentation skill and transfer to word learning, developmental spelling and phonological memory. In addition LPA training had a greater effect than LO training on phoneme segmentation skill, transfer to word learning, developmental spelling, and nonword decoding.

The present study was an experiment with a pretest-posttest control group design in which participants were randomly assigned to the three experimental conditions. This allows the positive effects of training, demonstrated in the posttest results, to be attributed soley to the instructional treatments that were manipulated. The positive effects of training on children's phonemic segmentation and sight word learning ability were found one day following training and persisted for up to seven days. Twenty children participated in each of the three conditions resulting in a total of 60 participants. This provided sufficient statistical power for hypothesis testing.

Threats to the internal validity of the study were addressed. During the present study, children were matched to form triplets, based on similar scores on the segmentation, nonword/word reading, developmental spelling and vocabulary pretests, and members were randomly assigned to each of the three conditions. This method of assigning participants to conditions is generally considered to strengthen a study. A problem occurred because the majority of children received zero scores on the pretest measures used to form triplets. This resulted in the matches being based largely on children's pretest scores on the PPVT-4. It would have been better to match triplets based on the pretest measures that resulted in the greatest variability between children's scores. For example, the findings from the phoneme segmentation measure of sounds segmented correctly and the alphabet letter measures of the total uppercase/lowercase letters named correctly demonstrated variability across children's scores. By chance the LO group demonstrated a significantly higher level of performance on the phoneme segmentation measure of sounds segmented than the control group. This problem was addressed through the use of the pretest phoneme segmentation scores as a covariate in the binomial logistic regression and ANCOVA analyses.

During segmentation training children in both the two instructional conditions received as many training sessions as were necessary in order for each child to reach criterion on all sections of training. The decision to structure training based on a performance criteria rather than on instructional time was made in order to increase the chances that both treatment groups would achieve similar mastery levels of phoneme segmentation ability. Children in the LO group were taught to segment words with letters and children in the LPA group were taught to segment words with both letters and

mouth pictures. This resulted in LPA children spending significantly more time in training than LO children. Instructional time was found to explain none of the variance when included as a covariate in the posttest analyses. In addition, correlations revealed no relationship between instructional time and posttest performance. These findings show that instructional time is not a viable explanation of outcomes.

Castiglioni-Spalten and Ehri (2003) reported differences in the motivational level of the two instructional conditions within their study. Children who were taught to segment words with mouth pictures demonstrated higher levels of engagement and less off task behavior than children who were taught to segment words with blocks. In contrast, children from both instructional conditions administered in the present study demonstrated high levels of engagement during training. The experimenter noted that children from both treatment groups were able to pay attention and follow instructions during training. Children in the LPA group enjoyed using the mirror to watch their mouth movements. Children from both treatment groups were excited about learning to work with the letters and would often spontaneously point to letters and say their sounds as the experimenter set out the tiles. The children demonstrated a strong desire to learn and expressed pride in their achievements. These observations suggest that motivation was not a confounding variable between the two treatment groups in the present study.

The present study has limited external validity. Children were sampled from two preschools located in upper middle class neighborhoods. The parents of these children tended to be very involved in their children's education. This was demonstrated by the high percentage of signed consent forms that were returned to the examiner (95%). In addition, the vocabulary levels of the children who qualified for participation in the study

were above the national norms on the PPVT-4. The sample was drawn from a narrow population making it unclear whether results would generalize to other populations. Future studies are needed to examine the effects of segmentation instruction involving letter and articulatory training on other student populations, such as children at risk, or older students in kindergarten, or lower SES students.

A study performed by Castiglioni-Spalten and Ehri (2003) examined the effect of articulation training on the phonemic awareness, reading, and spelling ability of lower SES kindergartners. The study found that teaching children to attend to their articulatory movements during phonemic segmentation instruction resulted in increased phonemic awareness, spelling and phonetic cue reading ability. These results provide some evidence that combining articulation training with phonemic awareness instruction may be effective with lower SES populations.

Preschoolers in Literacy Research

The present study examined the effects of two types of phoneme segmentation training on the early literacy development of preschoolers. The involvement of preschoolers as participants is an aspect of the study that deserves some attention. The majority of studies examining children's reading development tend to involve older children who are receiving concurrent reading instruction in school. The choice to focus on the development of older children may be due to an assumption that preschoolers are too young to effectively participate in training programs and are developmentally unprepared to learn the skills necessary for the development of early literacy skills.

The results of the present study demonstrate that when studies are designed to be sensitive to the children's young age and developmental phase, preschoolers can

successfully undergo and complete training. For example, during the present study training sessions were 20 minutes or less and children participated in as many training sessions as were necessary to reach criteria on all of the training tasks. This allowed a child to participate in a greater number of shorter training sessions if they encountered difficulties in concentrating for the full 20 minute session. As a result, all of the children in both training groups successfully reached criteria on all aspects of training. In addition, all of the children were able to participate for the full 20 minutes per session by the end of training.

Children who participated in the present study were very young. The mean age of participants was 4.9 years with the youngest child being 4.1 years. Results showed that children as young as four years can successfully acquire the segmentation skills and alphabet knowledge that are the foundation for early literacy development. The preschoolers were able to learn the letter-sound and articulatory movement-sound correspondences for 15 alphabet letters and how to use these correspondences to create phonemic word spellings. In addition, the children demonstrated that they were capable of transferring the skills taught during training to phoneme segmentation, word reading and nonword repetition tasks.

One advantage of preschoolers as participants in research examining early literacy development is that these children have not begun receiving formal reading instruction. This provides researchers with the opportunity to examine the effects of training prior to the influence of formal reading instruction on the children's reading development. Older children have already begun their educational careers and bring their knowledge base and educational experiences to the study. This can undermine effects of the experimental

treatment. The use of preschoolers as participants allows study results to be attributed to the experimental treatment provided rather than to an interaction between ongoing educational experience and treatment. In addition, the control group is not subject to the influence of competing classroom instruction during the course of the study. This allows a more accurate calculation of training effects. For example, the present study reported large effects of training for many of the posttest measures. This could be due, in part, to the fact that controls remained in the regular preschool classroom during the study and did not receive formal reading instruction as part of their curriculum.

One potential difficulty that can arise from the use of preschoolers as participants during literacy research comes from the children's status as prereaders. Preschoolers often possess little to no ability in the areas of interest within early literacy research. This can result in a higher proportion of zero scores in the data collected. This issue can be addressed through the selection of statistical analyses capable of handling skewed distributions of scores. Within the present study, children were selected for participation based on their possessing little to no segmentation, spelling or word reading ability prior to the start of training. This selection process resulted in a high proportion of zero scores for all the children across the pretest measures and for controls across the posttests measures. This problem was addressed through the use of Binomial logistic regressions instead of ANOVAs in order to determine whether the three groups were equivalent on the pretest measures prior to training and to compare the performance of the two training groups to the control group on the posttests measures.

Implications for Practice and Future Research

Findings from the present study carry important educational implications. The development of early literacy skills is given a high priority within the current preschool curriculum utilized in today's schools (Christie & Roskos, 2006; Scott-Little, Kagan, & Frelow, 2006). Research has identified a number of literacy skills as being necessary for children's future reading achievement. Phonemic awareness ability is generally recognized as providing the foundation for young children's early reading and spelling development (Snow et al., 1998). The present study demonstrated that children as young as preschoolers are capable of participating in and benefitting from phonemic awareness training. In addition, the study shows that effective phonemic awareness training can be provided to preschoolers without expensive materials. This suggests that phonemic segmentation training should hold an important position in the preschool classroom.

The findings from the present study demonstrated the beneficial effects of including training in sound-letter spelling and articulatory picture-sound correspondences to teach phoneme segmentation. This indicates the importance of including both ingredients in the systematic phonics instruction provided by teachers to beginning readers. It is important for teachers at the preschool level to be taught about phonological awareness and its importance for early literacy development in order to promote more phonological awareness instruction as part of preschool classroom education.

Further experimental research is needed to provide support for the findings of the present experimental study regarding the directionality of the causal relationship between children's early literacy skill and phonological memory skill. Results from previous correlational studies have led to the conclusion that children's phonological memory

capacity predicts children's reading ability. In contrast, results from the present study indicate that training aimed at increasing young children's graphophonemic skills had a beneficial effect on their phonological memory skill. Previous studies examining children's phonological memory skill have failed to adequately address the importance of graphophonemic skills to the development of children's phonological memory skills. This is also a topic that requires future attention from researchers.

Appendix A

Consent Form

To Parents of Students

My name is Nancy Boyer and I am a student in the Educational Psychology PH.D. program at the Graduate Center of the City University of New York (CUNY), and the Principal Investigator of this project, entitled "Phonemic awareness instruction: Effects of letter manipulation and articulation training on learning to read and spell."

I invite your child to participate in this research project. Its purpose is to study how beginners can be taught to detect the sounds in words and to relate the sounds to letters and how this helps them learn to read and spell words. I will work with each student individually during school hours. First I will give students some tasks in order to see how much the student knows about the letters and sounds in words. Some of the students, whose performance indicates that they would benefit from my instruction, will receive tutoring. The study will involve ten to thirteen sessions with each session lasting about 25 minutes. Children who participate in the study will miss approximately 20 to 30 minutes of class for 10 to thirteen days. During the training sessions, children will be taught to divide words into sounds. At the end of training, I will give students some tasks to see whether the training helped them do better in reading and spelling. A randomly selected group of students will be assigned as the comparison group. They will be given the assessment activities but will not receive the instruction. There will be approximately

60 students who participate in the study. All the sessions will be recorded on audio tape so that I can check the accuracy of my data collection.

There will be no charge for the instruction. There are no known risks for children participating in the study. The tasks given to the students will be like those they perform in school as part of reading instruction. Children who participate in the study will benefit by learning to read and spell some new words.

In order for your child to participate, I must obtain your written permission. If you agree to this, please sign the permission form below and return it to your child's teacher as soon as possible. You may keep the second copy for your files.

Participation in this study is voluntary. Parents are free to withdraw their children from the study at any time and for any reason without consequence. In addition, children may choose to withdraw from the study at any time for any reason without consequence. Information about your child's reading and spelling skills that is useful to your child's teacher will be provided if the teacher asks for it provided you have no objection. All information gathered will be kept strictly confidential and will be stored in a locked file cabinet, to which only I, and my university advisor, will have access. The identities of all participants in the study will remain anonymous.

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

If you have any questions about this research, you can contact me at 914-234-6160 or nboyer9@aol.com, or my advisor Dr. Linnea Ehri at 212-817-8294 or lehri@gc.cuny.edu . If you have questions about your rights as a participant in this study, you can contact Kay Powell, IRB Administrator, The Graduate Center/City University of New York, (212) 817 – 7525, or kpowell@gc.cuny.edu.

Thank you for considering this request. If you agree to have your child participate, please sign blow:

I grant permission for my child named _____ to participate.

_____

(Signature of parent/guardian) (Date)

_____

(Signature of Investigator) (Date)

I agree to allow my child to be audio taped during the tutoring sessions.

_____

(Signature of parent/guardian) (Date)

I agree to allow information regarding my child's reading and spelling skills to be given to their teacher.

_____

(Signature of parent/guardian) (Date)

Formulario de consentimiento

Dirigido a los padres de alumnos,

Mi nombre es Nancy Boyer, estudiante de filosofía educacional PH.D en el programa del Centro de Graduados de la Universidad de Nueva York (CUNY), y principal investigador de este proyecto denominado: “Importancia de la Instrucción Fonética: efecto de la manipulación de letras y entrenamiento de articulación en el aprender a leer y deletrear”

Invito a su niño a participar en este proyecto de investigación. El objetivo del mismo es estudiar como niños principiantes pueden aprender a detectar los sonidos en las palabras y asociarlos con las letras y como esto los ayuda a aprender a leer y deletrear palabras. Cada estudiante será asistido por mí individualmente durante las horas de escuela. Como primer paso les daré algunas tareas a los estudiantes para tener un mayor entendimiento de cuanto el niño sabe acerca de las letras y sonidos en las palabras. Aquellos estudiantes cuyo desempeño demuestre que serán beneficiados a través de mi instrucción, serán asistidos individualmente. El estudio constará de diez a trece clases de veinticinco minutos cada una. Los niños participantes en este proyecto estarán ausentes de las clases regulares por 20 o 30 minutos aproximadamente por un lapso de 10 a 13 días. En estas sesiones de capacitación, los niños aprenderán a dividir palabras en sonidos. Al final de este proyecto, los estudiantes realizarán algunas tareas para conocer en cuanto este estudio los ayudó a leer y deletrear mejor. Un grupo de estudiantes escogido al azar será designado como grupo de comparación. Este grupo de comparación

realizará las tareas de evaluación pero no recibirá instrucción alguna. Aproximadamente 60 estudiantes participarán en este estudio. Todas las sesiones serán grabadas en cinta de audio con el objetivo de verificar la valides de los datos obtenidos.

La participación en este proyecto será gratuita. No existen riesgos conocidos para los niños participantes en este estudio. Las tareas dadas a los estudiantes son similares a aquellas que los niños realizan en las clases regulares de lectura. Aquellos niños que participen en este programa se beneficiarán aprendiendo a leer y deletrear palabras nuevas.

Para que su hijo/a pueda participar en este proyecto, debo obtener su permiso por escrito. Si Usted esta de acuerdo con la participación de su hijo/a, por favor firme el formulario de permiso que se encuentra en la siguiente página y entrégueselo al maestro de su hijo/a a la brevedad. Usted puede conservar la segunda copia para sus archivos.

La participación en este estudio es voluntaria. Usted puede retirar a su hijo/a del proyecto en cualquier momento y por cualquier motivo sin consecuencia alguna. Además, los niños pueden elegir también abandonar este estudio en cualquier momento y por cualquier motivo sin ningún tipo de consecuencia. Con su previo consentimiento, información acerca de las habilidades de su hijo para leer y deletrear serán brindadas al maestro si este la solicitara. Toda la información recaudada en este estudio será mantenida estrictamente confidencial y será guardada en un archivo cerrado al cual solo

yo y mi consejero de la universidad tendremos acceso. La identidad de los estudiantes participantes en este estudio será mantenida en el anonimato.

Puede que los resultados de este estudio sean publicados, aunque los nombres o cualquier característica sobre la identidad de los participantes no serán usados en ninguna publicación.

Si Usted tiene cualquier tipo de preguntas acerca de esta investigación, me puede contactar llamando al número de teléfono 914-234-6160 o a mi correo electrónico nboyer9@aol.com, o también lo puede hacer llamando a mi consejero Linnea Ehri al 212-817-8294 o a su correo electrónico lehri@gc.cuny.edu . Si Usted tiene preguntas acerca de sus derechos como participante en este estudio, Usted puede contactar a Kay Powell, Administrador de IRB, Centro del Graduado/ Universidad de la Ciudad de Nueva York llamando al 212-817-7525 o al correo electrónico kpowell@gc.cuny.edu .

Gracias por considerar la participación en este proyecto. Si Usted acepta la participación de su hijo/a, por favor firme el siguiente formulario:

Otorgo el permiso a mi hijo/a

(Escriba el nombre de su hijo/a): _____a participar

_____

(Firma del padre/ madre o tutor) (Fecha)

_____

(Firma Del Investigador) (Fecha)

Acepto a que mi hijo/a sea grabado durante las sesiones individuales.

_____

(Firma del padre/ madre o tutor) (Fecha)

Acepto que la información acerca de las habilidades para leer y deletrear de mi hijo sea compartida con su maestro.

_____

(Firma del padre/ madre o tutor) (Fecha)

Appendix B

Scripts

PRETEST

1. Introduction/oral consent

Turn on tape recorder at start of every session – Say child's name and the date.

Obtain child's consent at the start of the pretest session.

"My name is Ms. Boyer. What is your name? I am interested in learning about ways to help children learn to read. Your mother/father/guardian gave permission for you to work with me. Today I will ask you to show me what you know about the letters and sounds in words. I will also ask you to read some words. You may not be able to do some of the things because your teacher hasn't taught you yet. That's okay. Just try hard and do the best you can. Everyone will be proud of you for doing your best."

"You do not have to work with me and we can go back to your classroom whenever you want."

"Are you willing to work with me?"

(If child denies consent, thank them and return them to the classroom.)

2. Name Writing

Need: Sheet lined paper, pencil

Introduction

"I would like you to write your name on this paper. Could you write your name on this line?" (point to line on the sheet) "Do the best you can."

"Thank you."(Write the child's name on the paper if the child can't do it or if the name is illegible or incomplete. Do it non-obviously. Record which is the child's writing and which is your writing.)

3a. Name Letters

Need: Cards with letters of the alphabet in mixed up order, number card, blank card, stopwatch.

Introduction

(Show index card with the two rows of numbers) "I'm going to show you some numbers in mixed up order. I want you to point to each number and tell me its name. Start with this number (point to the first number on the card) and tell me its name. Go across the row and point to each letter as you name it. Name the numbers correctly but then move quickly to the next number and name it. Then go across the next row." (Point as you say this.)

(Begin timing when child says the name of the first number and stop timing when child says the name of the last number. If the child has difficulty provide them with corrective feedback and allow them to try again until they show that they understand the procedure.)

(Show letter sheet) "Now I will show you some letters. The letters are all mixed up. I want you to point to each letter and tell me its name. Start with this letter (point to the first letter) and tell me its name. Go across the row and point to each letter as you name it. (Point as you say this) I want you to name each letter correctly but then move quickly to the next letter and name it. If you don't know a letter's name, tell me its sound. Do the best you can. Guess if you aren't sure."

Routine - Upper case letters then lower case

- Record time child takes to identify letters on each letter card.
- (Point to first letter on the card and tell child to begin. Start the stopwatch as child says the name of the first letter on card. Stop timing when child says name of last letter on card.

Give child 5 seconds to respond and then ask them to try the next letter.

If the child misses letters on a card wait until the child has finished the card and then point to individual letters and ask their name. Mix in a few letters that the child knows.

Inclusion criterion: child must name all 15 uppercase target letters: A, B, D, E, F, K, L, M, N, O, P, S, T, V, Z across the three tasks combined.

End: "You did a good job. Thank you for trying so hard."

3b. Write Letters

Need: Pencil and lined sheet of paper or letter tiles

Introduction

"Now I will say some letter names. You say the letter name and write the letter on the paper. Do the best you can. Guess if you aren't sure."

Routine

Show sheet, point to the first line.

"The first letter is _____. You say _____ and write the letter on the first line."

Repeat routine for each letter not identified in the first letter naming task. Add a few letters child identified correctly in the previous letter name task.

Give child 5 seconds to respond.

(If no response) "It's okay to guess if you aren't sure."

End: "You did a good job. Thank you for trying so hard.

3c. Letter recognition

Need: Letter cards

Introduction

"Now I will show you some letters written on a card."

Routine

Show child letter array containing letters not correctly identified in previous letter naming task.

Can you find (letter name) in this row of letters?"

Ask about target letters not identified correctly in the previous letter name tasks.

Ask about a few letters the child identified correctly.

Give child 5 seconds to respond – if no response - "It's okay to guess if you aren't sure."

4. Phoneme Segmentation Task

Need: Mrs. Magic Mouth, five blank tiles

Introduction

(Place Mrs. Magic Mouth in front of child and place the five blank tiles in her mouth.)

"Look at Mrs. Magic Mouth. She has sounds in her mouth and you can see them." (Point to the tiles)

"I would like to play a word game with Mrs. Magic Mouth. I will say a word and I want you to repeat the word. Then I want you to say each sound in the word in order and remove a tile from her mouth as you say each sound."

1. "For example, if I say 'Oat', you should say 'Oat' then repeat each sound /o/-/t/ and remove a tile for each sound." (Demonstrate removing a tile as you say each sound and putting the tiles on the table next to Mrs. Magic Mouth.)

"Now you try to do the same thing with the word 'Oat'."

- (If correct) "That's right."
- (If wrong) "That was a good try. Now listen again." (Repeat procedure for the word and have child try again until provides correct response.)

2. Repeat procedure for "Bee"
3. Repeat procedure for "Mole"

Routine

Say the word and have the child repeat the word and then segment the word removing a tile from Mrs. Magic's mouth for each sound.

*For the first word in each word type -

1. (If correct) "That's right."

   (If wrong) "Listen. The word is 'Aid'." (Say each sound and remove a tile for each sound as you say it.) "/a/ - /d/. Now you try it." (CR)

2. (If correct) "That's right."

   (If wrong) "Listen. The word is 'Nay'." (Say each sound and remove a tile for each sound as you say it.) "/n/ - /a/. Now you try it." (CR)

3. (If correct) "That's right."

   (If wrong) "Listen. The word is 'Phase'." (Say each sound and remove a tile for each sound as you say it.) "/f/ - /a/ - /z/. Now you try it." (CR)

For all other words –

(Whether correct or incorrect) "Very good. Let's try the next word."

Scoring

- Score as correct only words child responds to accurately on his/her own.

- Circle correct component sounds.
- Record segments child says – whether larger units are given, CV or VC unit used, record which vowels and which consonants are given.
- Give credit for consonant phonemes which are followed by a schwa sound as long as the consonant is not followed by the vowel sound that is present in the word.

Inclusion criterion – no more than 3 segmented correct.

5. Reading Nonsense Words

Need: nonsense words on cards

Introduction

"Now I am going to show you some words that you have never heard or read before. They are made up words. They have no meanings but you can say them. Let me show you."

"Here is a made up word." (Present card and point to letters.)

"It has a sound but doesn't mean anything. First I look at the letters and say their sounds. Then I put the sounds together and say the word. These letters say 'ZED'." (Use long e sound)

"Now I have some silly words for you to read. Do the best you can. If you can't read a word, that's okay. Try to sound it out. You can use this card to keep your place."

Routine

"Read the (first, next) word."

- Give child about 5 sec. to respond.
- Record responses on data sheet – give credit for both long and short vowel pronunciations.

- Record phonetic spelling if nonword given.
- Record info about any strategies child uses, especially if s/he tries to sound out and blend word.
- Record exactly what child says if misreads word or attempts to read word but doesn't finish.

End: "You did a good job. I am proud of you for trying so hard.

Inclusion criterion: Child must read no more than 1 nonword correctly.

6. Preprimer Words Mixed with Pictures; Target Words

Introduction

"I am going to show you some pictures and words on cards. I would like you to read the words and name the pictures. Do the best you can. If you can't name a word, that's okay. You can guess or tell me that you don't know. Speak each word loudly so I can hear you."

(If child says that s/he cannot read at all, say: "Some children think they can't read but sometimes they can. Try your best. You will be able to name the pictures and maybe some words. Each word is printed on a card. Turn the cards to read each one."

Routine

"Tell me the (first, next) one." (Point)

- Give child 5 sec. to respond.
- If no response after 5 sec. - "Try the next one."
- Record response on data sheet, record word reading errors.
- Record whether reads words immediately or sounds out – Check whether reads in more or less than one second of seeing word.

- Give preprimer words to all children.
- If the child misses the first 11 words, show s/he the rest of the cards.

"Look over the words on these cards and see if you can read any of them."

End: "You did a good job. Thank you for trying hard."

Inclusion criteria – read no target words correct and no more than 3 preprimer words correct.

7. Invented Spelling Task

Need: Letter Tiles

Introduction

"Have you tried to spell words using letters? I would like you to use the letter tiles to spell some words for me. Please listen to the sounds in the words and then pick the letters that say the sounds you hear."

Routine

1. "The first word is _____. (Use the long vowel pronunciation for all the nonwords.)

2. "You say _____ and pick the letters that say the sounds you hear. (Make sure the child pronounces each word correctly.)

3. "Watch me do it." (Model the nonwords: 'EM' and 'PAK'. Use long vowel pronunciations for both words)

Inclusion criterion - Represent all sounds in no more than 1 nonword correct.

8. PPVT

Need: PPVT-R, Form M

"Now I am going to show you some pictures. I will say a word. You point to the picture that goes with the word."

(Start at the beginning of the test.)

End: "You did a good job. Thank you for trying hard."

Inclusion criterion - a minimum standard score which corresponds to one standard deviation below the mean for their age at the time of pretesting.

9. Non word Repetition Task

Need: Tape recorder, audio tape, Score Sheet

Introduction

"Now we're going to play a word game. When I turn on the tape recorder you will hear a funny made-up word. I would like you to say the funny word back to me as soon as you hear it."

"If the made-up word you hear is 'noop' (pronounced 'nupe'), you should say 'noop' back to me. Let's give it a try."

"Noop." (CR)

- (If correct) "Very good. Now let's turn the tape on and try some more words."
- (If incorrect) "That was a good try. Let's try again."

Repeat the procedure until the child makes a successful repetition attempt.

Test Administration

1. Make sure the child is paying attention – "Are you ready?"
2. Turn on the tape recorder – keep one hand on the pause switch.
3. Record responses on the score sheet.

4. If child doesn't repeat an item press the pause button on the recorder.

   "Can you say the word?"

   If the child responds – score the response.

   If the child indicates that they cannot remember or has no response score as an error. "That's okay"

   If the child asks to hear the word again – say the word aloud and let the child repeat it. However – score as an error even if the child repeats correctly.

5. Follow procedure for all 38 items.

6. "That's all for now. Thank you for trying so hard."

Letter Manipulation Only Script

Tape all sessions– record start and finish times for all sessions at the appropriate points on the data sheets.

Tutoring Schedule

Session 1: Pretest

Session 2 – 3: Correspondence training

Session 3 – 7: Segmentation training – CV/VC, CVC

Session 8: Word review

Session 9: One-day Posttest

Session 10: Seven-day Posttest

Session numbers are an estimate. Students will continue with tutoring until they have reached criterion on each of the sets in all correspondence and segmentation sets.

Need: 27 letter tiles (2 in. x 2 in.) – 2 each for the consonants – B, D, F, K, L, M, N, P, S, T, V, Z and 1 each for the vowels – A, E, O, 3 section letter frame, picture of ear and picture of Daffy Duck.

I. Letter – Correspondence Training

Need: Letter tiles, pictures of ear and Daffy Duck

Introduction

"Today we are going to play a game with sounds and letters. Do you know how sounds are heard? Cover your ears and say your name." C R (Child Responds)

"Now, uncover your ears and say your name." C R

"Can you hear the difference?" C R

"Here is a picture of the inside of your ear. We hear sounds when air moves and goes inside your ear. It touches these three little bones which make the sound very clear and it arrives at these tiny hairs. The hairs tickle a nerve, which tells your brain what kind of sound you are hearing."

"It is harder to hear sounds when you cover your ears because less air can get inside your ear."

"Here are the letters we will use to play the game."

(Place the letter tiles in front of the child with the letters facing up.)

"The tiles have letters drawn on them that show the sounds you make when you speak. Each of the different letters makes a different sound."

"My name is Ms. Boyer. The first letter in my last name is B and it makes the sound /b/. You can hear the letter sound /b/ in the letter name B. The name of the letter B helps me remember the sound, B - /b/.

Here is a picture of Daffy Duck. The first letter in his name is D. What sound does the letter D make? C R (If the child cannot make the correct sound model /d/.)

You can hear the letter sound /d/ in the letter name D. The name of the letter D helps me remember the sound, D - /d/.

"Now I would like to show you how to play the game of sounds and letters."

<u>Training Trial – Set 1</u>

(Sounds /p/, /t/, /f/, /a/)

(Set out the letter tiles – P, T, F, A.)

"I am going to say some sounds and show you some letters that say those sounds. Your job is to try and remember which letter says which sound."

(Be sure to minimize the schwa sound when saying sounds.)

"Here is the letter P. (Place the letter P in front of the child.)

"The letter P says /p/. You can hear the sound /p/ in the letter name P."

"You say P." C R

"Now say /p/." C R

"Can you hear the letter sound /p/ in the letter name P?" C R

(Put the P tile back in the display of letters)

"Point to the letter that says /p/."

"If you aren't sure which letter says /p/ try saying the letter names until you hear the sound /p/ in the letter name." CR

Repeat the training procedure for each letter in Set 1

Test Trial: Set 1

(Record child's first response)

(Set out the letter tiles - A, F, P, T)

"I'm going to say some sounds. Your job is to repeat each sound and point to the letter that says each sound. If you aren't sure which letter says which sound, say each letter name until you hear the sound."

(Avoid any mention of articulation – only discuss what the child hears.)

1. "Say /p/ and tell me what letter you hear." C R

"Point to the letter." C R

- (If correct) – "That is right."
- (If incorrect) – "That's a good try."

  (1^{st}) "Say the names of all the letters to find the one that says /p/."

(2^{nd}) "Listen, the letter P says /p/. You can hear the sound in the letter's name: P, /p/."

"You say P, /p/." C R

"Point to the letter P." C R

2. (Mix the letter P back into the letter set.)

Repeat procedure for /p/ as above – record child's response but do not count toward criterion.

Repeat the procedure for the sounds in Set 1 in random order to a criterion of 2 successive correct sets with no prompting or feedback.

Training Trial – Set 2

(Sounds /b/, /d/, /v/, /e/)

(Set out the letter tiles – D, B, V, E.)

"I am going to say some sounds and show you some letters that say those sounds. Your job is to try and remember which letter says which sound."

"Here is the letter B. (Place the Letter B in front of the child.)

"The letter B says /b/. You can hear the sound /b/ in the letter name B."

"You say B." C R

"Now say /b/." C R

"Can you hear the letter sound /b/ in the letter name B?" C R

(Put the B tile back in the display of letters)

"Point to the letter that says /b/."

"If you aren't sure which letter says /b/, try saying the letter names until you hear the sound /b/ in the letter name." CR

Repeat the training procedure for each letter in Set 2

Test Trial: Set 2

(Record child's first response)

(Set out the letter tiles - D, B, V, E)

"I'm going to say some sounds. Your job is to repeat each sound and point to the letter that says each sound. If you aren't sure which letter says which sound, say each letter name until you hear the sound."

(Avoid any mention of articulation – only discuss what the child hears.)

1. "Say /b/ and tell me what letter you hear." C R

"Point to the letter." C R

- (If correct) – "That is right."
- (If incorrect) – "That's a good try."

  (1st) "Say the names of all the letters to find the one that says /b/."

  (2nd) "Listen, the letter B says /b/. You can hear the sound in the letter's name: B, /b/."

  "You say B, /b/." C R

  "Point to the letter B." C R

2. (Mix the letter B back into the letter set.)

Repeat the procedure for /b/ as above – record child's response but do not count toward criterion.

Repeat the procedure for the sounds in set 2 in random order to a criterion of 2 successive correct sets – no prompting or feedback.

Training Trial – Set 3

(Sounds /l/, /m/, /k/, /s/)

(Set out the letter tiles – M, L, K, S.)

"I am going to say some sounds and show you some letters that say those sounds. Your job is to try and remember which letter says which sound."

"Here is the letter M. (Place the Letter M in front of the child.)

"The letter M says /m/. You can hear the sound /m/ in the letter name M."

"You say M." C R

"Now say /m/." C R

"Can you hear the letter sound /m/ in the letter name M?" C R

(Put the M tile back in the display of letters)

"Point to the letter that says /m/."

"If you aren't sure which letter says /m/, try saying the letter names until you hear the sound /m/ in the letter name." CR

Repeat the training procedure for each letter in Set 3

Test Trial: Set 3

(Record child's first response)

(Set out the letter tiles - L, M, K, S)

"I'm going to say some sounds. Your job is to repeat each sound and point to the letter that says each sound. If you aren't sure which letter says which sound, say each letter name until you hear the sound."

(Avoid any mention of articulation – only discuss what the child hears.)

1. "Say /l/ and tell me what letter you hear." C R

"Point to the letter." C R

- (If correct) – "That is right."
- (If incorrect) – "That's a good try."

  (1st) "Say the names of all the letters to find the one that says /l/."

  (2nd) "Listen, the letter L says /l/. You can hear the sound in the letter's name: L, /l/."

  "You say L, /l/." C R

  "Point to the letter L." C R

2. (Mix the letter L back into the letter set)

Repeat the procedure for /l/ as above – record child's response but do not count toward criterion.

Repeat the procedure for the sounds in set 3 in random order to a criterion of 2 successive correct sets – no prompting or feedback.

Training Trial – Set 4

(Sounds /z/, /n/, /o/)

(Set out the letter tiles – Z, N, O.)

"I am going to say some sounds and show you some letters that say those sounds. Your job is to try and remember which letter says which sound."

"Here is the letter Z. (Place the Letter Z in front of the child.)

"The letter Z says /z/. You can hear the sound /z/ in the letter name Z."

"You say Z." C R

"Now say /z/." C R

"Can you hear the letter sound /z/ in the letter name Z?" C R

(Put the Z tile back in the display of letters)

"Point to the letter that says /z/."

"If you aren't sure which letter says /z/, try saying the letter names until you hear the sound /z/ in

the letter name." CR

Repeat the training procedure for each letter in Set 4

Test Trial: Set 4

(Record child's first response.)

(Set out the letter tiles - Z, N, O)

"I'm going to say some sounds. Your job is to repeat each sound and point to the letter that says each sound. If you aren't sure which letter says which sound, say each letter name until you hear the sound."

(Avoid any mention of articulation – only discuss what the child hears.)

1. "Say /o/ and tell me what letter you hear." C R

"Point to the letter." C R

- (If correct) – "That is right."
- (If incorrect) – "That's a good try."

  (1st) "Say the names of all the letters to find the one that says /o/."

  (2nd) "Listen, the letter O says /o/. You can hear the sound in the letter's name: O, /o/."

  "You say O, /o/." C R

  "Point to the letter O." C R

2. (Mix the letter O back into the letter set.)

Repeat the procedure for /o/ as above – record child's response but do not count toward criterion.

Repeat the procedure for the sounds in set 4 in random order to a criterion of 2 successive correct sets with no prompting or feedback.

Review Trial

Need: Letter tiles

(Place all the letter tiles in front of the child)

"I'm going to say each sound. Your job is to repeat the sound and then point to the letter that says that sound. If you aren't sure you can name the letters to hear their sounds.

Routine

(Record child's first response.)

1. "The first (second, etc.) sound is /__/."

"Say /__/ and point to the letter that makes the sound /__/" C R

- (If correct) "That is right"
- (If incorrect) – "That's a good try but let's try again."

  (1st) "Say the names of all the letters to find the one that says /sound/."

  (2nd) "Listen, the letter XX says /xx/. You can hear the sound in the letter's name: (letter name), /sound/).

  "You say (letter name), /sound/." C R

  "Point to the letter /name/." C R

2. Repeat procedure for each letter as in occurs in the set – record response for both attempts – only response for first attempt counts toward criterion.

Repeat the sounds in random order to a criterion of 2 successive correct sets with no prompting or feedback.

II. Letter – Segmentation Training

Need: Letter tiles and 3 section letter frame

Introduction

"Now we will play a game with sounds, words, and letter tiles. I will say a word. Some of the words are real words with meanings. Other words are made up and do not have meanings but we can say them. We will think about the sounds we hear when we say the word. We will think about the letters that make the sounds we hear in the word."

"Let me show you."

"The first word is Abe."

"The word 'ABE' is a man's name. The name has 2 sounds - /a/ /b/."

(Say the separate sounds while lifting a finger for each sound.)

Let's find the two letters that make these sounds.

(Set out frame and cover unneeded spaces.)

"I say 'Abe' and listen to the sounds I hear. The first sound is /a/. The letter A has the sound /a/ in its name, so I put the letter A here" (place the letter tile in the first left hand space in the frame)

"The next sound in "Abe" is /b/. The letter B has the sound /b/ in its name, so I put the letter B here." (Place the letter tile in the next space in the frame).

"That's how to play the game. I will say a word and you will find the letters that you hear in the word." (Put the tiles back into the display)

"Now you say 'Abe' and decide which letters say the sounds you hear"

(Guide the child – provide corrective feedback, help them make the sounds; Do not talk about mouth movements; refer only to sounds you hear in the words)

"Good job. Let's do some more words."

Routine

(Record child's first response.)

*****Say each word normally as a whole – be careful not to prompt the child's segmentation of words. ******

(Set out the letter frame – cover the unneeded space.)

1. "The first (second, etc.) word is _____."

"There are # sounds in the word _____."

"Say _____ and find the letter that says each sound you hear in the word _____."

(Help the child put the letters in the appropriate spaces in the frame.)

- If the child has difficulty with the routine –
- "What's the first sound? What letter says that sound?"
- "What's the next sound? What letter says that sound?"

(Continue until all sounds are identified – record responses)

(Phase out prompts as child is able to respond on their own.)

Feedback

(Allow child to finish entire word before providing feedback.)

- (If correct) "That is right. Good job."
- (If incorrect – "That was a good try but let's check your letters."

  (Leave the child's letter tiles in the frame)
- (If totally incorrect) -

"The first sound in _____ is /__/."

"The letter that says /__/ is _____. I can hear the sound /__/ in the letter name _____.

(Place the correct letter tile over the child's tile.)

(Continue until all the correct letters are identified.)

- (If partially incorrect) – "That was a good try but let's check your letters."

  (Point to first (second, etc.) letter.)

- (If letter is correct) - "The first (second, etc.) sound in (word) is /__/. (Letter name) says /___/. Good job."

- (If letter is incorrect) - The first (second etc.) sound in (word) says /__/.

  "Does (Incorrect letter name) say /__/ or does the (correct letter name) say /__/?"

  "Which letter name contains /__/?"

  (When child provides correct response.) "Good job." (Put correct letter in frame over incorrect letter.)

  (Continue until all the letters are correct.)

2. Whether the first response to a word is correct or incorrect – mix all letter tiles back into the display and ask child to repeat the above procedure.

Record both responses to each word but only count the first response toward criterion.

Cycle through the word set until child segments 8 correct words in a row.

<u>End of session</u>: "Thank you for working so hard today. We will play again tomorrow."

<u>Resuming a new session</u> – "Do you remember the game we played yesterday? I said a word and you picked out the letters that say the sounds in the word. Let's see if you remember which letters say which sounds. I will say a sound and you point to a letter. I

say _____. You say _____ and point to the letter that says _____. Good job, let's play the game."

General instructions

1. Cycle through the set of CV/VC words until the child can segment 8 correct in a row (no feedback or prompting). Recycle through words as necessary.

2. Shift to the CVC words and cycle through until the child can segment 8 correct in a row (no feedback or prompting). Recycle through words as necessary.

III. Letter – Review of words

Need: Letter tiles and 3 section frame

"Now we are going to review the words that you learned over the last few days. The words will be mixed up, so they will not all have the same number of sounds. You will need to decide how many different sounds you hear in each word. Then your job will be to show me that you have learned how to put out letters to show the sounds in words. You should put the letters in the frame just like you did during practice."

Routine

(Record child's first response.)

(Place letter tiles and 3 section word frame in front of child.)

***Say each word normally as a whole – be careful not to prompt the child's segmentation of words. ***

1. "Say _____ and tell me how many sounds you hear in the word."

2. "Now say _____and find the letter that says each sound you hear in the word."

- If the child has difficulty with the routine –
    - "What's the first sound? What letter says that sound?"

- "What's the next sound? What letter says that sound?"

(Continue until all sounds are identified – record responses)

(Phase out prompts as child is able to respond on their own.)

Feedback

(Wait until child is completely finished selecting letters before providing feedback.)

- # Sounds -
  - (If correct) "Good job. There are # sounds in _____."
  - (If incorrect) "That's a good try but let's count the sounds together." (Help the child use their fingers to count the sounds until they can count the correct number of sounds in the word.)
- Letter Tiles
  - (If letters correct) – "Good job. The letters are correct."
  - (If completely incorrect) – "That was a good try but let's check your letters."

    (Leave child's letters in the frame.)
    - "The first sound in _____is /__/. Here is the letter _____ that says the sound /__/.

      I can hear the sound /__/ in the letter name ____."

      (Continue until all the letters are correct.)
  - (If partially incorrect) – "Let's check your letters."

    (Point to first (second, etc.) letter.)
    - (If letter is correct) - "The first (second, etc.) sound in (word) is /__/."

      " (Letter name) says /___/. Good job."
    - (If letter is incorrect) - The first (second etc.) sound in (word) says

/__/."

"Does (Incorrect letter name) say /__/ or does the (correct letter name) say /__/?"

"Which letter name contains /__/?"

(When child provides correct response.) "Good job."

(Put correct letter in frame over incorrect letter.)

(Continue until all the letters are correct.)

3. Whether the first response to a word is correct or incorrect – mix all letter tiles back into the display and ask child to repeat the above procedure.

Record both responses to each word but only count the first response toward criterion.

Cycle through the word list until child segments 8 correct in a row.

End of session- "Thank you for working so hard today. We will play again tomorrow."

Resuming a new session – "Do you remember the game we played yesterday? I said a word and you picked out the letters that showed all the sounds in the word. Your job is to do what we did during practice and show me that you have learned how to put out letters to show the sounds in words."

Letter plus Articulation Script

Tutoring Schedule

(Tape record sessions – record start and finish times for each session at the appropriate points on data sheets)

Session 1: Pretest

Session 2: Articulation – Correspondence training

Session 3: Segmentation training – CV/VC

Session 4: Letter – Correspondence training

Session 5: Segmentation training – CV/VC

Session 6: Articulation Segmentation training – CVC

Session 7 Letter Segmentation training – CVC

Session 8: Word review – articulation and letter

Session 9: One-day Posttest

Session 10: Seven-day Posttest

(Session numbers are an estimate. Students will continue with tutoring until they have reached criterion on each of the sets in all correspondence and segmentation sets.)

Need: 27 letter tiles (2 in. x 2 in.) – 2 each for the consonants – B, D, F, K, L, M, N, P, S, T, V, Z and 1 each for the vowels – A, E, O, 13 mouth tiles (2 in. x 2 in.) – 2 each for the mouth pictures representing consonants and 1 each for the mouth pictures representing vowels, 3 section letter frame, 2 x3 section letter frame, picture of mouth and throat, and hand mirror.

I. Articulation – Correspondence Training:

Need: Mouth tiles, picture of mouth and throat, and hand mirror

Introduction

"Today we are going to play a game with sounds. Do you know how sounds are made when you speak?" C R

"Put your hand in front of your mouth and say your name." C R

"Do you feel the air coming out of your mouth when you say your name? Air pushed out through your mouth or nose is what makes word-sounds."

"Different sounds are made when you use different parts of your mouth in different ways. Let's look at this picture of your mouth." (Show child a drawing of the neck and mouth cavity)

"When you breathe you take air in; when you speak you make sounds by pushing air out, like you did when you said your name. Say your name again and feel the air." C R

Sounds are made in different ways, but they are all made by pushing air through the mouth, tongue, lips, teeth, roof of the mouth and throat. Show me where your tongue is in the picture." C R

"Good. Now show me your lips, C R

your teeth, C R

the roof of your mouth, (C R)

and your throat." (C R)

"Very good."

Training Trial – Set 1

(Sounds /p/, /t/, /f/, /a/)

(Set out mouth pictures for /p/, /t/, /f/, /a/)

"I am going to say some sounds and show you some pictures of your mouth saying those sounds. Your job is to learn which picture shows how your mouth feels when you say that sound."

(Be sure to minimize the schwa sound when saying sounds.)

"Here is a picture of your mouth saying /p/. (Place the appropriate mouth picture in front of the child.)

"Look in the mirror and say /p/. Watch and feel what your mouth does when you say /p/."

"You put your lips close together and push the air through your lips."

"Put your hand in front of your mouth and feel the air when you say /p/." C R

"Look at the picture of your mouth saying /p/." (Point to the picture – draw the child's attention to the lips)

"See how the lips are close together? These lines show the air being pushed through the lips as the mouth says /p/."

"Now I want you to explain how the picture shows what you do when you say /p/." CR

(Provide feedback if necessary and encourage child until can explain correctly)

"Here is a picture of your mouth saying /t/." (Place the appropriate mouth picture in front of the child.)

"Look in the mirror and say /t/. Watch and feel what your mouth does when you say /t/."

"The tip of your tongue touches the top of your mouth. Look in your mouth and see your tongue touch the top of your mouth." C R

"Look at the picture of your mouth saying /t/." (Point to the picture – draw attention to the tongue)

"See how your tongue touches the top of the mouth as the mouth says /t/."

"Now I want you to explain how the picture shows what you do when you say /p/." C R

(Provide feedback if necessary and encourage child until can explain correctly)_____

"Here is a picture of your mouth saying /f/. (Place the appropriate mouth picture in front of the child.)

"Look in the mirror and say /f/. Watch and feel what your mouth does when you say /f/."

"Your upper teeth touch your lower lip and you push air through your lips."

"Put your hand in front of your mouth and feel the air when you say /f/." C R

"Look at the picture of your mouth saying /f/." (Point to the picture – draw attention to the teeth and lips)

"See how the upper teeth touch the lower lip. These lines show the air being pushed through the lips as the mouth says /f/."

"Now I want you to explain how the picture shows what you do when you say /f/." CR

(Provide feedback if necessary and encourage child until can explain correctly)_____

"Here is a picture of your mouth saying /a/. (Place the appropriate mouth picture in front of the child.)

"Look in the mirror and say /a/. Watch and feel what your mouth does when you say /a/."

"You open your mouth and if you look in the mirror you can see your tongue." C R

"Look at the picture of your mouth saying /a/." (Point to the picture – draw attention to the mouth and tongue.)

"See how the mouth is open and you can see the tongue as the mouth says /a/."

"Now I want you to explain how the picture shows what you do when you say /a/." CR

(Provide feedback if necessary and encourage child until can explain correctly.)

Test Trial: Set 1

(Record child's first response)

(Place the mouth pictures for /a/, /f/, /p/, /t/ in front of the child.)

"I'm going to say some sounds. Your job is to repeat each sound and then point to the mouth picture that shows what you feel your mouth doing when you say that sound. If you aren't sure which mouth picture goes with which sound, you can look at your mouth in the mirror."

(During the test trials – say whatever is necessary in order to help the child detect what they feel their mouth doing as they select pictures for the sounds. Fade out the use of prompts based on the child's need.)

Sample Prompts:

- Compare and contrast similar pictures.
- Ask the child what makes them think a particular picture represents a particular sound.
- Direct the child to think about what they feel their mouth doing when they say a particular sound – Is your mouth open or closed? Where is your tongue? Do your teeth touch your lips? Do you feel your lips or your tongue saying /sound/? etc)

Routine

"Say /p/ and feel what your mouth is doing." C R

"Now show me what mouth picture is making the sound /p/?"

- (If correct) "That is right"
- (If incorrect)

(1st) Have child repeat the sound, tell you what she feels her mouth doing, look in a mirror to see what mouth is doing, then find picture showing this action.

(2nd) Say whatever is necessary in order to help the child detect what they feel their mouth doing as they select pictures for the sounds. See prompts. Review training for /p/.

Repeat the sounds in random order to a criterion of 2 successive correct sets with no prompting or feedback.

Training Trial – Set 2

(Sounds /b/ /d/ /v/ /e/)

(Set out the mouth pictures for /b/, /d/, /v/, /e/)

"Now I am going to say some other sounds and show you some pictures of your mouth saying those sounds. Your job is to learn which picture shows how your mouth feels when you say that sound."

"Here is a picture of your mouth saying /b/. (Place the appropriate mouth picture in front of the child.)

"Look in the mirror and say /b/. Watch and feel what your mouth does when you say /b/."

"You put your lips close together and push the air through your lips."

"Put your hand in front of your mouth and feel the air when you say /b/." C R

"Look at the picture of your mouth saying /b/." (Point to the picture – draw the child's attention to the lips)

"See how the lips are close together? These lines show the air being pushed through the lips as the mouth says /b/."

"Now I want you to explain how the picture shows what you do when you say /b/." CR

(Provide feedback if necessary and encourage child until can explain correctly)

"Here is a picture of your mouth saying /d/. (Place the appropriate mouth picture in front of the child.)

"Look in the mirror and say /d/. Watch and feel what your mouth does when you say /d/."

"The tip of your tongue touches the roof of your mouth. Look in your mouth and see your tongue touch the roof of your mouth." C R

"Look at the picture of your mouth saying /d/." (Point to the picture – draw attention to the tongue)

"See how your tongue touches the roof of the mouth as the mouth says /d/."

"Now I want you to explain how the picture shows what you do when you say /d/." CR

(Provide feedback if necessary and encourage child until can explain correctly)

"Here is a picture of your mouth saying /v/. (Place the appropriate mouth picture in front of the child.)

"Look in the mirror and say /v/. Watch and feel what your mouth does when you say /v/."

"Your upper teeth touch your lower lip and you push air through your lips."

"Put your hand in front of your mouth and feel the air when you say /v/." C R

"Look at the picture of your mouth saying /v/."

(Point to the picture – draw attention to the teeth and lips)

"See how the upper teeth touch the lower lip. These lines show the air being pushed through the lips as the mouth says /v/."

"Now I want you to explain how the picture shows what you do when you say /v/." CR

(Provide feedback if necessary and encourage child until can explain correctly)

"Here is a picture of your mouth saying /e/. (Place the appropriate mouth picture in front of the child.)

"Look in the mirror and say /e/. Watch and feel what your mouth does when you say /e/."

"Your lips smile wide." C R

"Look at the picture of your mouth saying /e/."

(Point to the picture – draw attention to the mouth and tongue.)

"See how the lips smile wide as the mouth says /e/."

"Now I want you to explain how the picture shows what you do when you say /e/." CR

(Provide feedback if necessary and encourage child until can explain correctly)

Test Trial: Set 2

(Record child's first response.)

(Place the mouth pictures for /d/, /b/, /v/, /e/ in front of the child.)

"I'm going to say some sounds. Your job is to repeat each sound and then point to the mouth picture that shows what you feel your mouth doing when you say that sound. If you aren't sure which mouth picture goes with which sound, you can look at your mouth in the mirror."

(During the test trials – say whatever is necessary in order to help the child detect what they feel their mouth doing as they select pictures for the sounds. Fade out the use of prompts based on the child's need.)

For example:

- Compare and contrast similar pictures.
- Ask the child what makes them think a particular picture represents a particular sound.
- Direct the child to think about what they feel their mouth doing when they say a particular sound – Is your mouth open or closed? Where is your tongue? Do your teeth touch your lips? Do you feel your lips or your tongue saying /sound/? etc)

Routine

"Say /b/ and feel what your mouth is doing." C R

"Now show me what mouth picture is making the sound /b/?"

- (If correct) "That is right"
- (If incorrect)

  (1st) Have child repeat the sound, tell you what she feels her mouth doing, look in a mirror to see what mouth is doing, then find picture showing this action.

  (2nd) Say whatever is necessary in order to help the child detect what they feel their mouth doing as they select pictures for the sounds. See prompts. Review training for /b/.

Repeat the sounds in random order to a criterion of 2 successive correct sets with no prompting or feedback.

Training Trial – Set 3

(Sounds /m/ /l/ /k/ /s/)

(Set out the mouth pictures for /m/, /l/, /k/, /s/)

"Now I am going to say some other sounds and show you some pictures of your mouth saying those sounds. Your job is to learn which picture shows how your mouth feels when you say that sound."

"Here is a picture of your mouth saying /m/. (Place the appropriate mouth picture in front of the child.)

"Look in the mirror and say /m/. Watch and feel what your mouth does when you say /m/."

"You put your lips close together." C R

"Look at the picture of your mouth saying /m/." (Point to the picture – draw the child's attention to the lips)

"See how the lips are close together? These lines show the air being pushed through the lips as the mouth says /m/."

"Now I want you to explain how the picture shows what you do when you say /m/." CR

(Provide feedback if necessary and encourage child until can explain correctly)

"Here is a picture of your mouth saying /l/. (Place the appropriate mouth picture in front of the child.)

"Look in the mirror and say /l/. Watch and feel what your mouth does when you say /l/."

"The tip of your tongue touches the roof of your mouth. Look in your mouth and see your tongue touch the roof of your mouth." C R

"Look at the picture of your mouth saying /l/." (Point to the picture – draw attention to the tongue)

"See how your tongue touches the roof of the mouth as the mouth says /l/."

"Now I want you to explain how the picture shows what you do when you say /l/." CR

(Provide feedback if necessary and encourage child until can explain correctly)

"Here is a picture of your mouth saying /k/. (Place the appropriate mouth picture in front of the child.)

"Look in the mirror and say /k/. Watch and feel what your mouth does when you say /k/."

"This sound is harder to see but you can feel it in the back of your mouth. The back of your tongue hits you throat and makes a scraping sound."

"Look in your mouth and see your tongue pulling back and hitting your throat." C R

"Look at the picture of your mouth saying /k/." (Point to the picture – draw attention to the tongue)

"See how the tongue pulls back and hits the throat as the mouth says /k/.

"Now I want you to explain how the picture shows what you do when you say /k/." CR

(Provide feedback if necessary and encourage child until can explain correctly)

"Here is a picture of your mouth saying /s/. (Place the appropriate mouth picture in front of the child.)

"Look in the mirror and say /s/. Watch and feel what your mouth does when you say /s/."

"You hold your teeth together and push air through to make a hissing sound. Put your hand in front of your mouth and feel the air come out." C R

"Look at the picture of your mouth saying /s/." (Point to the picture – draw attention to the teeth.)

"See how the teeth come together? These lines show how the air pushes through the teeth as the mouth says /s/."

"Now I want you to explain how the picture shows what you do when you say /s/." CR

(Provide feedback if necessary and encourage child until can explain correctly)

Test Trial: Set 3

(Record child's first response.)

(Place the mouth pictures for /l/, /m/, /k/, /s/ in front of the child.)

"I'm going to say some sounds. Your job is to repeat each sound and then point to the mouth picture that shows what you feel your mouth doing when you say that sound. If you aren't sure which mouth picture goes with which sound, you can look at your mouth in the mirror."

(During the test trials – say whatever is necessary in order to help the child detect what they feel their mouth doing as they select pictures for the sounds. Fade out the use of prompts based on the child's need.)

For example:

- Compare and contrast similar pictures.
- Ask the child what makes them think a particular picture represents a particular sound.
- Direct the child to think about what they feel their mouth doing when they say a particular sound – Is your mouth open or closed? Where is your tongue? Do your teeth touch your lips? Do you feel your lips or your tongue saying /sound/? etc)

Routine

"Say /m/ and feel what your mouth is doing." C R

"Now show me what mouth picture is making the sound /m/?"

- (If correct) "That is right"

- (If incorrect)

  (1st) Have child repeat the sound, tell you what she feels her mouth doing, look in a mirror to see what mouth is doing, then find picture showing this action.

  (2nd) Say whatever is necessary in order to help the child detect what they feel their mouth doing as they select pictures for the sounds. See prompts. Review training for /m

Repeat the sounds in random order to a criterion of 2 successive correct sets with no prompting or feedback.

Training Trial – Set 4

(Sounds /z/ /n/ /o/)

(Set out mouth pictures for /z/, /n/, /o/)

"Now I am going to say some other sounds and show you some pictures of your mouth saying those sounds. Your job is to learn which picture shows how your mouth feels when you say that sound."

"Here is a picture of your mouth saying /z/. (Place the appropriate mouth picture in front of the child.)

"Look in the mirror and say /z/. Watch and feel what your mouth does when you say /z/."

"You hold your teeth together and push air through to make a hissing sound." C R

"Look at the picture of your mouth saying /z/." (Point to the picture – draw the child's attention to the teeth)

"See how the teeth come together? These lines show how the air pushes through the teeth as the mouth says /z/."

"Now I want you to explain how the picture shows what you do when you say /z/." CR

(Provide feedback if necessary and encourage child until can explain correctly)

"Here is a picture of your mouth saying /n/. (Place the appropriate mouth picture in front of the child.

"Look in the mirror and say /n/. Watch and feel what your mouth does when you say /n/."

"The tip of your tongue touches the roof of your mouth. Look in your mouth and see your tongue touch the roof of your mouth." C R

"Look at the picture of your mouth saying /n/." (Point to the picture – draw attention to the tongue)

"See how your tongue touches the roof of the mouth as the mouth says /n/."

"Now I want you to explain how the picture shows what you do when you say /n/." CR

(Provide feedback if necessary and encourage child until can explain correctly)

"Here is a picture of your mouth saying /o/. (Place the appropriate mouth picture in front of the child.)

"Look in the mirror and say /o/. Watch and feel what your mouth does when you say /o/."

"You round your lips to make a circle." C R

"Look at the picture of your mouth saying /o/." (Point to the picture – draw attention to the shape of the mouth)

"See how the lips make a circle as the mouth says /o/."

"Now I want you to explain how the picture shows what you do when you say /o/." C R

(Provide feedback if necessary and encourage child until can explain correctly)

Test Trial – Set 4

(Record child's first response.)

(Place the mouth pictures for /z/, /n/, /o/ in front of the child.)

"I'm going to say some sounds. Your job is to repeat each sound and then point to the mouth picture that shows what you feel your mouth doing when you say that sound. If you aren't sure which mouth picture goes with which sound, you can look at your mouth in the mirror."

(During the test trials – say whatever is necessary in order to help the child detect what they feel their mouth doing as they select pictures for the sounds. Fade out the use of prompts based on the child's need.)

For example:

- Compare and contrast similar pictures.
- Ask the child what makes them think a particular picture represents a particular sound.
- Direct the child to think about what they feel their mouth doing when they say a particular sound – Is your mouth open or closed? Where is your tongue? Do your teeth touch your lips? Do you feel your lips or your tongue saying /sound/? etc)

Routine

"Say /z/ and feel what your mouth is doing." C R

"Now show me what mouth picture is making the sound /z/?"

- (If correct) "That is right"
- (If incorrect) "That's a good try."

(1st) Have child repeat the sound, tell you what she feels her mouth doing, look

in a mirror to see what mouth is doing, then find picture showing this action.

(2nd) Say whatever is necessary in order to help the child detect what they feel their mouth doing as they select pictures for the sounds. See prompts. Review training for /z/.

Repeat the sounds in random order to a criterion of 2 successive correct sets with no prompting or feedback.

End: You did a good job learning those sounds and pictures. I am proud of you for trying so hard.

Review Trial

(Set out all the mouth pictures)

"I'm going to say each sound. Your job is to repeat each sound and then point to the mouth picture that is making that sound. If you aren't sure you can look at your mouth in the mirror.

Routine

(Record child's first response.)

"The first (second, etc.) sound is /__/."

"Say / / and feel what your mouth is doing.

"Now point to the mouth picture that is making the sound / _/."

- (If correct) "That is right."
- (If incorrect) "That's a good try but let's try again."

(1st) Have child repeat the sound, tell you what she feels her mouth doing, look in a mirror to see what mouth is doing, then find picture showing this action.

(2nd) Say whatever is necessary in order to help the child detect what they feel

their mouth doing as they select pictures for the sounds. See prompts above. Repeat the sounds in random order to a criterion of 2 successive correct sets with no prompting or feedback.

II. Articulation – Segmentation Training – CV/VC

Need: mouth tiles, 3 section frame, and hand mirror.

Introduction

"Now we will play a game with sounds, words, and mouth pictures. I will say a word. Some of the words are real words with meanings. Other words are made up and do not have meanings but we can still say them. We will think about the sounds we hear when we say the word. We will think about how our mouth moves when we say the word. Let me show you."

"The first word is 'ABE'"

"The word 'ABE' is a man's name. The name has 2 sounds - /a/ /b/

(Say the separate sounds while lifting up a finger for each sound)

"Let's find two pictures to show how our mouth moves to say those sounds."

(Set out frame and cover unneeded spaces)

"I say 'Abe' and look in the mirror to see what my mouth does when I say the sounds."

(Look in mirror and say "Abe")

"The first sound is /a/. When I say /a/ my mouth is open and I can see my tongue. Here is the mouth picture of /a/. See how the mouth is open and we can see the tongue" (Show child the picture. Place the mouth block in the first left hand space in the frame)

"The next sound in "Abe" is /b/. When I say /b/ I put my lips close together and push air through. Here is the mouth picture of /b/. See how the lips are close together. The lines

show the air pushing through the lips." (Show child the picture. Place the mouth block in the next frame.)

"That's how to play the game. I will say a word and you will find the mouth pictures showing what you feel your mouth doing when you say that word. You can also look in the mirror to see what your mouth is doing to say the word. You will put those pictures here (point to the letter frame).

(Put the mouth pictures back into the display)

"Now you say "Abe" and decide which mouth pictures show the sounds you hear."

(Guide the child – provide corrective feedback, encourage them to look in the mirror, help them make the sounds)

"Good job. Let's do some more words."

Routine

(Record child's first response.)

**** (Say each word normally as a whole – be careful not to prompt the child's segmentation of words.) ****

(Set out the letter frame – cover the unneeded space.)

"The first (second, etc.) word is____."

"There are # sounds in the word _____"

"Say _____ and find the mouth pictures that show how your mouth moves when you say each sound in the word _____."

(Help the child put the mouth pictures in the appropriate spaces in the frame.)

- If the child has difficulty with the routine:
    - What's the first sound? What mouth picture shows how your mouth moves

when you make that sound?"

- "What's the next sound? What mouth picture shows how your mouth moves when you make that sound?

(Continue until all sounds identified – record responses)

(Phase out prompts as child is able to respond on their own.)

Feedback

(Allow child to finish entire word before providing feedback.)

- (If correct) – "That is right. Good job."
- (If incorrect) –

  (Leave child's mouth pictures in the frame)

  - (If totally incorrect) - "That was a good try but let's check your mouth pictures."

    "The first sound in _____ is /__/."

    "Here is a picture of the mouth saying /__/."

    (Place the correct mouth picture over the child's mouth picture)

    (Review how mouth moves when it says /__/ - draw attention to the mouth picture, have child say sound and look at mouth in the mirror.)

    (Continue until all the correct mouth pictures are identified.)

  - (If partially incorrect) – "That was a good try but let's check your mouth pictures."

    (Point to first (second, etc.) mouth picture.)

    (If the mouth picture is correct) "The first (second, etc.) sound in ___ is /__/."

"This picture shows the mouth saying /__/. Good job."

(If mouth picture is incorrect) – "Does your mouth move like this (point to incorrect mouth picture) or like this (point to correct mouth part) when you say /__/. (Encourage child to look in mirror while saying sound.)

(When child provides correct response.) "Good job."

(Put correct mouth picture in frame over incorrect mouth picture.)

(Continue until all mouth pictures are correct.)

Cycle through the word set until child segments 8 correct words in a row.

End of session- "Thank you for working so hard today. We will play again tomorrow."

Resuming a new session – "Do you remember the game we played yesterday? I said a word and you picked out the mouth pictures that show all the sounds in the word. Let's see if you remember which mouth picture goes with which sound. I will say a sound and you point to the picture. I say ____ you say _____. Now point to the mouth picture for____. Good job, let's play the game."

III. Letter – Correspondence Training

Need: Letter tiles

Training Trial – Set 1

(Sounds /p/, /t/, /f/, /a/)

(Set out the letter tiles – P, T, F, A.)

"I am going to say some sounds and show you some letters that say those sounds. Your job is to try and remember which letter says which sound."

(Be sure to minimize the schwa sound when saying sounds)

"Here is the letter P. (Place the letter P in front of the child.)

"The letter P says /p/. You can hear the sound /p/ in the letter name P."

"You say P." C R

"Now say /p/." C R

"Can you hear the letter sound /p/ in the letter name P?" C R

(Put the P tile back in the display of letters)

"Point to the letter that says /p/."

"If you aren't sure which letter says /p/, try saying the letter names until you hear the sound /p/ in the letter name." C R

Repeat the training procedure for each letter in Set 1

Test Trial: Set 1

(Record child's first response.)

(Place the letters P, T, F, A in front of the child.)

"I'm going to say some sounds. Your job is to repeat each sound and point to the letter that says each sound. If you aren't sure which letter says which sound, say each letter name until you hear the sound."

(Avoid any mention of articulation – only discuss what the child hears.)

"Say /p/ and tell me what letter you hear." C R

"Point to the letter." C R

- (If correct) – "That is right."
- (If incorrect) – "That's a good try."

  (1st) "Say the names of all the letters to find the one that says /p/."

  (2nd) "Listen, the letter P says /p/. You can hear the sound in the letter's name:

P, /p/."

"You say P, /p/." C R

"Now point to the letter P." C R

Repeat the procedure for sounds in Set 1 in random order to a criterion of 2 successive correct sets with no prompting or feedback.

Training Trial – Set 2

(Sounds /b/, /d/, /v/, /e/)

(Set out the letter tiles – D, B, V, E.)

"I am going to say some sounds and show you some letters that say those sounds. Your job is to try and remember which letter says which sound."

"Here is the letter B. (Place the letter B in front of the child.)

"The letter B says /b/. You can hear the sound /b/ in the letter name B."

"You say B." C R

"Now say /b/." C R

"Can you hear the letter sound /b/ in the letter name B?" C R

(Put the B tile back in the display of letters)

"Point to the letter that says /b/."

"If you aren't sure which letter says /b/, try saying the letter names until you hear the sound /b/ in the letter name." C R

Repeat the training procedure for each letter in Set 2

Test Trial: Set 2

(Record child's first response)

(Place the letters D, B, V, E in front of the child)

"I'm going to say some sounds. Your job is to repeat each sound and point to the letter that says each sound. If you aren't sure which letter says which sound, say each letter name until you hear the sound."

(Avoid any mention of articulation – only discuss what the child hears.)

"Say /b/ and tell me what letter you hear." C R

"Point to the letter." C R

- (If correct) – "That is right."
- (If incorrect) – "That's a good try."

  (1st) "Say the names of all the letters to find the one that says /b/."

  (2nd) "Listen, the letter B says /b/. You can hear the sound in the letter's name: B, /b/."

  "You say B, /b/." C R

  "Point to the letter B." C R

Repeat the procedure for the sounds in Set 2 in random order to a criterion of 2 successive correct sets – no prompting or feedback.

Training Trial – Set 3

(Sounds /l/, /m/, /k/, /s/)

(Set out the letter tiles – M, L, K, S.)

"I am going to say some sounds and show you some letters that say those sounds. Your job is to try and remember which letter says which sound."

"Here is the letter M." (Place the letter M in front of the child.)

"The letter M says /m/. You can hear the sound /m/ in the letter name M."

"You say M." C R

"Now say /m/." C R

"Can you hear the letter sound /m/ in the letter name M?" C R

(Put the M tile back in the display of letters)

"Point to the letter that says /m/."

"If you aren't sure which letter says /m/, try saying the letter names until you hear the sound /m/ in the letter name." C R

Repeat the training procedure for each letter in Set 3

Test Trial: Set 3

(Record child's first response)

(Place the letters L, M, K, S in front of the child)

"I'm going to say some sounds. Your job is to repeat each sound and point to the letter that says each sound. If you aren't sure which letter says which sound, say each letter name until you hear the sound."

(Avoid any mention of articulation – only discuss what the child hears.)

"Say /l/ and tell me what letter you hear." C R

"Point to the letter." C R

- (If correct) – "That is right."
- (If incorrect) – "That's a good try."

  (1st) "Say the names of all the letters to find the one that says /l/."

  (2nd) "Listen, the letter L says /l/. You can hear the sound in the letter's name: L, /l/."

  "You say L, /l/." C R

  "Point to the letter L." C R

Repeat the procedure for the sounds in Set 3 in random order to a criterion of 2 successive correct sets – no prompting or feedback.

Training Trial – Set 4

(Sounds /z/, /n/, /o/)

(Set out the letter tiles – Z, N, O.)

"I am going to say some sounds and show you some letters that say those sounds. Your job is to try and remember which letter says which sound."

"Here is the letter Z. (Place the letter Z in front of the child.)

"The letter Z says /z/. You can hear the sound /z/ in the letter name Z."

"You say Z." C R

"Now say /z/." C R

"Can you hear the letter sound /z/ in the letter name Z?" C R

(Put the Z tile back in the display of letters)

"Point to the letter that says /z/."

"If you aren't sure which letter says /z/, try saying the letter names until you hear the sound /z/ in the letter name." C R

Repeat the training procedure for each letter in Set 4

Test Trial: Set 4

(Record child's first response.)

(Place the letter tiles Z, N, O in front of the child)

"I'm going to say some sounds. Your job is to repeat each sound and point to the letter that says each sound. If you aren't sure which letter says which sound, say each letter name until you hear the sound."

(Avoid any mention of articulation – only discuss what the child hears.)

"Say /o/ and tell me what letter you hear." C R

"Point to the letter." C R

- (If correct) – "That is right."
- (If incorrect) – "That's a good try."

  (1st) "Say the names of all the letters to find the one that says /o/."

  (2nd) "Listen, the letter O says /o/. You can hear the sound in the letter's name: O, /o/."

  "You say O, /o/." C R

  "Point to the letter O." C R

Repeat the procedure for the sounds in Set 4 in random order to a criterion of 2 successive correct sets with no prompting or feedback.

Review Trial

Need: letter tiles

(Place all the letter tiles in front of the child)

"I'm going to say each sound. Your job is to repeat the sound and then point to the letter that says that sound. If you aren't sure you can name the letters to hear their sounds.

Routine

"The first (second, etc.) sound is /__/."

"Say /__/ and point to the letter that makes the sound /__/." C R

- (If correct) "That is right"
- (If incorrect) – "That's a good try but let's try again."

  (1st) "Say the names of all the letters to find the one that says /sound/."

(2nd) “Listen, the letter XX says /xx/. You can hear the sound in the letter’s name: (letter name), /sound/).

“You say (letter name), /sound/.” C R

“Point to the letter /name/.” C R

Repeat the sounds in random order to a criterion of 2 successive correct sets with no prompting or feedback.

IV. Letter – Segmentation Training – CV/VC

Need: Letter tiles and 3 section frame

Introduction

“Now we will play a game with sounds, words, and letter tiles. Remember how we did this with the mouth pictures? I will say a word. Some of the words are real words with meanings. Other words are made up and do not have meanings but we can still say them. We will think about the sounds we hear when we say the word. We will think about the letters that go with the sounds we hear in the word.”

“Let me show you.”

“The first word is Abe.”

“The word ‘ABE’ is a man’s name. The name has 2 sounds - /a/ /b/.”

(Say the separate sounds while lifting a finger for each sound.)

“Let’s find the two letters that make these sounds.”

(Set out frame and cover unneeded spaces.)

“I say ‘Abe’ and listen to the sounds I hear. The first sound is /a/. The letter A has the sound /a/ in its name, so I put the letter A here” (place the letter tile in the first left hand

space in the frame) “The next sound in “Abe” is /b/. The letter B has the sound /b/ in its name, so I put the letter B here.” (Place the letter tile in the next space in the frame).

“That’s how to play the game. I will say a word and you will find the letters that you hear in the word.” (Put tiles back into the display)

“Now you say ‘Abe’ and decide which letters say the sounds you hear”

(Guide the child – provide corrective feedback, help them make the sounds; Do not talk about mouth movements; refer only to sounds you hear in the words)

“Good job. Let’s do some more words.”

Routine

(Record child’s first response.)

****Say each word normally as a whole – be careful not to prompt the child’s segmentation of words*****

(Set out the letter frame – cover the unneeded space.)

1. “The first (second, etc.) word is _____.”

“There are # sounds in the word _____”

“Say _____ and find the letters that say the sounds you hear in the word _____.”

(Help the child put the letters in the appropriate spaces in the frame.)

- If the child has difficulty with the routine –
    - “What’s the first sound? What letter says that sound?”
    - “What’s the next sound? What letter says that sound?”

(Continue until all sounds are identified – record responses)

(Phase out prompts as child is able to respond on their own.)

Feedback

(Allow child to finish entire word before providing feedback.)

- (If correct) “That is right. Good job.” (Leave the child’s letter tiles in the frame)
- (If totally incorrect) - “That was a good try but let’s check your letters.”

  “The first sound in _____ is /__/.”

  “The letter that says /__/ is _____. I can hear the sound /__/ in the letter name _____.

  (Place the correct letter tile over the child’s tile.)

  (Continue until all the correct letters are identified.)
- (If partially incorrect) – “That was a good try but let’s check your letters.”

  (Point to first (second, etc.) letter.)

  - (If letter is correct) - “The first (second, etc.) sound in _____ is /__/. (Letter name) says /___/. Good job.”
  - (If letter is incorrect) – “The first (second etc.) sound in _____ says /__/.”

    “Does (Incorrect letter name) say /__/ or does the (correct letter name) say /__/?”

    “Which letter name contains /__/?”

    (When child provides correct response.) “Good job.”

    (Put correct letter in frame over incorrect letter.)

    (Continue until all the letters are correct.)

Cycle through the word set until child segments 8 correct words in a row.

End of session: “Thank you for working so hard today. We will play again tomorrow.”

Resuming a new session – "Do you remember the game we played yesterday? I said a word and you picked out the letters that say the sounds in the word. Let's see if you remember which letters say which sounds. I will say a sound and you point to a letter. I say _____. You say _____ and point to the letter that says _____. Good job, let's play the game."

V. Articulation – Segmentation Training – CVC

See script for Articulation Segmentation training CV/VC

Shift to the CVC words and cycle through word list until the child can segment 8 correct in a row (no feedback or prompting). Recycle through words as necessary.

VI. Letter – Segmentation Training – CVC

See script for Letter Segmentation training CV/VC

Shift to the CVC words and cycle through word list until the child can segment 8 correct in a row (no feedback or prompting). Recycle through words as necessary.

VII. Review of words

Need: Mouth tiles, Letter tiles, 2 x 3 word frame, and hand mirror

Introduction

"Now we are going to review the words that you learned over the last few days. The words will be mixed up, so they will not all have the same number of sounds. You will need to decide how many different sounds you hear in each word. Then your job is to show me that you have learned how to put out mouth pictures and letters to show the sounds in words. You should put the mouth pictures and letters in the frame just like you did during practice."

Routine

(Record child's first response.)

(Place letter tiles, mouth pictures, and 2x3 word frame in front of child.)

(Cover the letter tiles until the child is finished selecting mouth pictures).

***Say each word normally as a whole – be careful not to prompt the child's segmentation of words. ***

1. "Say _____ and tell me how many sounds you hear in the word."

2. "Now say _____ and find the mouth picture that shows how your mouth moves when you say each sound in the word."

- If the child has difficulty with the routine –
  - What's the first sound? What mouth picture shows how your mouth moves when you make that sound?"
  - "What's the next sound? What mouth picture shows how your mouth moves when you make that sound?

(Continue until all sounds identified – record responses)

(Phase out prompts as child is able to respond on their own

3. (When child is finished with the mouth pictures uncover the letter tiles.)

"Good job. Now say _____ and find the letter that says each sound you hear in the word."

- If the child has difficulty with the routine –
  - "What's the first sound? What letter says that sound?"
  - "What's the next sound? What letter says that sound?"

(Continue until all sounds are identified – record responses)

(Phase out prompts as child is able to respond on their own.)

Feedback

(Wait until child is completely finished selecting mouth pictures and letter tiles before providing feedback.)

Sounds

- (If correct) “Good job. There are # sounds in _____.”
- (If incorrect) “That’s a good try but let’s count the sounds together.” (Help the child use their fingers to count the sounds until they can count the correct number of sounds in the word.)

Mouth pictures/letters

- (If both mouth pictures and letters correct) – “Good job. You picked the correct mouth pictures and letters for the word _____. Let’s try another word.”

Mouth Pictures

(Leave child’s mouth pictures in the frame.)

- (If mouth pictures correct) – “Good job. The mouth pictures are correct.”
- (If completely incorrect) - “That was a good try but let’s check your mouth pictures

  “The first sound in _____ is /__/.”

  “Here is a picture of the mouth saying /__/.”

  (Place the correct mouth picture over the child’s mouth picture)

  (Review how mouth moves when it says /__/ - draw attention to the mouth picture, have child say sound and look at mouth in the mirror.)

  (Continue until all the correct mouth pictures are identified.)

- (If partially incorrect) – "That was a good try but let's check your mouth pictures."

  (Point to first (second, etc.) mouth picture.)
- (If the mouth picture is correct) "The first (second, etc.) sound in _____ is /__/."

  "This picture shows the mouth saying /__/. Good job."
- (If mouth picture is incorrect) – "Does your mouth move like this (point to incorrect mouth picture) or like this (point to correct mouth part) when you say /__/. (Encourage child to look in mirror while saying sound.)

  (When child provides correct response.) "Good job." (Put correct mouth picture in frame over incorrect mouth picture.)

  (Continue until all mouth pictures are correct.)

Letter Tiles

- (If letters correct) – "Good job. The letters are correct."
- (If completely incorrect) – "That was a good try but let's look at your letters."

  (Leave child's letters in the frame.)

  "The first sound in _____is /__/. Here is the letter _____ that says the sound /__/."

  "I can hear the sound /__/ in the letter name ____."

  (Continue until all the letters are correct.)
- (If partially incorrect) – "That was a good try but let's check your letters."

  (Point to first (second, etc.) letter.)
- (If letter is correct) - "The first (second, etc.) sound in _____ is /__/." "(Letter name) says /___/. Good job."

- (If letter is incorrect) – "The first (second etc.) sound in _____ says /__/."

  "Does (Incorrect letter name) say /__/ or does the (correct letter name) say /__/?"

  "Which letter name contains /__/?"

  (When child provides correct response.) "Good job."

  (Put correct letter in frame over incorrect letter.)

  (Continue until all the letters are correct.)

Cycle through the words until child segments 8 correct in a row.

End of session- "Thank you for working so hard today. We will play again tomorrow."

Resuming a new session – "Do you remember the game we played yesterday? I said a word and you picked out the mouth pictures and letters that showed all the sounds in the word. Your job is to do what we did during practice and show me that you have learned how to put out mouth pictures and letters to show the sounds in words."

One-Day Posttest

1. Phoneme Segmentation Task

Need: Mrs. Magic Mouth, five blank tiles

Introduction

"I would like to play the word game we played before with Mrs. Magic Mouth. I will say a word and I want you to repeat the word. Then I want you to say each sound in the word in order and remove a tile from her mouth as you say each sound."

1. "For example, if I say 'Oat', you should say 'Oat' then repeat each sound /o/-/t/ and remove a tile for each sound." (Demonstrate removing a tile as you say each sound and putting the tiles on the table next to Mrs. Magic Mouth.)

"Now you try to do the same thing with the word 'Oat'."

- (If correct) "That's right."
- (If wrong) "That was a good try. Now listen again." (Repeat procedure for the word and have child try again until provides correct response.)

2. Repeat procedure for "Bee".

3. Repeat procedure for "Mole".

Routine

(Say the word and have the child repeat the word and then segment the word removing a tile from Mrs. Magic's mouth for each sound)

*For the first word in each word type -

1. (If correct) "That's right."

   (If wrong) "Listen. The word is 'Aid'." (Say each sound and remove a tile for each sound as you say it.) "/a/ - /d/. Now you try it." (CR)

2. (If correct) “That’s right.”

   (If wrong) “Listen. The word is ‘Nay’.” (Say each sound and remove a tile for each sound as you say it.) “/n/ - /a/. Now you try it.” (CR)

3. (If correct) “That’s right.”

   (If wrong) “Listen. The word is ‘Phase’.” (Say each sound and remove a tile for each sound as you say it.) “/f/ - /a/ - /z/. Now you try it.” (CR)

4. (If correct) “That’s right.”

   (If wrong) “Listen. The word is ‘Peeks’.” (Say each sound and remove a tile for each sound as you say it.) “/p/ - /e/ - /k/ - /s/. Now you try it.” (CR)

For all other words –

(Whether correct or incorrect) “Very good. Let’s try the next word.”

Scoring

- Score as correct only words child responds to accurately on his/her own.
- Circle correct component sounds.
- Record segments child says – whether larger units are given, CV or VC unit used, record which vowels and which consonants are given.
- Give credit for consonant phonemes which are followed by a schwa sound as long as the consonant is not followed by the vowel sound that is present in the actual word.

2. Invented Spelling Task

Need: Letter Tiles

Introduction

Now I will say some words. I will say a word and then I want you to repeat the word.

I would like you to listen to the sounds you hear in the word and pick the letters that make the sounds you hear. Do the best you can."

Routine

1. "The first word is _____. (Use the long vowel pronunciation for all the nonwords.)

2. "You say _____ and pick the letters that say the sounds you hear. Put the letters in order in front of you. (Make sure the child pronounces each word correctly.)

3. "Watch me do it." Model the nonwords 'EM' and 'PAK'. (Use the long vowel pronunciations)

End: "You did very well. Thank you for trying so hard."

3. Sight word learning

Need: Word cards

Introduction

"Now I am going to teach you how to read some words. I will give you practice so you can get better at it. First I will tell you how to read words."

Routine: Study Trial

1. (Give sentence. Show word on card.)

2. "This word says _____. You say it."

Word List

SA	SAY	You should say thank you if someone gives you a present.
BEK	BEAK	The bird eats with his beak.
TAL	TAIL	A dog wags his tail when he is happy.
BO	BOW	That girl has a pretty bow in her hair.

Word List (continued)

TE TEA My mother drinks tea in the morning.

SOP SOAP You should use soap and water to wash your hands.

End: "You did very well. Now I will show you those words again. Look at each one and remember how I told you to read it."

Routine: Test Trials

1. (Present word. If no response after 5 sec.) "Try to read it." (Record response)

2. (If correct). "That is right."

(If incorrect) "This word says _____. You say it."

Give child a minimum of 5 trials and a maximum of 8 trials. Stop at 5 trials if perform 3 perfect successive trials.

End: "You did very well remembering how to read those words. Thank you for trying so hard."

Record: Whether child reads word within 1 second or more of seeing word.

Child's response if word is incorrect.

Whether child sounds out word during reading.

4. Sight word Spelling Recall

Introduction

"Now I will say the words that you just learned. Your job is to remember how the words where spelled and use the letter tiles to spell them. Do the best you can."

Routine

1. "The first word is _____. (Give sentence.)

2. "You say _____ and pick the letters that spell _____.

Word List

SA	SAY	You should say thank you if someone gives you a present.
SOP	SOAP	You should use soap and water to wash your hands.
BEK	BEAK	The bird eats with his beak.
TAL	TAIL	A dog wags his tail when he is happy.
TE	TEA	My mother drinks tea in the morning.
BO	BOW	That girl has a pretty bow in her hair.

5. Reading Nonsense Words

Need: nonsense words on cards

Introduction

"Now I am going to show you some made up words. They don't have any meanings but you can say them. Let me show you."

"Here is a made up word. (Present card and point to letters.)

"It has a sound but doesn't mean anything. First I look at the letters and say their sounds. Then I put the sounds together and say the word. These letters say 'zed'" (long e pronunciation).

"Now I have some silly words for you to read. Do the best you can. If you can't read a word, that's okay. Try to sound it out. You can use this card to keep your place."

Routine

"Read the (first, next) word."

- Give child about 5 sec. to respond.
- Record responses on data sheet – give credit for both long and short vowel pronunciations.

- Record phonemic spelling if nonword given.
- Record info about any strategies child uses, especially if s/he tries to sound out and blend word.
- Record exactly what child says if misreads word or attempts to read word but doesn't finish.

End: "You did a good job. I am proud of you for trying so hard.

6. Nonword Repetition Task

Need: Tape recorder, audio tape, Score Sheet

Introduction

"Now we're going to play a word game. When I turn on the tape recorder you will hear a funny made-up word. I would like you to say the funny word back to me as soon as you hear it."

"If the made-up word you hear is 'noop' (pronounced 'nupe'), you should say 'noop' back to me. Let's give it a try."

"Noop." (CR)

- (If correct) "Very good. Now let's turn the tape on and try some more words."
- (If incorrect) "That was a good try. Let's try again."

Repeat the procedure until the child makes a successful repetition attempt.

Test Administration

1. Make sure the child is paying attention – "Are you ready?"
2. Turn on the tape recorder – keep one hand on the pause switch.
3. Record responses on the score sheet.
4. If child doesn't repeat an item press the pause button on the recorder.

"Can you say the word?"

If the child responds – score the response.

If the child indicates that they cannot remember or have no response score as an error.

"That's okay"

If the child asks to hear the word again – say the word aloud and let the child repeat it. However – score as an error even if the child repeats correctly.

5. Follow procedure for all 38 items.

6. "That's all for now. Thank you for trying so hard."

7. Letter Sounds

Need: Card with the alphabet letters representing the 15 target sounds in mixed up order

Introduction

(Show letter sheet) "Now I will show you some letters. The letters are all mixed up. I want you to point to each letter and tell me the sound it makes in words. Start with this letter (point to the first letter) and tell me the sound it makes. Go across the row and point to each letter as you tell me its sound. (Point as you say this) Do the best you can. Guess if you aren't sure."

Routine
- Point to the first letter on the card and tell child to begin.
- Give child 5 seconds to respond and then ask them to try the next letter.
- Record response on data sheet
  - If sound correct, circle letter.
  - If gives letter name write LN next to letter –
  - If incorrect record letter or sound given.

End: "You did a good job. Thank you for trying so hard."

8. Articulatory Movement Pictures

Need: Tiles printed with the 8 mouth pictures representing the 15 target sounds

Introduction

(Place the tiles printed with the 8 mouth pictures in front of the child) “Now I will show you some pictures of your mouth saying different letter sounds. I am going to say some sounds. Your job is to repeat each sound and then point to the mouth picture that is making that sound. Do the best you can. Guess if you aren’t sure.”

Routine - (Record child’s first response.)

“The first (second, etc.) sound is /_/.”

“Say /_/ and point to the mouth picture that is making the sound /_/.”

Seven-Day Posttest

1. Sight Word Memory

Introduction

"Now I will show you the words you learned to read last week. I want you to look at each word and remember how I told you to read them."

Routine:

1. (Present word. If no response after 5 sec.) "Try to read it." (Record response)
   - (If correct) "That is right."
   - (If incorrect) "This word says _____. You say it."

2. Phonemic Segmentation Task

Need: Mrs. Magic Mouth, five blank tiles

Introduction

"I would like to play the word game we played before with Mrs. Magic Mouth. I will say a word and I want you to repeat the word. Then I want you to say each sound in the word in order and remove a tile from her mouth as you say each sound."

1. "For example, if I say 'Oat', you should say 'Oat' then repeat each sound /o/-/t/ and remove a tile for each sound." (Demonstrate removing a tile as you say each sound and putting the tiles on the table next to Mrs. Magic Mouth.)

   "Now you try to do the same thing with the word 'Oat'."

   - (If correct) "That's right."
   - (If wrong) "That was a good try. Now listen again." (Repeat procedure for the word and have child try again until provides correct response.)

2. Repeat procedure for "Bee".

3. Repeat procedure for “Mole”.

Routine

Say the word and have the child repeat the word and then segment the word removing a tile from Mrs. Magic’s mouth for each sound.

*For the first word in each word type -

1. (If correct) “That’s right.”

   (If wrong) “Listen . The word is ‘Ate’.” (Say each sound and remove a tile for each sound as you say it.) “/a/ - /t/. Now you try it.” (CR)

2. (If correct) “That’s right.”

   (If wrong) “Listen . The word is ‘See’.” (Say each sound and remove a tile for each sound as you say it.) “/s/ - /e/. Now you try it.” (CR)

3. (If correct) “That’s right.”

   (If wrong) “Listen. The word is ‘PAID’.” (Say each sound and remove a tile for each sound as you say it.) “/p/ - /a/ - /d/. Now you try it.” (CR)

4. (If correct) “That’s right.”

   (If wrong) “Listen . The word is ‘Dotes’.” (Say each sound and remove a tile for each sound as you say it.) “/d/ - /o/ - /t/ - /s/. Now you try it.” (CR)

For all other words –

- Whether correct or incorrect - “Very good. Let’s try the next word.”

3. Invented spelling Task

Need: Letter Tiles

Introduction

Now I will say some words. I will say a word and then I want you to repeat the word.

I would like you to listen to the sounds you hear in the word and pick the letters that make the sounds you hear. Do the best you can."

Routine

1. "The first word is _____. (Use the long vowel pronunciation.)

2. "You say _____ and pick the letters that say the sounds you hear. Put the letters in order in front of you. (Make sure the child pronounces each word correctly.)

3. "Watch me do it." Model nonwords EM and PAK. (long vowel pronunciations)

End: "You did very well. Thank you for trying so hard."

4. Sight Word Learning

Need: Word cards

Introduction

"Now I am going to teach you how to read some words. I will give you practice so you can get better at it. First I will tell you how to read words."

Routine: Study Trial

1. Give sentence. Show word on card.

2. "This word says _____. You say it."

Word List

POL	POLE	The fireman slid down the pole.
LO	LOW	The sun is high and the ground is low.
KE	KEY	The key unlocks the door.
PA	PAY	You have to pay for the candy before you leave the store.
LEF	LEAF	The leaf is green.
KAV	CAVE	The bat lives in a cave.

End: "You did very well. Now I will show you those words again. Look at each one and remember how I told you to read it."

Routine: Test Trials

1. (Present word. If no response after 5 sec.) "Try to read it." (Record response)

2. (If correct). "That is right."

(If incorrect) "This word says _____. You say it."

Give child a minimum of 5 trials and a maximum of 8 trials. Stop at 5 trials if perform 3 perfect successive trials.

End: "You did very well remembering how to read those words. Thank you for trying so hard."

Record: Whether child reads word within 1 second or more of seeing word.

Child's response if word is incorrect.

Whether child sounds out word during reading.

5. Sight word Spelling Recall

Introduction

"Now I will say the words that you just learned. Your job I to remember how the words where spelled and use the letter tiles to spell them. Do the best you can."

Routine

1. "The first word is _____. (Give sentence.)

2. "You say _____ and pick the letters that spell _____.

Word List

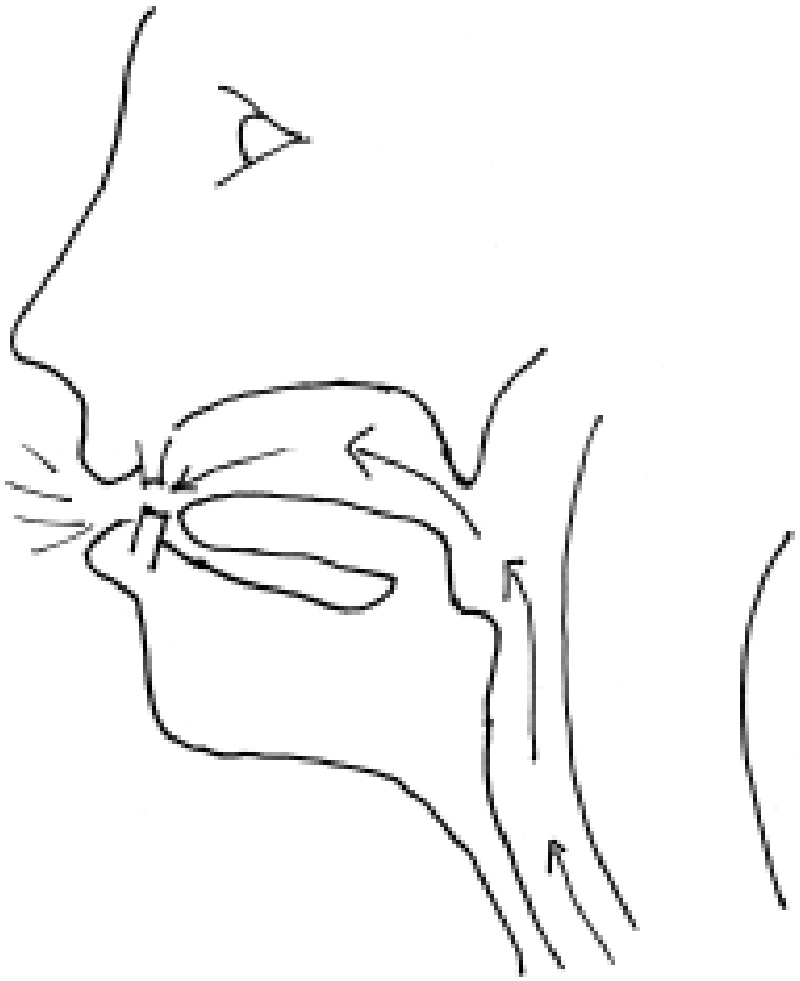
KAV	CAVE	The bat lives in a cave.
LO	LOW	The sun is high and the ground is low.

Word List (continued)

KE	KEY	The key unlocks the door.
PA	PAY	You have to pay for the candy before you leave the store.
LEF	LEAF	The leaf is green.
POL	POLE	The fireman slid down the pole.

Appendix C

Drawing of the Mouth



Appendix D

Drawing of the Ear

Appendix E

Word and Nonword Lists

Pretest Tasks

Phoneme Segmentation

Sample Words – OAT, BEE, MOLE

Words - AID, EAT, FOE, NAY, BOWL, COPE, PHASE, SEAM, TAKE, VEAL

Reading Nonsense Words

Sample Nonword - ZED

Nonwords - AF, EB, OS, PO, TA, VE, DEM, NAK, ZOL,

Preprimer/Target Words

Preprimer Words - BIG, WE, PLAY, LOOK, FUN, BALL, NO, ME, HE, DADDY, SEE, YOU, IT, GO, THE, RED, AND, MOTHER, HELP, STOP, DOG, UP

Target Words - BO (BOW), SA (SAY), TE (TEA), BEK (BEAK), SOP (SOAP), TAL (TAIL), KE (KEY), LO (LOW), PA (PAY), KAV (CAVE), LEF (LEAF), POL (POLE)

Invented Spelling

Sample Nonwords – EM, PAK

Nonwords - AN, EP, OL, KO, VA, ZE, BOS, MEF, TAD

LO/LPA Conditions

Segmentation Training

VC Words/Nonwords –AK (ACHE), AL (AIL), AM (AIM), AS (ACE), EK

(EEK), EN (EEN), EV (EVE), EZ (EAZE), OB (OBE), OF (OAF), OP (OPE), OZ (OWES)

CV Words/Nonwords – BA (BAY), DA (DAY), DE (DEE), FA (FAY), KA (KAY), LE (LEE), ME (ME), MO (MOW), NO (NO), PE (PEA), TO (TOE), VO (VOE)

CVC Words/Nonwords – BAK (BAKE), BEZ (BEES), BON (BONE), KOM (COMB), DOZ (DOZE), FAK (FAKE), FAL (FAIL), FAT (FATE), FEL (FEEL), KEZ (KEYS), LOD (LOAD), MAN (MANE), MEN (MEAN), NES (NEICE), NOT (NOTE), PAS (PACE), PAL (PAIL), PEV (PEEVE), POZ (POSE), SEP (SEEP), TEM (TEAM), TOD (TOAD), VAS (VASE), VOT (VOTE)

<u>One-Day Posttests</u>

Phoneme Segmentation

Sample Words – BEE, OAT, MOLE

Words - AID, EAT, FOE, NAY, BOWL, COPE, PHASE, SEAM, TAKE, VEAL, BEAN, DATE, GNOME, OLD, BLOW, PEEKS, STEAK

Invented Spelling

Sample Nonwords – EM, PAK

Nonwords - AN, EF, EP, OL, KO, VA, ZA, ZE, BOS, MEF, PON, TAD

Sight Word Learning

Words - BO (BOW), SA (SAY), TE (TEA), BEK (BEAK), SOP (SOAP), TAL (TAIL)

Sight Word Spelling Recall

Words - BO (BOW), SA (SAY), TE (TEA), BEK (BEAK), SOP (SOAP), TAL (TAIL)

Reading Nonsense Words

Nonwords - AF, EB, OS, PO, TA, VE, DEM, NAK, ZOL

Seven-Day Posttests

Sight Word Memory

Words - BO (BOW), SA (SAY), TE (TEA), BEK (BEAK), SOP (SOAP), TAL (TAIL)

Phoneme Segmentation

Sample Words – BEE, OAT, MOLE

Words - ATE, OAK, DOE, SEE, DEAN, FEES, FOAM, LOBE, PAID, VANE, ACHES, DOTES, PLEA, BLEAT

Invented Spellings

Sample Nonwords – EM, PAK

Nonwords - AN, EF, EP, OL, KO, VA, ZA, ZE, BOS, MEF, PON, TAD

Sight Word Learning

Words - KE (KEY), LO (LOW), PA (PAY), KAV (CAVE), POL (POLE), LEF (LEAF)

Sight Word Spelling Recall

Words - KE (KEY), LO (LOW), PA (PAY), KAV (CAVE), POL (POLE) LEF (LEAF)

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