EFFECTS OF TWO METHODS OF PHONEMIC AWARENESS TRAINING ON WORD READING AND SPELLING IN KINDERGARTEN CHILDREN

by

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Abstract

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The purpose of this study was to examine 2 phonemic awareness training procedures to determine whether either enhanced kindergartners' phonemic awareness, their ability to learn to read words, to decode nonwords, and to generate spellings. One type of training involved teaching children to analyze their mouth movements when they segmented words into sounds, called the mouth condition. A second type of training involved teaching children to segment words into sounds by listening to the sounds, the ear condition. Children with similar preprimer word reading skill and spoken vocabularies were randomly assigned to one of 3 groups, the mouth group, the ear group, or the no-treatment control group. Following

training, experimental and control children were given several posttests to assess their phonemic awareness, their ability to learn to read words and to decode nonwords, and their ability to invent spellings of words. Analyses of variance were used to assess effects of training.

Results were in general positive. On the segmentation posttest, trained students outperformed control students to the same extent, indicating that both training procedures were effective in teaching segmentation skill. However, students trained to detect articulatory gestures were much more intrinsically interested and motivated than students trained to detect sounds in words. On the transfer tasks, trained students in both groups spelled more sounds in words than control students, indicating positive transfer to spelling. Trained students did not outperform control students in learning to read words accurately when given several practice trials. However, mouth-trained students outperformed controls in the use of partial letter-sound cues to read words in this task, indicating that articulatory training produced limited transfer to word learning processes. Little if any decoding skill was exhibited on posttests by all of the groups, indicating no transfer effects.

In conclusions, results of this study identify a superior method of teaching phonemic awareness to novice beginners. Training students to segment words into articulatory gestures is as effective as more traditional ways of teaching phonemic awareness, and it is much more motivating. Moreover, the procedures are easy for teachers to learn and the materials are minimal in cost.

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All children are wonderful: the children who participated in this study were, if possible, even more wonderful. If I close my eyes I can see their small hands shooting up, fingers wiggling, every time I entered the classrooms to pick them up and take them to the room where we could work. "Take me, please take me" they would say, some shy, some bolder. And although some complained that the training was too difficult and others were tired after the training, they never tired of raising their hands and wanting to start all over again each new day.

To the many children who were selected for the study and to the many I left behind in the classroom I want to say thank you. In particular I want to thank one little girl, who could not segment any sounds when I first pretested her, and neither could she read any preprimer or any Boder word. She kept her head low while repeating: "I am sorry, I don't know". She trained tirelessly with the mouth blocks, refusing to go back to the class because she wanted to learn to read.

And learn to read she did. I will never forget the triumphant look she gave me after she read, really read her first word. The joy we shared was well worth the effort it took to complete this study.

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Section I

Introduction

Most children who enter kindergarten as prereaders do not understand that speech is composed of a sequence of individual sounds, despite the fact that they can clearly produce and comprehend spoken English (Singer, 1979). The relationship between language acquisition and reading acquisition has been studied for over 20 years by researchers at Haskins Laboratories (Liberman, Shankweiler, Fischer, & Carter, 1974). According to their perspective, the language faculty is independent from other cognitive faculties and is composed of four autonomous subsystems: phonology, lexicon, syntax and semantics. When a person learns to read, this "biologically-coherent, nature-created speech system" and its subsystems must be adapted to the requirements of reading (Shankweiler & Crain, 1986). The beginner reader must discover how to analyze the internal structure of the spoken word and the internal structure of the printed word and how they are related. When a word is spoken, its phonological units are not produced one at a time, but rather they are coarticulated. That is, consonants and vowels are assigned to the places in the mouth where they are shaped and then produced almost at the same time. As Liberman and Shankweiler (1985) explain, coarticulation has the advantage of speedy delivery of speech, although inevitably it destroys any simple, direct correspondence between the acoustic segments and the phonological segments conveyed. Thus, readers can understand why a printed word has a certain number of letters only if they are aware that the corresponding spoken word is divisible into as many segments, although they do not need to consciously be aware of this fact when they speak.

The motor theory of speech perception proposed by Liberman and Mattingly (1985) specifies that a phonetic segment is the product of one or more phonetic gestures (for example "tongue backing" or "lip rounding"). Each gesture in turn must be viewed as a group of features (for example "labial", "stop", "nasal"). A phonetic gesture is a class of movements by one or more articulators that results in a particular linguistically significant deformation of the vocal-tract configuration. The linguistic function of the gesture is phonetic contrasts, the basis of phonological categories. Liberman and others at Haskins Laboratories (Liberman, 1996) have shown that articulatory gestures are at the heart of phonological knowledge. Based on this, one would expect that articulatory training would be an effective means of giving beginning readers access to the phonological representations of words in their language and enabling them to segment words into phonemes. However, none of the tasks currently used to test and teach phonemic awareness - rhyming tasks, segmentation and blending tasks, deletion tasks - assesses awareness of articulatory gestures. Also, most of them do not involve the use of printed letters or printed words (Lenchner, Gerber & Routh, 1990; Spector, 1992; Stahl & Murray, 1994; Stanovich, Cunningham & Cramer, 1984; Yopp, 1988).

Understanding the relationship between phonemic awareness and reading development is important for both theoretical and practical reasons. From a theoretical point of view, a great number of researchers have tried to answer the question of cause and effect between phonemic awareness and reading and spelling achievement. There is evidence to support the theory that phonemic awareness is a precursor of reading ability (Bradley & Bryant, 1983; Lundberg, Frost & Petersen, 1988) and evidence to support the theory that phonemic awareness may develop as a consequence of learning an alphabet (Ehri, 1979; Ehri, 1984; Ehri & Wilce, 1983, 1986; Mann, 1986; Morais, Bertelson, Cary & Alegria, 1986). For example, Chinese adults who were literate only in Chinese characters were found to be unable to delete consonants in spoken Chinese words, whereas Chinese adults literate in alphabetic spelling as well as characters could perform the same task readily and accurately (Read, Yun-Fei, Hong-Yin, & Bao-Qing, 1986).

From a practical point of view, Ehri (1989) has pointed out that if instruction fails to teach phonemic awareness and spelling skills early, students who have low levels of phonemic awareness will be left to their own devices to find out how the system works. Some of them might never find out. Many children develop problems when they start learning to read, and failure to learn to read may account at least in part for the high rate of high school drop-outs. According to the New York City Board of Education, the graduation rate for students in the class of 1987 five years after entering ninth grade was 54%, indicating that 46% had failed to graduate (Annual Dropout Report, 1989). The Young Adult Literacy Survey (Kirsch & Yungeblut, 1986) found that although 5% of American 21-to 25-year-olds cannot read or write many more, almost 25%, have problems in reading texts requiring inferences and understanding across sentences. Poor readers lacking decoding skill miss the more frequent reading experiences of their classmates who learned to read normally in the early grades, with severe consequences on their reading comprehension and writing skills (Juel, 1988).

The purpose of this study was to compare two methods of phonemic awareness training to determine whether either method enhances kindergartners' phonemic awareness and as a result improves their ability to learn to read words by sight and to generate spellings of words. One type of training, based on the relationship between articulatory gestures and phonemic awareness (Liberman, 1996), involved teaching children to analyze their mouth movements when they segment words into sounds (the mouth condition). A second more traditional type of training involved teaching children to segment words into sounds by listening to the sounds (the ear condition). In the third control condition, children were given no special treatment.

The literature review provides several sections dealing with various aspects of phonemic awareness and draws on three lines of research. In the first section the line of research consists of studies defining the construct of phonemic awareness as measured by several tasks which have been employed to test or train it. Because English orthography encodes speech at the level of phonemes, a critical step in becoming literate is to understand how words are comprised of phonemes and how to distinguish and manipulate these phonemes. This ability is known as phonemic awareness.

In the second section the line of research consists of correlational studies investigating how phonemic awareness contributes to the development of reading and spelling. Although the nature of the relationship between phonemic awareness and learning to read is not yet completely clear and could very well be one of reciprocal causation (Yopp, 1992), there seems to be considerable evidence that some level of phonemic awareness is necessary although not sufficient for the acquisition of phonological recoding ability.

In the third section the line of research consists of studies providing experimental evidence that phonemic awareness training facilitates learning to read and spell in preschoolers, kindergarten and first-grade children.

Section II

Literature Review I: Phonemic Awareness

What is Phonemic Awareness?

Researchers have used the terms phonemic awareness, phoneme awareness, phonological awareness, phonetic segmentation, phoneme segmentation and metaphonological abilities interchangeably to refer to the awareness that spoken words consist of individual sounds, even when, physically, they are perceived as an unbroken flow. The terms auditory discrimination and auditory perception have also been used, although they refer more accurately to the ability to perceive phonemic differences between words, whereas the term phonemic awareness refers to the ability to recognize and manipulate the internal structure of words (Ball & Blachman, 1991a).

Recently, Lindamood (1996) introduced the concept of comparator function. The comparator function is "the ability to compare two phonological structures by holding their phoneme and/or syllable segments in mind so any variations in the number, identity or order of their segments can be explicitly noted and represented." According to Lindamood, this specialized type of ability explains the self-correcting competence shown in both oral and written language, and its assessment provides critical information in understanding reading and spelling problems.

Linguistically, speech sounds are represented at two levels: at their most basic level, the phonetic level, they are represented by phones; at their more complex level, the phonological level, they are represented by phonemes. Phonemes are collections of phones (allophones) which include all the variations in speech that do not alter the identity of that phoneme (Wagner & Torgesen, 1987). For example, the sounds of the letter "l" in the words "leaf", "please", "peal", and "belt" differ phonetically yet all are allophones of the consonant phoneme /l/. Speech sounds in all languages can be divided into two major classes, consonants and vowels, depending on whether the flow of air travelling through the mouth is obstructed or not. In the spoken form of language, abstract consonant and vowel phonemes are converted into <u>articulatory gestures</u> through the use of phonological rules. In the written form of language, alphabet letters usually represent phonemes. When language is represented at the phonological level, as the English language is, writing and reading are related, although not perfectly, to the sounds of the words represented. Every beginning reader of English has to learn how printed symbols, or graphemes, represent units of speech, or phonemes (Wagner & Torgesen, 1987).

The construct of phonemic awareness has been defined as "the ability to manipulate individual sounds in the speech stream, or, more simply, as control over phonemic units of speech" (Yopp, 1988) on the basis of the tasks used to measure it. These tasks do not require students to manipulate printed letters or printed words but only sounds in speech. The tasks can be grouped into four major categories: <u>rhyming tasks</u>; <u>phonemic segmentation</u> and <u>blending tasks</u>; <u>deletion tasks;</u> and <u>articulatory tasks</u>. Examples of tasks belonging to the first category are: recognition of rhymes ("Does fish rhyme with dish?") and phoneme substitution ("Say fish. Now say it with /d/ instead of /f/). Among the second group are: phonemic segmentation ("What are the three sounds in fish?"); counting the phonemes in a word ("How many sounds do you hear in the word fish?"); isolating a beginning, medial or final sound ("What is the first - medial, last - sound of fish?"); blending, or responding to a sequence of isolated speech sounds by recognizing and pronouncing a word ("What word is this -/f/,/I/,/š/?"). Deletion tasks (also defined as *strip consonant* or *phoneme elision* tasks) include deletion of a phoneme at the beginning, in the middle or at the end of a word ("Say fish. Now say it without the /f/.") and specifying which phoneme has been deleted ("Say fish. Now say ish. Which sound was left out of the second word?") (Lewkowicz, 1980). None of these tasks assesses awareness of articulatory gestures, although auditory tasks such as sound-to-word matching ("Does fish start with /f/?") and word-to word matching ("Does fish start with the same sound as feather?") as well as tasks requiring students to label places and manners of articulation ("/f/ is a lip cooler") (Lindamood, 1969) appear to tap aspects of articulatory awareness.

Tasks vary in level of difficulty and several researchers have tried to rank them on the basis of how easy or difficult it is for students to perform them. Adams (1990) identified five levels of task difficulty: recognizing familiar rhymes; sorting them into patterns; syllable segmentation; full phoneme segmentation; and phoneme deletion, the most difficult to perform. In computing reliabilities of ten tests currently used to measure phonemic awareness Yopp (1988) found that rhyme and phoneme blending tasks were among the easiest, and phoneme deletion tasks among the most difficult to perform. Interestingly, the easiest task, phoneme blending, and the two most difficult tasks, phoneme segmentation and phoneme deletion, exhibited the highest reliability coefficients. Similarly, Stanovich et al. (1984) found that phoneme deletion was the most difficult among a group of tasks administered to kindergarten students, whereas the three easiest tasks involved substituting initial consonant, supplying rhymes and choosing rhymes.

The cognitive processes required for each task were further analyzed using factor analysis (Yopp, 1988). The list of cognitive requirements necessary for successful performance of the tasks is quite impressive and includes hearing and perceiving sounds; holding items in memory; segmenting, counting, locating, identifying, isolating sounds; holding a sound in memory while performing other operations; holding sounds other than a given sound in memory; blending sounds together; comparing two sounds or words; discriminating between two sounds or words; articulating a sound, word or number; making a judgment and responding to a forced-choice item. Two factors emerged from the analysis: factor 1 was labeled <u>simple phonemic awareness</u> and included segmentation, blending, sound isolation and phoneme counting. Factor 2 was labeled <u>compound phonemic awareness</u> and included two phoneme deletion tasks and the word-to-word matching task.

There seems to be agreement among researchers who have studied the validity and reliability of phonemic awareness tests that most of the tasks appear to tap similar abilities. However, some researchers have expressed concern over the scarcity of research aimed at assessing the relationships among tasks measuring phonemic awareness, phonological coding in working memory (coding information in a sound-based representation system), and retrieval of phonological codes from a long-term store (retrieving pronunciations of letters, word segments, or whole words from long-term storage). All three capabilities should influence the degree to which phonological information is used (Wagner, Torgesen, Laughon, Simmons & Rashotte, 1993).

In addition Spector (1992) discovered significant, positive correlations between phonemic awareness scores and word recognition using dynamic rather than static phonemic assessment measures. The use of dynamic measures (measures which emphasize the processes of assessment, requiring the interaction between tester and student) rather than static measures (measures which might reflect the child's lack of understanding of task requirements or difficulty in meeting related task demands), was responsible for the discovery that students who showed the most growth in word recognition were those who were helped most by increasingly supportive prompts and cues provided during dynamic assessment when children were unable to segment words.

Rhyming Tasks

Awareness of rhymes is the most rudimentary form of phonemic awareness task and one of the easiest tasks for young children to master. Sounds in words can be separated into two units, the onset and the rime. The onset is represented by the initial consonant (or consonant cluster) and the rime is represented by the subsequent vowel (and following consonant or consonants, depending on the word). The onset of the word "fish" is "f" and the rime is "ish." Children as young as four are able to separate words into their component onset and rime units (Treiman, 1985). The widely held assumption that prereaders cannot isolate phonemes has been questioned as prereaders were found to be able to identify some single phonemes when the phoneme represented a viable speech unit such as the onset of a word, although they were not able to do so when the phoneme represented part of such a unit, for example, part of a consonant cluster or rime. These prereaders did not need to be trained to segment, which seems to favor the conclusion that some forms of phonemic awareness precede reading (Kirtley, Bryant, MacLean & Bradley, 1989).

Other researchers compared performance of illiterate and ex-illiterate adults on tasks designed to assess the effect of literacy training on speech segmentation (Morais, Cary, Alegria, & Content, 1987). The illiterate subjects were unable to detect phonetic segments and were inferior to the ex-illiterate subjects in deleting segments and detecting rhymes. Morais et al., (1987) postulated that there is a difference between phonemic awareness and rhyme awareness. They defined rhyme awareness as a "global" form of phonemic sensitivity, having little relevance to the type of phonemic awareness leading to success in learning to read.

In a correlational study, Cardoso-Martins (1994) asked preschool, kindergarten and first-grade children to choose from two Brazilian-Portuguese test words (i.e. "soco", "coro") the word that rhymed with the target word ("soro"). Results supported the "global" theory. In contrast to other rhyming studies, the rhyming test word in this study was not acoustically more similar to the target word than the nonrhyming test word, making it unlikely that phonemic similarity alone could account for successful performance. Both preschoolers and kindergartners performed very poorly in the task. The fact that they were much more successful in other rhyming studies clearly suggests that rhyme perception does not involve conscious attention to segments. In fact, preschoolers and kindergartners performed better in a deletion task than in the rhyming categorization task, suggesting that attention to an intermediate segment may impose a greater analytical effort than attention to the first segment in a word. Still it is possible that the contrasting results obtained by Cardoso-Martins (1994) might be due to differences in the linguistic structure of the stimuli (disyllabic and multisyllabic words used by Portuguese speaking subjects versus monosyllabic words used by English-speaking subjects).

Although more studies are required in order to decide whether rhyme identification is a more global form of phonemic sensitivity or whether it involves some level of analysis, it has been demonstrated that beginners need some decoding skill to read words by analogy to rhyming words (Ehri & Robbins, 1992). Decoding skill is needed to store the base (analog) words in memory in sufficient detail to recognize that spellings of base and new words are not identical but share rime units, to segment the words into onsets and rimes and to blend onsets of new words with rimes of base words. In contrast to decoders, most nondecoders were insensitive to analogical relations between known and unknown printed words.

The ability to separate an onset from a rime seems to help children with word recognition. Stahl and Murray (1994) found that several children who could manipulate onsets and rimes were not able to read words at preprimer level, but that only a very limited number of children who could read several words had difficulty analyzing onsets and rimes, suggesting that onset-rime awareness may be necessary to read words. They also found that several children who could read above preprimer level had difficulty analyzing rimes into vowels and codas, whereas few children who performed well on this task could not read at preprimer level. This suggests that the ability to recognize words could help breaking rimes into vowels and codas.

Phonemic Segmentation and Blending

Phonemic segmentation and blending are also often described respectively as analysis (the ability to segment larger units of speech into smaller ones) and synthesis (the ability to blend smaller units of speech to create larger ones). Segmentation and blending have been identified as basic phonemic awareness tasks (Lewkowicz, 1980).

Phonemic segmentation can be measured by several tasks that vary in which and how many units are identified: for example isolation of the initial phoneme, or definition of how many sounds are in a word. Feedback after a mistake might or might not be given.

Another example of analysis is provided by sound isolation and sound categorization tasks. The sound isolation task requires the student to repeat one of the sounds heard in a word, which can be the first, the middle or the last sound. The sound categorization task requires the student to select the odd word out of a set of four words, all of them except one starting or ending with the same sound, for example ball, bird, dog, bat.

For some of these tasks, visible models consisting of blocks or chips are often supplied to help students segment better. Hohn and Ehri (1983) tested both Lewkowicz's (1980) claim that the use of alphabet letters instead of blank blocks would confuse students and Marsh and Mineo's (1977) assertion that the value of letters in phonemic analysis is doubtful. Based on Ehri's (1979) view that letters in spellings provide lasting symbols for short-lived sounds, Hohn and Ehri supplied students with alphabet letters displayed on tokens, to help with the distinction and the conceptualization of the separate sounds. Compared with children who were trained with blank tokens and control children who received no training, the letter-trained participants learned to segment the particular sounds they practiced more effectively, because the letters helped them focus on the correct identity and length of the sound units to be segmented. In other words, phonemic analysis with letters enabled students to establish a symbolizing system which they could use to represent the smallest (phoneme-size) units in memory during segmentation training. An important conclusion was that segmentation training with letters facilitated the acquisition of the alphabetic principle.

As already mentioned, the major difficulty in understanding the alphabetic principle in reading and writing for learners is the realization that the speech stream is composed of phonemes. Despite having successfully learned larger-scale speech segments using colored geometric forms, most children experienced difficulty with the particular level of analysis required to discover by themselves how to segment phonemes (Byrne & Fielding-Barnsley, 1989). Preschoolers were trained in two aspects of phonemic awareness, segmental awareness (awareness of the separate status of the initial phoneme in the word) and segment identity (ability to recognize the identity of "m" in "mat" and "m" in "mow"). Then they were taught letter-sound knowledge to determine the point at which alphabetic insights emerged. Children fell into two clear groups, those who could segment and those who could only imitate. Those who could segment and could recognise the identity of initial sounds in different words were able to perform in a transfer task, but only after letter-sound training. This result shows that neither phonemic awareness nor knowledge of the correspondence between letters and phonemes by themselves are sufficient for the emergence of initial insight into the alphabetic principle.

Synthesis or blending tasks include blending onset and rime to pronounce the resulting word and phoneme blending. During this task the researcher usually pronounces separate phonemes at very short intervals and asks the student to combine them and pronounce the resulting word. In analyzing the relationships among auditory blending, phonemic segmentation and phonetic decoding Lechner et al. (1990) found a significant correlation between auditory blending and three segmentation tasks, suggesting that the ability to blend taps an underlying process similar to the ability to segment, even though the two types of tasks do not appear to be identical or interchangeable.

Deletion Tasks

One of the concerns expressed in the research literature is that many of the tasks used to assess phonemic awareness measure more than just segmentation or isolation of individual phonemes (Lenchner et al., 1990; Tunmer & Nesdale, 1985). This is particularly true of the deletion tasks, which are generally considered to be more difficult than other segmentation tasks (Lewkowicz, 1980; Stanovich et al., 1984; Yopp, 1988).

In phoneme deletion tasks, students might be asked to repeat a word after deleting the initial or the final phoneme. The resulting unit might or might not be a recognizable word. Or students might be asked to replace the initial phoneme with another one, creating a new word. The very high correlation found between deletion tasks and decoding measures, even with very young children, could be attributed to the fact that phoneme deletion and substitution require both the ability to segment and to blend, plus the ability to manipulate phonemes. When deleting a phoneme, one needs to keep the word in memory, mentally remove a phoneme and reconstitute the word (Stahl & Murray, 1994). According to Stanovich et al. (1984) the difficulty of deletion tasks might be dependent on the position of the phoneme to be deleted within the word, as performance in deletion tasks is superior when the phoneme to be deleted is at the beginning rather than at the end of a word.

Bruck and Treiman (1990) assert that the position of the phoneme within a spoken word is often confounded with the word's linguistic structure. They hypothesize that initial phonemes are easier to delete when they appear in CVC (consonant-vowel- consonant) words and more difficult when they appear in CCVC words. Deletion tasks were presented to normal and dyslexic students in an auditory and in a visual mode. Deletion of an entire initial cluster did not present difficulty. However when subjects had to drop a single phoneme from a cluster, they found it easier to delete the second phoneme than the first phoneme. Both dyslexic and normal students experienced difficulty, which persisted into the third grade. It is interesting to note that both types of students performed better in the auditory task than in the visual task when deleting the initial consonant of a cluster. A complete auditory approach in the beginning stages of word analysis was also advocated by Marsh and Mineo (1977). They found that clusters at the ends of words were not especially difficult. Because error rates in the deletion tasks exceeded the omission rates in spelling tasks by large margins, deletion may be assumed to involve skills above and beyond those required for spelling.

Deletion as a measure of phonemic awareness was related to reading performance even in third- and fourth-grade, beyond the early stages of instruction which are most commonly investigated (Lenchner et al., 1990).

Articulatory Gestures

Observations from a wide variety of sources emphasize that the methodology for teaching phonemic awareness, especially through segmentation and blending, requires pupils to engage in very slow, stretched pronunciations of the words to be segmented or blended and to pay attention to articulatory clues as well as auditory clues (Lewkowicz, 1980). Even speech training of short duration for normal speakers has been found to considerably improve the rate of reading mastery (Van Riper & Butler, 1955).

Although based on a limited number of participants, two early studies exploring the relationship between auditory ability and oral kinesthetic sensitivity lend support to the theory that listeners interpret auditory percepts such as phonemes, syllables and words in terms of the articulatory movements needed to produce them. Larsen and Hudson (1973) found that an oral form of discrimination test significantly differentiated between good and poor readers. Skjelfjord (1976) reported that many preschool Norwegian children relied heavily on articulatory information when asked to segment words. They would slowly articulate words over and over in silence before producing the sound or sounds requested; furthermore, two children who had no analytical ability at all, after six weeks of training, made sudden progress and even caught up with the other children when they were specifically told to pay attention to how the words were articulated.

Lindamood and Lindamood (1969) were so persuaded of the importance of perception of articulation that they began their reading training program by teaching students how speech sounds are produced. The Auditory Discrimination in

Depth (A.D.D.) program was designed to establish awareness of specific auditory, visual and kinesthetic relations among articulated phoneme contrasts. It requires the students to manipulate colored blocks to indicate knowledge of identities and relationships among spoken sounds. The A.D.D. however is not a test of phonemic awareness per se, although it has been used to determine phonemic awareness. It is rather a program aimed at providing students with "a grasp of the inter-relationships between speech, writing and reading, by establishing a circular auditory-visual-vocal check system" which should allow each skill to support and reinforce the others (Lindamood, 1969). In a study including students from kindergarten to twelfth grade, performance on three Lindamood subtest scores predicted 50% or more of the variance on a reading achievement test (Calfee, Lindamood & Lindamood, 1973).

Children who had been trained by Ehri and Sweet (1991) to associate four mouth articulation pictures (adapted from those used by Lindamood & Lindamood, 1975) with their corresponding sounds - /e/ (long a as in ate), /m/, /s/ and /l/ - were then asked to segment blends (e.g., /em/) into sounds by selecting the constituent mouth pictures as they spoke the specific individual sounds. Phonemic awareness was then measured by: (a) the number of trials to reach criterion in learning associations between pictures and sounds; (b) the number of individual sounds represented correctly; and (c) the number of blends correctly segmented, thus assessing the children's ability to focus on the articulatory movements needed to produce sounds rather then on their ability to perceive them.

The instrument suggested for the measurement of the comparator function is the Lindamood Auditory Conceptualization Test (L.A.C.T.)(1979), which uses colored blocks for phonemes. The measure allows the categorization of errors into phoneme addition, substitution, omission, repetition and reversal of order. Although this measure detects the ability to make auditory-to-auditory comparisons, it does not measure specific knowledge of articulatory gestures.

Summary and Discussion

Defining phonemic awareness and determining how to measure it are the first steps in investigating the relationship between phonemic awareness and learning to read and spell. Several tasks of varied difficulty have been used to conceptualize the construct, from the very easy onset/rime manipulation, whose status as part of the phonemic awareness construct is in doubt (Morais et al., 1986), to the most difficult, phoneme deletion, which might include other cognitive aspects and might be even more difficult than decoding itself. Stahl and Murrary (1994) also suggest that spelling tasks are easier measure of phonemic awareness than oral phonological measures, based on their finding that most children who passes the onset-rime criteria were consistently good spellers. In children who know letter names invented spelling might help minimize memory requirements.

Task comparability (Lewkowicz, 1980), task validity (Calfee et al, 1973) and task reliability (Yopp, 1988) have all been demonstrated in the studies reviewed. In addition, the finding of two possible factors, simple and compound phonemic awareness, suggests that other abilities, involving short term memory and manipulation of phonemes may also be important for decoding (Yopp, 1988).

In contrast to the number of tasks devised to measure abilities such as rhyming, segmenting/blending and deletion, only three tasks specifically designed to assess children's knowledge of speech gesture production have been found. They are the Auditory Discrimination in Depth, A.D.D., which is both a task to measure auditory discrimination and a program to facilitate language and literacy development (Lindamood, 1969); the Lindamood Auditory Conceptualization Test (L.A.C.T.)(1979); and the mouth articulation pictures used by Ehri and Sweet in their 1991 study on preschoolers' fingerpoint-reading.

Section III

Literature Review II: Relationship of Phonemic Awareness to Reading and Spelling

Phonemic Awareness and Reading and Spelling

Four possible types of relationship between level of phonemic awareness and reading and spelling ability have been proposed by Ehri (1979). Phonemic awareness (or one of its aspects) could be a prerequisite, and lack of it could impede or severely limit the acquisition of reading skills. Phonemic awareness could also be a facilitator, and lack of it could just render reading acquisition slower or more difficult. Phonemic awareness could be a consequence of learning to read, in which case it would not be present before reading instruction begins but would result from learning to read and spell. Phonemic awareness finally could be a correlate of reading skills as both could derive their relationship from a third, unmeasured variable, such as intelligence.

Some of the most compelling evidence showing that phonemic awareness and reading and spelling are related comes from studies which compare normal readers to disabled readers. Cole and Mengler (1994) compared phonemic awareness ability of learning-disabled readers to same-age average readers and concluded that the learned-disabled children were deficient in rhyme detection, phoneme segmentation and phoneme deletion skills. Other studies have demonstrated that performance on a number of phonemic awareness tasks distinguishes good from poor readers (Torneus, 1984) and that disabled readers' ability to discriminate information at a phonemic level was significantly below that of nondisabled readers (Hurford & Sanders, 1990) possibly due to a deficiency in the processing of phonemic information at the perceptual discrimination level.

The relationship between phonemic awareness and various beginning reading and spelling processes is considered below.

Fingerpoint Reading

A very young child picks up a book and begins to recite the story from memory while turning the pages. The child is performing the earliest form of reading, referred to as storybook or pretend reading. Most children progress from less mature to more mature strategies of pretend reading, for example, from attempts to read which are regulated by pictures to attempts which are regulated by print. Children who score high on measures of print awareness tend to score high on reading achievement tests (Sulzby, 1985). However, there is no evidence that pretend reading by itself is one of the elements which facilitate reading.

A more difficult activity, involving some knowledge about the alphabetic system is fingerpoint reading, which requires pointing to the words as a memorized text is recited. Ehri and Sweet (1991) investigated which types of print knowledge are related to successful fingerpoint-reading in preschoolers. In particular, the researchers were interested in determining the role of letter knowledge and phonemic segmentation as predictors of reading achievement. Ability to fingerpoint-read a story was measured by the accuracy at reciting lines of text verbatim, accuracy at pointing to the words in each line, and ability to organize these two behaviors to match print with speech. Analysis of the data suggested that phonemic awareness was important. Phonemic awareness was found to enhance students' memory for words in text and to enhance their ability to match print with speech during fingerpoint-reading. As for the contribution of letter knowledge, it enabled subjects to recognize letter modifications and to remember elements of letter configuration, but it was found to be less important for fingerpoint-reading than phonemic awareness, probably because students relied on their memory for the text, on the pictures which accompanied the text and on the spaces between words, rather than on printed letter cues to read correctly. In contrast, Morris (1993) concluded that knowledge of initial consonant letters/sounds in words enhanced the ability to match written words to spoken words, which in turn improved phonetic awareness, which enabled mastery of word reading. One reason for the greater importance of phonemic awareness in the Ehri and Sweet (1991) study may be found in the way it was measured. An articulatory segmentation task involving the use of mouth pictures may have provided an especially sensitive measure of phonemic awareness.

Sight Word Reading

Beginners might use several ways to read words: by sight, by phonological decoding (also referred to as phonological recoding), by analogizing, and by contextual guessing. Sight word reading is faster then the other ways because words read by sight are read as whole units. Phonological decoding is slower because it involves the application of grapheme-phoneme correspondences to assemble spellings into pronunciations. Analogizing involves searching lexical memory for known words having the same parts as the word being read. Contextual guessing of unfamiliar words requires knowledge of surrounding words and often is only partially accurate.

There is disagreement among researchers about the role phonemic awareness plays in learning to read words by sight. A more traditional view, the dual route view, holds that it is not involved at all, because sight words are stored in memory by creating access routes between the words' visual form and the words' meaning. Evidence for this view is the assumption that because irregularly spelled words cannot be decoded accurately, they must be read by sight (Baron 1979).

Ehri (1987) proposed a different view of sight word learning, according to which phonemic awareness plays an indispensable role. When beginners learn to read, they might first rely on nonalphabetic visual cues in a process called logographic (Ehri, 1994) but as soon as they acquire some phonemic awareness and some knowledge of letter names or sounds, they progress through a phase Ehri (1994) calls phonetic cue reading, during which they form access routes between some of the letters seen in spelling (the initial or the initial and the final for example) and their sounds (which they might derive from the letters' names or from the words' pronunciation). Evidence that children switch to phonetic cue reading as soon as they master letters comes from experiments performed by Ehri and Wilce (1985, 1987) and Scott and Ehri (1990). For example: children who had been trained to spell used memory rather than guessing to read words in a task which followed the training; they used letter-sound relations to sound out and blend some of the words and they misread letters on the basis of phonetic similarities.

The next phase of learning to read is known as phonemic map reading. Grapheme-phoneme correspondences are used to create complete connections between the letters in spelling of words and sounds detected in their pronunciation. In this way the orthographic representation of the word is amalgamated to its phonemic representation and stored in memory. Once the access route is established, words can be read by sight without recourse to phonological rules, because the sight of the spelling immediately activates the word's pronunciation in memory. Evidence that familiar words are read by sight and not by decoding comes from a study by Ehri and Wilce (1983). Elementary school children's speed to read familiar words and equally decodable unfamiliar nonwords was measured. As hypothesized, skilled readers read the familiar words much faster than nonwords, showing that the words were accessed from memory rather than decoded.

Evidence of the relevance of phonemic awareness in learning to read words by sight comes from several correlational studies in which phoneme awareness skills and success in learning to read were compared (Ball & Blachman, 1991b; Bradley & Bryant, 1983; Calfee et al., 1973; Stahl & Murray, 1994). In particular, the correlations between phoneme awareness skill - including auditory segmentation and initial phoneme deletion - and reading achievement at kindergarten and first grade were the highest among 39 correlations calculated, reaching .66 in kindergarten and .62 in first grade (Share, Jorm, MacLean & Matthews, 1984). The high diagnostic value of measures of phonemic awareness has been defined as "truly impressive." In fact, seven nonrhyming measures of phonemic awareness correlated with first-grade reading more strongly than did a standardized IQ test (Stanovich et al., 1984).

Nonword Reading

Phonological decoding allows readers to read unfamiliar words and nonwords accurately. Because nonwords (which are also referred to as pseudowords, synthetic words or nonsense words) and unfamiliar words have not been seen before, it is assumed that readers who do not have knowledge of grapheme-phoneme correspondence would not be able to read them. Lenchner's et al., (1990) high correlation between phonemic awareness tasks - such as consonant deletion and substitution - and phonological decoding of nonwords, suggests that phonemic awareness might be a prerequisite of phonological decoding. All students who had good decoding skill were found to be good at the deletion and substitution tasks, although not all of those who were good at deletion and substitution were good at decoding with the implication that phonemic awareness is probably necessary, but not sufficient, to learn phonological decoding.

Hohn and Ehri (1983) found that neither letter segmentation training nor letter-sound training received by subjects prior to a decoding task was sufficient to enable them to decode nonsense syllables. Two possible explanations were proposed: that blending instruction is required, or alternatively that segmentation ability does not contribute to decoding skill, letter-sound knowledge and blending skill being the main ingredients.

Tunmer, Herriman and Nesdale (1988) and Tunmer and Nesdale (1985) studied the emergence of phonemic awareness longitudinally from prereading to second grade reading. Results suggested not only that some minimal level of phonemic awareness is necessary for children to acquire phonological decoding skills (by using their letter-name knowledge), but also that phonemic awareness in first grade, as measured by decoding of nonwords, affects reading comprehension indirectly.

The same conclusion was reached in another longitudinal study by Juel (1988). She found that poor phonemic awareness at the beginning of first grade contributed to such a delayed start in learning spelling-sound correspondences that some children had not yet achieved in fourth grade the level of decoding that the average reader had reached by the end of first grade. The probability that a student with poor phonemic awareness in first grade would remain a poor reader at the end of fourth grade was .88, whereas the probability that an average reader in first grade would become a poor reader at the end of fourth grade was .12.

Iversen and Tunmer (1993) performed a path analysis to determine the effect of systematic instruction in phonological decoding skills on reading performance of first-grade at-risk readers. They identified the phonemic awareness variable, measured by phoneme segmentation and phoneme deletion, as primarily responsible for the development of nonword decoding ability for all children involved.

Invented spelling

In 1971 Read collected invented spelling from preschoolers. He showed that some children categorize the sounds of English in unexpected ways, treating some phonetic differences as important and others as less important, and that their highly abstract phonology differs in specific ways from the phonology of their parents and teachers. Although his report was based on twenty subjects only, they had all arrived at roughly the same spelling system which, although seemingly implausible from an adult's point of view, could be explained in terms of the children's organization of English sounds. In Read's study, the pre-school children who "invented" the spellings of the words they wanted to write, knew their pronunciations, knew some syntactic and semantic relations among words and some regular phonetic alternations (i.e. that /s/ forms plurals) and knew letter names. They did not know the phonological rules that account for standard spellings, but they knew a system of phonetic relationships.

From Read's (1971) data, it is apparent that phonemic awareness enables beginners to segment words into phonemes to invent spellings. The scenario representing the relationship between phonemic awareness and spelling skill proposed by Griffith (1991) is the following: phonemic awareness and spelling interact so that each improves the other's development. Some ability to focus on a word's phonemic structure allows children to begin inventing spellings. As they start to write, they are able to enhance their phonemic awareness by focusing on the spelling of the words. When children who possess a high level of phonemic awareness read a word, they analyze its structure and store it in their memory. When they spell a word, they are able to segment it into its constituents, thereby achieving a better performance in representing component phonemes in print. Griffith (1991) investigated the effects of phonemic awareness on spelling development and the relationship between phonemic awareness and the acquisition of orthographic word-specific information with first-grade and third-grade students. They were divided into low-awareness and high-awareness groups. Multiple regression was used to determine the impact of phonemic awareness and word specific information on spelling ability at each grade. Phonemic awareness contributed 56% to the variance in first graders' spelling scores and 27% to the variance in third graders' spelling.

Learning to spell has been found to improve kindergarten students' ability to learn to read words. Ehri and Wilce

(1987a) trained a group of children to spell words by putting letter tiles in a frame and compared them to a control group trained to match letter tiles to isolated sounds. The trained subjects outperformed control subjects on posttest measures which included printed word learning, nonword spelling, spelling recognition, and phonemic segmentation.

Bruck and Treiman (1990) examined spelling and phonemic awareness among a group of dyslexics and a group of spelling-level matched normal readers. They focused on onset clusters. In word and nonword spelling tasks, dyslexics made more omissions than normal students. Furthermore, consonants were more likely to be omitted in the second position of a CCVC than in the second position of VCV. The results for the two tasks are consistent with one another on the assumption that within an onset cluster, the first consonant is more salient or more available than the second. A visual deletion task - in which children were asked to remove a block corresponding to the phoneme to be deleted - had worse results than an auditory deletion task - in which children were simply asked to repeat a word after removing a phoneme - possibly because the visual presentation added difficulty to the task. Phonemic awareness measures of recognition rather than deletion might be a precondition for spelling. As far as dyslexics' performance is concerned, although they performed more poorly than normal children of the same spelling level, their patterns of performance were qualitatively similar to those of the controls and possibly reflected, in part, their problems in accessing the phonemes in spoken words.

Clarke (1988) compared the progress of children encouraged to use invented spelling with those encouraged to use traditional spelling. Two of the posttest results show that children using invented spelling had significantly greater phonemic awareness than children using traditional spelling and that low initial achievers accounted for most of the gain in spelling and reading that resulted from using invented spelling. Foorman, Francis, Novi, and Liberman (1991) analyzed the relative merits of code-emphasis (letter-sound) instruction versus meaning-emphasis (meaningful context) instruction in teaching first-grade students to read. No significant difference was found in segmentation tasks; significant differences favoring the more letter-sound classes in spelling and significant differences favoring the letter-sound classes in accuracy in reading exception words. Effects were not simply due to superior ability or to superior phonemic segmentation ability, rather it is the segmenting and blending of letter-sound instruction that appears facilitative to the development of reading and spelling skill.

Summary and Discussion

A large number of correlational studies clearly establish a very strong relationship between phonemic ability and reading and spelling achievement.

As seen, some phonemic awareness might be a prerequisite for fingerpoint-reading, which represents the very beginning of learning to read (Ehri & Sweet, 1991). Other results consistently point to the fact that children with a high level of phonemic awareness are more likely to become better readers and spellers in the early grades than children with a low level of phonemic awareness.

These findings however fail to settle the issue of causality: phonemic awareness could be the cause of reading performance but it could as well be the result of learning to read. The correlation between phonemic awareness, whether emerging independently from instruction or being a by-product of instruction, and learning to read real words by sight or to read nonwords is very high (Share, Jorm, MacLean, & Matthews, 1984) as is the contribution of phonemic awareness to invented spelling, and development of spelling to reading acquisition (Ehri, 1989).

Phonemic awareness seems therefore to be a necessary, although not sufficient, condition for the development of initial successful reading and spelling behaviors. Whether phonemic awareness is a prerequisite to learn to read and spell or a consequence of learning to read and spell, it is important to investigate what types of training develop or enhance it.

Section IV

Literature Review III: Effects of Phonemic Awareness Training

Effects of Phonemic Awareness Training

Over thirty years ago McNeil and Stone (1965) found that children who received what was then called phonetic analysis training using nonwords made fewer errors during training and on posttests than children trained with meaningful words. This suggests that one difficulty underlying the development of the ability to analyze spoken words phonetically stems from the holistic nature of words and their sounds in children's experience. Using nonsense words may have enabled children "to disrupt the cohesion of a word's sound elements". Since then, many more experimental studies have assessed the effect of training on phonemic awareness as well as on the acquisition of reading and writing skill.

The most important result of almost three decades of research on phonemic awareness and reading is the consensus among researchers that the focus of investigation should converge on those aspects of processing which are or might be related to reading and spelling (Wagner & Torgesen, 1987). In fact researchers have tried to answer questions about causal relationships between phonemic awareness skill and reading and spelling achievement for almost 30 years.

Effect of Training on Phonemic Awareness

The Lundberg et al., (1988) longitudinal study conducted in Denmark was set up to answer questions involving the effects of phonemic awareness on aspects of reading development such as these: can phonemic awareness be developed by training? What is actually learned during training? Does the effect last and transfer to other tasks? In this study teachers were carefully prepared to administer the program, which started with listening games followed by rhyming games, sentence segmentation, syllables segmentation and finally initial phoneme and within words phoneme segmentation. The program progressed slowly to ensure that all children experienced success. According to the results, metaphonological training over a long period of time (eight months) did not seem to promote general language comprehension, but it did enhance skill requiring manipulation of phonemes. Mathematics test scores suggested that the training effect was specific to literacy tasks. (Results about the effects of phonemic awareness training on reading achievement are reported in the next chapter).

Results similar to the ones reached by the Lundberg's (1988) study, which included children at various levels of phonemic awareness, were obtained by Fox and Routh (1984) who found that low phonemic awareness children who received training to segment words phonemes performed better in phonemic segmentation posttest than untrained subjects.

Hurford and Sanders (1990) experimentally explored the trainability of yet another group of young readers. Participants in their study were reading-disabled children in second and fourth grade. After remediation aimed at improving phonemic discrimination skills, subjects were tested on a transfer task, which showed a significant improvement in efficient processing of phonemic information.

Phonemic discrimination training may improve phonemic segmentation by helping disabled readers become aware of the nature of phonemes.

Researchers have evaluated several instructional programs which focus on phonemic awareness training and found them for the most part effective. Castle, Riach, and Nicholson(1994) investigated the consequence of providing phonemic awareness instruction at school entry to 5-year-old, low phonemic awareness children within the context of a whole language program. Children were divided into three groups, a segmentation and blending training group; a word meaning group and a no training group. Although all children improved, children who received phonemic awareness training did better on posttest measures of phonemic awareness tests than children who had received no training.

Evidence of the effect of instruction on the enhancement of phonemic awareness in learning-disabled children was provided by a study which evaluated training that included phoneme analysis and phoneme blending, letter-sound correspondences and decoding. The significant improvement here was for middle phonemes and phoneme blending tasks (Williams, 1980).

A program aimed at kindergartners, Sound Foundation, based on research indicating that phoneme identity provides stronger influence on achieving alphabetic insight than phoneme segmentation, was experimentally evaluated by Byrne and Fielding-Barnsley (1991). Experimental children's improvement in posttest measures of phoneme recognition, especially trained sounds and initial phonemes, was significantly higher than control children's, who received semantic training.

Effect of Training on Reading

Researchers have tried to determine what specific types of phonemic awareness training influence kindergarten and first-grade children's subsequent ability to learn to read. A number of studies have examined the contribution of segmenting and blending training, either alone or in combination. Fox and Routh (1984) examined the effect of phonemic analysis and synthesis on a reading analog task in children with low phonemic segmentation skill. They were assigned to either a segmenting group or a segmenting and blending group. Low and high segmenters served as control groups. Phonemic segmentation training alone (without blending) was not sufficient to enable children to decode written words to speech, although some children learned to read letterlike forms and words. Combined segmenting and blending training enabled children to master a paired-associate word learning task. In another study, explicit instruction in analysis and synthesis of the spoken syllables allowed students to take advantage of spelling-sound relations when they learned to read corresponding written items, even overcoming the negative effect of similarity among items (Treiman & Baron, 1983).

The effect on reading achievement of adding letter-sound instruction to other phonemic awareness tasks was studied by Hohn and Ehri (1983). They found that neither letter segmentation training nor letter-sound training just prior to decoding was sufficient to enable prereaders to decode nonsense syllables. They suggest that integrating blending instruction with segmentation instruction might be required to enable subjects to successfully decode.

O'Connor, Jenkins and Slocum (1994), assigned children with more than average difficulty in learning to read to one of two treatments and a control condition of high- and low-skilled readers. One treatment taught only auditory blending and segmenting with limited letter-sound correspondences; the other taught a more global array of phonemic awareness tasks, also with limited letter-sound correspondences. Treatment effects were compared to a low-skilled control condition in which children received only letter-sound instruction, and to end-of-the-year scores for a high-skilled untreated group. Despite the differences in instructional content, children in the two treatments performed comparably on phonological measures and transfer of learned skills. Children who spent their entire sessions on blending and segmenting performed more like the high-skilled children and had stronger reading effects than children who learned the global array of tasks. Although the global treatment was designed to encourage a broader, more encompassing ability to do many different kinds of phonological manipulations, the blend/segment treatment produced transfer as strong as the varied, global treatment on the transfer measures, and both treatments produced levels commensurate with those of the high-skilled children.

An experimental study which found significant effects on early reading achievement of phonemic awareness training without letter-sound instruction is the longitudinal Danish study (Lundberg et al., 1988). Although reading scores were only minimally significant at the end of the first year of reading instruction, they became more so at the end of the second year, probably resulting from a combination of phonemic awareness training received in kindergarten and letter-sound instruction received in first and second grades.

On the other hand Fox and Routh (1980) assessed the contribution to transfer of three components of decoding: letter-sound training; phonemic segmentation training; and blending training. Only the experimental group, which was taught letter-sound training, phonemic segmentation and blending training, learned to read words to criterion. Control subjects did not learn to read the word list even after 40 trials of practice.

Cunningham (1990) contrasted decontextualized phonemic awareness training to metaphonological instruction which directed kindergarten and first-grade children to reflect on their own thinking regarding the purpose of learning phonemic awareness. At posttest, both experimental groups performed significantly better than an untrained control group in both grades for all measures of phonemic awareness. Type of instruction however did make a difference in the first graders reading achievement, as evidenced by the fact that students who reflected upon the value and utility of phonemic awareness did significantly better on a transfer reading task than children who received a drill type of instruction. Three measures of phonemic awareness (phoneme deletion, phoneme oddity, and the Lindamood Auditory Conceptualization Test, 1979, phoneme discrimination task) accounted for 60% of the variance in the kindergarten and 51% in the variance in first-grade children reading achievement. Interestingly, trained kindergarten children performed better on all three tasks of phonemic awareness than the control first graders.

Studies involving disabled readers have helped researchers to study the relationship between phonemic awareness and literacy skill. Williams (1990) evaluated a two-year program (ABD's of Reading) aimed at improving learning-disabled children's decoding strategies. The program teaches the concept of word analysis; phoneme analysis by using blocks and phoneme combinations of consonants and vowels; phoneme blending instruction and letter-sound correspondences. Experimental subjects did almost as well on posttest measures of nonsense word reading as they did on real words. They considerably outperformed control students on the number of correctly read nonwords, clearly indicating that phoneme awareness including analysis, blending and letter-sound correspondence was the most effective in teaching general decoding strategies to this particular group of students.

Effect of Training on Spelling

When people spell, they use their knowledge of letters, their knowledge of the spelling system and their memory for the spellings of specific words (lexical knowledge). Knowledge of the spelling system includes phoneme-grapheme relations and how to translate pronunciations into phonemes.

The following spelling developmental stages have been proposed by Ehri (1989). The earliest stage is the precommunicative stage, during which spellings do not bear any correspondence to sounds in words (numbers or scribbles might be used to represent letters). During the next stage, the semiphonetic stage, knowledge of letter names or sounds is utilized to spell words (an example is HKN for chicken by associating the final sound in aich with the letter H). During the following stage, the phonetic stage, children produce spellings that contain letters for all of the sounds in words, and they learn to spell vowels. The mature stage of spelling is morphemic during which phonetic spellings are supplemented by word-based spelling patterns.

Assessing the effect of phonemic awareness instruction on spelling achievement has been the objective of several researchers. Teaching students how to segment words into phonemes and teaching them to represent the sounds with letters are both necessary to help children in their transition from the semiphonetic to the phonetic stage.

Torneus (1984) investigated the effects of phonemic awareness training on segmentation, sound blending, and spelling and concluded that there is indeed a causal effect of phonemic abilities on spelling, at least in its very early phase.

Training consisting of activities aimed at increasing phonemic awareness (phoneme segmentation, phoneme substitution, phoneme deletion and rhyme) together with phonemic-based playing games was compared to instruction in writing activities by Castle, Riach, and Nicholson (1994) who found that phonemic awareness training significantly facilitates spelling acquisition.

As part of a first-grade reading program, Uhry and Shepherd (1993) combined segmentation and spelling training (using differently colored blocks for vowels and consonants to break words into phonemes, later replaced by lettered labels) with computer spelling games. Their trained students produced significantly higher scores than control students not only for nonsense word reading but also for spelling short-vowel words with consonant clusters. Use of blocks to take words apart and to put them back together was considered to be a key training factor.

Ball and Blachman (1991b) explored the effect of segmentation and letter-name/letter-sound training on the spelling ability of kindergarten children and compared them to the effect of language activities. The phonemic awareness group manipulated disks representing phonemes in progressing order of difficulty and received other segmentation, letter-name and letter-sound training. The language activities group read stories learning semantic categorization and receiving the same letter-sound instruction received by the first group and a third group received no treatment. The spelling scores of children in the phoneme awareness group were significantly higher than the scores of children in the other two groups, indicating that letter-name and letter-sound training, provided without phoneme awareness training, is not sufficient to improve early spelling skill.

Articulatory Gesture Training

In explaining the motor theory of speech perception Liberman (1992) argued that phonetic representations which are naturally appropriate for language differ from reading and writing representations and that only by understanding these differences can we understand why learning to read and write present more difficulties than learning to speak. Although phonetic speech gestures evolved for spoken language only, reading and writing representations must be specified by the same articulatory movements evoked by the sounds of speech.

The relevance of focusing students' attention on articulatory gestures to enhance their phonemic sensitivity when they begin reading seems apparent. However, only a limited number of programs use labeling and syntactical mediation to establish awareness of auditory, visual, and kinesthetic relationships among the phonemes of English. One of this programs - Auditory Discrimination in Depth (Lindamood, 1969) - moves through three levels: the gross level establishes the concept of the ear as a monitor in various life situations; the aural-oral level identifies pairs of voiced and unvoiced phonemes of English, labeled as, for example, /p b/ lip poppers, /t d/ tip tappers and vowels in a modification of the basic vowel circle; the sound-symbol level lets the child discover how words are generated.

Only two studies investigating the relationship between articulatory gestures and reading could be found. One (Ehri & Sweet, 1991) used moveable blocks, displaying pictures of mouth positions depicting different sounds, for example, a mouth with lips closed portraying /m/. The pictures were adapted from those used by Lindamood and Lindamood (1975) to assess the relationship between phonemic segmentation skill and fingerpoint-reading performance. Phonemic segmentation skill was strongly correlated with beginners' ability to fingerpoint-read memorized text and to remember how to read individual words in text.

The second study by Wise, Ring, Sessions, and Olson (1997) compared the effect of phonological training with a speech-motor component to the effect of training without a specific articulatory component on second- to fifth-grade students with reading disabilities. Both types of training enhanced reading and spelling performance. Children with the poorest phonological skills gained the most from articulatory training, whereas children who had higher phonological skills improved more with the nonarticulatory training.

Summary and Discussion

Evidence for and against each of the contrasting views that phoneme awareness facilitates reading and that learning to read and spell enhance phonemic awareness has been found in a large number of experimental studies. Likewise much evidence has been gathered documenting that the large majority of poor readers and spellers, adults and children alike, are deficient in phonemic awareness.

Several experimental and longitudinal studies, some with very large numbers of participants, have documented the causal relationship between phonemic awareness training and reading and spelling achievement. Although not all researchers are in agreement, segmentation training by itself or in combination with blending and letter-sound instruction, seems to be the most effective training available at present to enhance reading and spelling achievement in preschoolers, kindergarten and first graders, with results extending to later grades as well. In addition, phonemic awareness training has obtained encouraging results in enhancing reading and spelling progress in both students with low levels of phonemic awareness and in learning disabled students. In particular children with low levels of phonemic awareness seem to benefit the most from training with emphasis on articulatory gestures.

Section V

The Study - Part I: Purpose and Rationale

Summary of Literature Review

Phonemic awareness, the ability to detect individual sounds in words, has been measured by a wide number of tasks, which can be grouped into four categories: rhyming tasks, phonemic analysis and synthesis tasks, deletion tasks, and articulatory tasks. The validity and reliability of most of these tasks (possibly with the exclusion of rhyming tasks) has been widely acknowledged. Only the Auditory Discrimination in Depth (A.D.D.) program, although not a test of phonemic awareness per se, is used to determine phonemic awareness (Lindamood, 1969).

Longitudinal studies have shown that tests of phoneme awareness are strong predictors of later achievement in reading and spelling. In fact, tests evaluating phonemic awareness, whether measuring phoneme segmentation, phoneme blending, or phoneme deletion abilities are the single best predictors of facility in word identification. Phonemic awareness explains considerably more of the variance on measures of literacy than measures of IQ explain. Extensive studies have shown experimentally that phonemic awareness training has the effect of developing or enhancing not only phonemic awareness itself, but also subsequent reading and spelling acquisition.

Major questions such as which particular type of training is more effective and whether particular training procedures are more effective when used alone or in combination still await further investigation. One aspect of phonemic awareness which has been extensively discussed in theory but overlooked in practice and which might provide effective training for children with low levels of phonemic awareness involves having students focus their attention on speech articulatory gestures and translate these into phonetic representations for reading and spelling. This possibility is important to investigate for several reasons. Children who show low levels of phonemic awareness are clearly at risk of becoming disabled readers. Fox and Routh

(1980) reported that first graders with severe reading disability showed a striking deficit in phonemic analysis, although they did not differ in intellectual ability from average readers. Wagner et al.(1993) claimed that phonological processing abilities have the type of stability that renders gains through training "hard won." Juel (1988) concluded that poor first-grade readers with low phonemic awareness were almost always still poor readers by the end of fourth grade.

Only one experimental study reviewed, that by Wise et al. (1997) has provided segmentation training involving the analysis of articulatory gestures. The need for early and accurate assessment of phonemic deficits and for effective, easy to administer phonemic awareness instruction appears to be extremely valuable.

Purpose of the Study

The overall goal of this study was to investigate the effect of two kinds of segmentation training to determine whether either type enhanced kindergartners' phonemic awareness and whether either type improved their ability to learn to read words by sight, to decode nonwords, and to generate spellings of words. One type of training involved teaching children to analyze their mouth movements when they segmented words into sounds (the mouth condition). A second type of training involved teaching children to segment words into sounds by listening to the sounds (the ear condition). The study included a control condition whose participants were not given any special treatment.

It was anticipated that results would indicate whether phonemic awareness training based on articulatory gestures facilitates learning to read and spell more than phonemic awareness based on training of sound analysis.

It was further anticipated that results would help to validate phonetic cue reading as a process underlying learning to read sight words. In phonetic cue reading, beginners form access routes in memory between some of the letters seen in spellings, commonly the initial or final letters, and sounds detected in the word's pronunciation

(Ehri, 1994).

Results were expected to clarify which method of phonemic awareness instruction might be more efficacious and efficient in helping children acquire literacy skills.

Study Design

Participants in this study were kindergarten children who could name a certain number of alphabet letters but who had not yet learned how to read or spell. Qualifying children were randomly assigned to one of two training groups or a control group. One training method involved analysis of mouth movements during segmentation of words into sounds. It used blocks depicting the mouth saying the individual sounds and a mirror to compare the reflection of the child's own mouth to the picture on the block (the mouth condition). The second training method involved segmenting words into sounds by using blocks representing undifferentiated ear pictures (the ear condition). The control group received no treatment (the no treatment condition).

One set of pretest measures and two sets of posttest measures were given. Pretest measures yielded the following scores: number of letters written, number of letters named, number of whole words segmented, number of individual sounds segmented, number of nonsense words read, number of spelled sounds, number of words read in preprimer and Boder list, and number of correctly identified pictures on the Peabody Picture Vocabulary Test (PPVT-R)(Dunn & Dunn, 1981).

One set of posttest measures was administered immediately after training (the immediate posttest) and one set was administered after one week (the delayed posttest) to test the transfer effect of the training. The immediate posttest measures yielded the following scores: number of whole words segmented, number of individual sounds segmented, number of spelled sounds, number of sight words read over five trials. The delayed posttest measures yielded the following scores: number of whole words segmented, number of individual sounds segmented, number of spelled sounds, number of "old" sight words read over one trial, number of "new" sight words read over five trials.

Hypotheses

Children were either trained to segment words into component sounds by using blocks representing pictures of the mouth (the mouth condition) or trained to segment words into sounds by using undifferentiated ear-picture blocks (the ear condition).

The first hypothesis was that children in the mouth condition and children in the ear condition would do better on the immediate posttest measure of segmentation than children who received no treatment.

The second hypothesis was that children in the mouth condition would do better on the immediate posttest measure of reading pseudowords than children in the ear condition.

The third hypothesis was that children in the ear condition would do better on the immediate posttest measure of reading pseudowords than children who received no treatment.

The fourth hypothesis was that children in the mouth condition would do better on the immediate posttest measure of spelling than children in the ear condition.

The fifth hypothesis was that children in the ear condition would do better on the immediate posttest measure of spelling than children in the no treatment condition.

The sixth hypothesis was that students in the mouth condition would do better on the immediate posttest measures of learning to read sight words over five trials than children in the ear condition.

The seventh hypothesis was that children trained in the ear condition would do better on the immediate posttest measure of learning to read sight words over five trials than children who received no treatment.

The eighth hypothesis was that children trained in the mouth condition and children trained the ear condition would do better on the delayed posttest measure of segmentation than children who received no treatment.

The ninth hypothesis was that children in the mouth condition would do better on the delayed posttest measure of spelling than children in the ear condition.

The tenth hypothesis was that children in the ear condition would do better on the delayed posttest measure of spelling than children in the no treatment condition.

The eleventh hypothesis was that children in the mouth condition would remember how to read more words learned in the immediate posttest when asked to do so during the delayed posttest than children in the ear condition.

The twelfth hypothesis was that children in the ear condition would remember how to read more words learned in the immediate posttest when asked to do so during the delayed posttest than children in the no treatment condition.

The thirteenth hypothesis was that students in the mouth condition would do better on the delayed posttest measures of learning to read sight words over five trials than children in the ear condition.

The fourteenth hypothesis was that children trained in the ear condition would do better on the delayed posttest measure of learning to read sight words over five trials than children who received no treatment.

These hypotheses are based on the rationale that articulatory training results would compare to sound detecting training results in enhancing beginners ability to segment words; that articulatory training, by giving beginners access to the phonological representations of words, would enhance their ability to generate spellings of words, their ability to read pseudowords and their ability to read sight words in comparison to beginners who received training in detecting sounds in words; and that training in detecting sounds in words would enhance students' abilities on these same tasks when compared with no training.

Section VI

The Study - Part II: Method

Participants

The initial pool selected for the study included 75 children, 43 female and 32 male, ranging in age from 4.11 to 7.4 years (M = 5.8 years), all considered by the experimenter to be proficient in English, although 35 also spoke another language at home (25 spoke Spanish, four spoke Italian, two spoke Polish, one spoke respectively Yugoslav, Vietnamese, Thai and an unidentified African language). Of these 75 children 47 eventually qualified for the study. They were drawn from eight kindergarten classes and one first grade class in two private schools and one public urban school serving students from predominantly working class families. Their parents read a description of the study and returned parental permission forms giving informed consent to participate (see Appendix A). The five children who attended first grade had been pretested and dismissed the year before during a pilot test because they could not name any alphabet letters and could not write their names.

In order to be included in this study, children had to meet the following criteria: name at least 13 out of 17 target letters; fail to segment more than three words containing two or three phonemes; fail to read more than nine words at primer level on the Boder and Jarrico (1982) word reading test; fail to read more than one CVC nonword; display a raw vocabulary score of at least 35 on the Peabody Picture Vocabulary Test-Revised (PPVT-R; Dunn & Dunn, 1981). Of the 75 children who were pretested, 15 were dismissed because they lacked sufficient letter knowledge, three because they could segment, nine because they could read more than one nonsense word, one because her PPVT score was too low (i.e., score of 15).

Among the 47 children who qualified for the study, triplets were formed based on enrollment in the same school, similar pretest scores of correctly segmented sounds, total preprimer words read, and scores on the PPVT-R. Two children who qualified could not be matched so they were not included.

Members of triplets were randomly assigned to one of three groups, the mouth group, the ear group, or the control, no-treatment group. Characteristics of students in the three groups are reported in Table 1. Training was given to children in the mouth and the ear groups. Control children remained in their classrooms during training. Three children in the mouth group completed the pretest, the training and the immediate posttest but were not available for the delayed posttest.

Materials and Procedure

Children included in the study were individually tested during six to nine sessions each lasting 20-30 minutes. The pretest was given during the first session. The number of training sessions ranged from three to six depending on the number of sessions students needed to reach criteria. A cut-off of six training sessions was set. An immediate posttest and a posttest delayed by one week constituted the final two sessions. Prestest and training took place at the end of December in one private school, at the beginning of March in

Table 1. Mean performances on the pretests and mean characteristics of the groups given mouth training, ear training and no training.

Dependent Measures	Training Group: Mouth (N=15) M (SD)	Ear (N=15) M (SD)	No Trainig (N=15) M (SD)	F-stat (df=2,42)	
Age (year; month)	5;11 (.63)	5;9 (.48)	5;8 (.39)	.56	n.s.
Gender	10F;5M	10F;5M	9F;6M		
Letters (26 max)	25.0 (1.3)	24.7 (2.1)	24.9 (1.9)	.24	n.s.
Target letters (17max)	16.5 (.9)	16.5 (1.0)	16.6 (.6)	.03	n.s.
Preprimer Words(22max)	6.8 (4.0)	6.7 (3.5)	6.5 (4.3)	.03	n.s.
Boder Words (32 max)	1.9 (3.2)	1.3 (3.1)	1.7 (3.3)	.17	n.s.
PPVT Raw	62.2 (14.3)	64.6 (13.0)	63.3 (9.3)	.13	n.s.
Age-equivalent	5;4	5;7	5;5		
Phonemic Segmentation					
Sounds					
Pretest (21 max)	7.9 (3.7)	7.1 (3.9)	6.8 (3.7)	.32	n.s.
Words					
Pretest (8 max)	.7 (.9)	.5 (.9)	.5 (.9)	.35	n.s.
Reading Nonsense Words					
Pretest (5 max)	.2 (.4)	.1 (.2)	.2 (.6)	.79	n.s.
Spelling Sounds in Words					
Pretest (33 max)	14.4 (5.2)	13.9 (6.5)	13.0 (6.5)	.20	n.s.

Note. There were 15 students in each group.
n.s. = not significant; * $p < .05$; ** $p < .01$; *** $p < .001$.

the other private school and at the beginning of May in the public school. Participants were pretested individually by the experimenter and two other doctoral students; trained individually by the experimenter; and posttested by either one of the two doctoral students.

In one school a separate room was made available where the children could be trained and tested in relative privacy and silence. In the other two schools, children had to undergo training in the cafeteria, a corridor, the library or a windowless supply room, all to be shared with other support staff working with students on a variety of projects, including singing, dancing and gymnastics. A three panel screen was built out of cardboard to try to isolate the children from the noise and the distraction. Several tests were given in the order listed below. Complete instructions for administering the tests are given in Appendix B.

Pretests

Letter Name Knowledge

The experimenter showed an index card with all 26 capital letters in mixed order and asked the child to name them as s/he moved across the rows and pointed at each letter. Only accurate responses were scored. This test yielded two measures: the total number of letters named correctly (26 maximum), and the number of target letters named correctly (17 maximum). The target letters were: a,b,c,d,e,f,g,e,l,m,n, o,p,s,t,v,z. These were letters symbolizing the sounds employed in training and test materials.

Yopp-Singer Segmentation Task (modified)

The Yopp-Singer segmentation task was developed by Yopp (1988) to measure a child's ability to articulate the separate sounds in words. The original task included 22 words based on an analysis of their component sounds (i.e. consonants according to manner and place of articulation, vowels according to the height of the tongue and the tongue's location in the mouth) as well as their frequency. Eight words, one from the Yopp task plus seven added for this experiment to represent trained sounds were selected for the pretest. These words had been found to be among the easiest to segment in a previous pilot study. The words were: aid, tame, knee, bowl, leave, seed, toe, dope. Segmentation responses were scored to yield two measures: the number of words segmented correctly (eight maximum), and the number of individual sounds segmented correctly (21 maximum). The original Yopp-Singer segmentation task has a reliability of .95 and a predictive validity of .67 (Yopp, 1988).

Reading Nonsense Words

Each child was presented with six CVC nonwords to read: zowd, tek, nuf, bav, mod, zil. S/he was told that these were silly words the experimenter had invented and that although they had no meaning, they could still be read. The first word was modeled for the child, and the child was encouraged to try to sound out the words. If a child failed to read a word after five seconds, the researcher told him/her to read the next word. Scores had a possible range from zero to five correct responses. Credit was given both for long and short vowel pronunciations.

Invented Spelling Task

The spelling test consisted of five words and two nonwords: coast, blamed, sleeves, playmate, steamboat, fleesk, spoaft. The experimenter modeled how to write the first word. Children were told that if they knew how to write the word as spelled in a book, they should write those letters. The spelling task was scored to measure the number of sounds spelled phonetically (33 maximum).

Reading Preprimer Words

This test included 22 preprimer words mixed with pictures to minimize nonreaders' sense of failure, followed by two lists of words taken from the Boder and Jarrico (1982) reading test. The Boder was given only to those children who read more than three preprimer words. Children were given five seconds to respond to each word and then were told to try the next word. Preprimer words were individually printed on index cards. Boder words were printed in lists also on index cards. Children were supplied with a card to keep their place when reading down a list of words. Responses were scored to yield two measures: the number of preprimer words read (22 maximum), and the number of Boder words read (32 maximum).

Peabody Picture Vocabulary Test (PPVT-Revised)

Each child was administered the PPVT-R, Form M, regular edition (Dunn & Dunn, 1981). The children were asked to look at four pictures, to listen to the word pronounced by the experimenter, and to point to the picture which went with the word. Raw scores were used as measures of receptive vocabulary.

Experimental Training Materials and Procedures

The purpose of training was to teach students to segment words into their smallest sounds. In both conditions, 3x3-inch wooden blocks were used as manipulatives to mark the separate sounds. Blocks in the mouth condition displayed eight different mouth positions. There were five mouth pictures representing consonant sounds: p,b,m (labial); t,d,n,l (alveolar); k,g (velar); f,v (labio dental); s,z (hissing). There were three mouth pictures for vowel sounds: e (smile), a (mouth open), o (rounded lips). In contrast, blocks in the ear condition were uniform and displayed the profile of one ear. Figure 1 shows the nine pictures which were mounted on the wooden blocks.

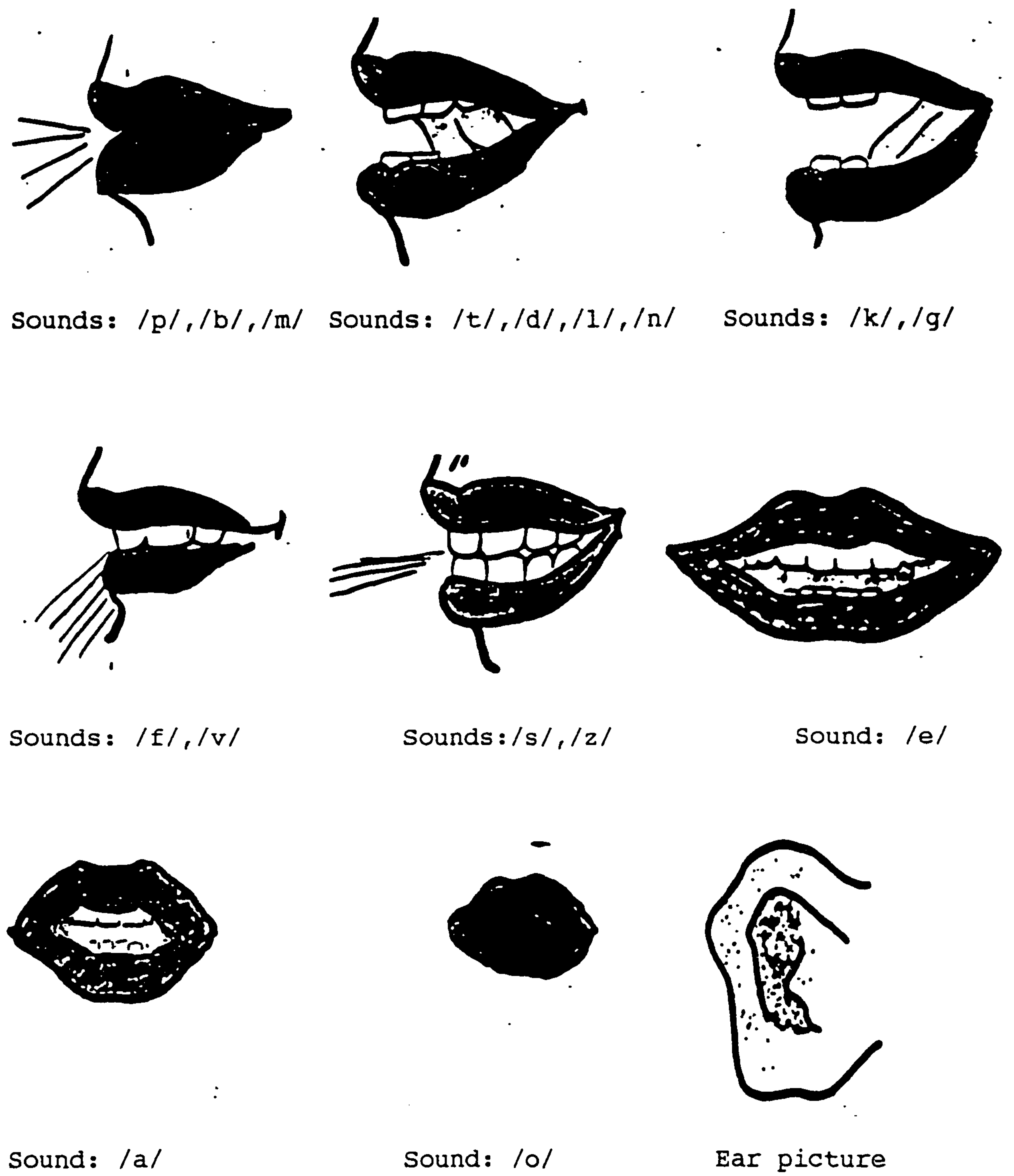
Each training condition included the following steps:

- a correspondence training phase
- a segmentation training phase
- a segmentation exit task, the criterion phase.

Mouth Pictures Correspondence Training Phase

Children were asked whether they knew how speech sounds are made. They were instructed to put a hand in front of their mouth and to say their name, while noticing the flow of air coming from the mouth. After they acknowledged the feeling, they were shown a drawing of the inside of the neck and the mouth cavity, with the different parts involved in speech production highlighted and asked to point to their own corresponding body parts (Appendix C). After this introduction, the experimenter picked up the block containing the mouth picture for the first target sound and described the movement involved in its articulation (lips, teeth, tongue, mouth roof, or throat), asking students to repeat the

<u>Figure 1.</u> Mouth pictures for trained sounds



sound four or five times, while checking both the picture on the block and the reflection of their own mouth in a small hand mirror. For example, for the sound /z/ she said: "You hold your teeth together and push air through to make a hissing sound." Correspondence training was given for four sets of four sounds each. After each sound in a set had been described, participants were given the four sounds in a random order and asked to point to their pictures. Responses were scored and the experimenter progressed to the next set only after children completed eight consecutive correct test trials. The four sets of sounds were: (1) p, t, f, a; (2) b, e, v, d; (3) m, l, k, s; (4) z, n, g, o.

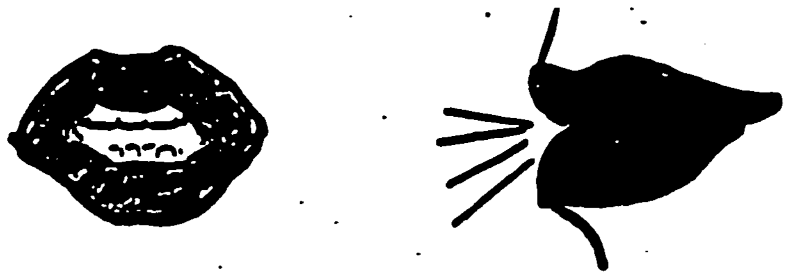
Mouth Pictures Segmentation Training Phase

The segmentation phase included training with 26 CV/VC words and nonwords, 17 VCC/CCV words and nonwords, and 20 CCVC words and nonwords. Each word was depicted by either a hand-drawing or a black and white photograph of the object named. The experimenter began by showing a CV word drawing and placing a two-space cardboard frame on a mirrored surface.

She pronounced the word, then segmented it into two sounds while looking at her own mouth in the mirror. She then picked the mouth picture block representing the initial sound of the word and placed it on the left-hand frame on the mirror. Similarly she picked the second mouth picture block representing the final sound of the word and put it on the second frame. She read the mouth pictures in their segmented version and then blended the sounds to say the word. Students were instructed to copy her by saying the same word, figuring out what their mouth was doing when saying the word, and picking up the mouth pictures representing the two sounds in sequence. Examples of these sequences are reproduced in Figure 2. If the response was correct, the experimenter proceeded to the next picture. If the response was wrong, she left the incorrect blocks on the mirror, placed the correct blocks on top of them and pointed out the difference(s).

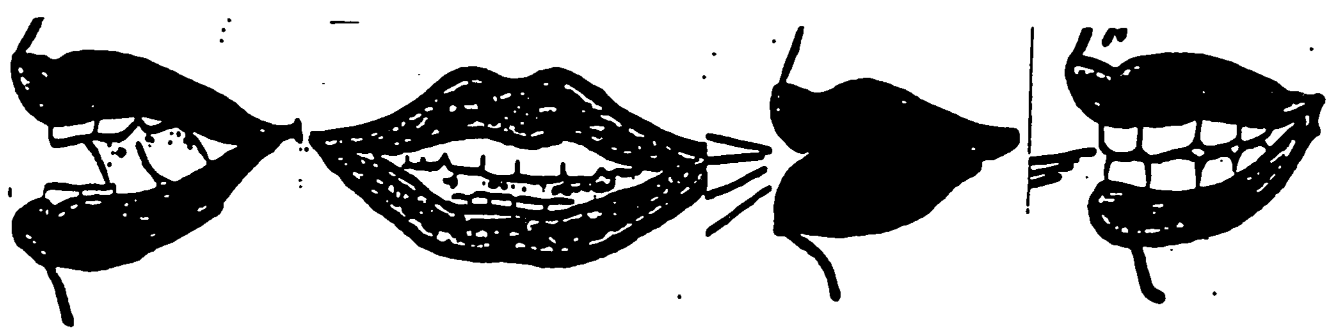
After the child had correctly segmented eight consecutive two-sound words, the experimenter proceeded to the three sound words followed by the four sound words. The

Figure 2. Examples of block sequences



Block segmentation of word ABE

Block segmentation of word STAY



Block segmentation of word TEAMS

frame was modified accordingly to provide spaces for either three or four blocks. If a segmentation training session had to be interrupted, abbreviated instructions to refresh students' memory were given when the session was resumed. (See Appendix D for the list of segmentation training words.)

Mouth Picture Criterion Exit Task Phase

A segmentation task with the mouth pictures was given to verify that students had acquired the skill. It consisted of six words: poke, feet, tail, taste, steep, plane. First the children memorized the spoken words by looking at six pictures of the objects named. This was done so that the researcher did not have to pronounce the words aloud and hence inadvertently supply the students with segmentation clues. The researcher said a sentence containing the target word and asked the child to say the word when she pointed to the picture. She then repeated the sentence, without saying the word, but pointing at it and letting the child supply the word. When the child demonstrated that s/he knew the words, s/he was asked to say the words and to use the mouth blocks to segment the sounds in them. If the child was unable to segment all items correctly, additional training was provided. The additional training consisted of a review of the six memorized criterion words. The child was reminded that s/he had to supply one block for each sound pronounced when saying the words. The criterion task was included in the study in order to verify that students had learned to use the mouth pictures to segment words into phonemes.

Ear Picture Correspondence Training Phase

Children were asked whether they knew how speech sounds are heard. They were told first to say their own name, then to put both hands behind their ears and to repeat it, while noticing whether there was a difference in the sounds heard. After children acknowledged that the latter sound was louder, they were shown a drawing of the inside of the ear cavity, with the different parts involved in hearing highlighted (Appendix E). They were asked to produce some different sounds (for example a dog barking) and to notice how sound-carrying air enters the ear and tickles nerves which convey the sound to the brain.

After this introduction the experimenter repeated twice the first target sound to be trained, picked up one ear block and bounced it on the table twice, explaining that two sounds were involved. The experimenter then progressed to two different sounds, this time picking up one ear block, bouncing it on the table, then picking up a second ear block and bouncing it on the table. When the participants reached criterion in bouncing two sequences correctly (either once for same sound or twice for different sounds), the experimenter progressed to three of the same sound, three of different sounds, four of the same sound and four of different sounds. Whether the sounds were the same or different was randomly mixed to avoid habituation.

Ear Picture Segmentation Training Phase

The segmentation training for the ear group was similar to the training for the mouth group, with the exception that children had to find and place on the frames ear pictures rather than mouth pictures. After eight consecutive correctly selected sounds for two-sound words, the experimenter proceeded to the three and the four-sound words.

Ear Picture Criterion Exit Task Phase

A segmentation task similar to the one administered to the mouth group followed the segmentation training. It consisted of the same six words. The children were instructed to supply one block for each sound they heard when they said the criterion words.

Off-task Behavioral Measures during Training

Training during the pilot test had been occasionally hindered by students' off-task behaviors. For this reason the experimenter kept notes during both the mouth and the ear training sessions to record how frequently each student exhibited any of the following off-task behaviors: (a) student leaves seat without permission, (b) student plays with blocks on table, (c) student throws blocks on floor, (d) student refuses to use blocks, (e) student refuses to use mirror, (f) student talks about extraneous topics, (g) student interacts with other(s) in room, (h) student refuses to complete training (but is persuaded to finish).

These responses were tallied to create eight corresponding measures of off-task behaviors.

Immediate Posttests

Yopp-Singer Segmentation Task (modified). Fifteen words were included, each containing sounds that children practiced segmenting during training. The words were: aid, tame, knee, bowl, leave, seed, toe, dope, fate, bean, nose, flay, eeks, old, steak. Directions for administering the test were the same as for the pretest. Incorrect responses were modeled correctly by the experimenter during the task. Segmentation responses were scored to yield two measures: the number of words segmented correctly (15 maximum), and the number of individual sounds segmented correctly (43 maximum).

Invented Spelling Task. The spelling test consisted of the same seven words used in the pretest. The same procedures were followed. Spelling responses were scored to yield one measure: the number of sounds spelled phonetically (33 maximum).

Sight Word Learning.

Students were taught to read eight words. These words had not been included as part of segmentation training but were constructed with target sounds used in the training. The words all began with the sound /s/ as a singleton consonant or part of a consonant cluster, they were either four or five letters long, and included one of the target vowels (long a, e, o). A single study trial was followed by several test trials with corrective feedback. During the first study trial, the experimenter read a meaningful sentence containing the word and defining it and then pointed to the word printed on an index card and said: "The word to read is ____". The child was asked to repeat the word.

During subsequent trials the subject's ability to read the words was tested. Each word was presented, the subject had five seconds to read it, and then the experimenter read the word and asked the child to repeat it. Learning was continued to a criterion of two perfect trials or a maximum of five trials. The order of the words was varied across trials. The words were: _safe_, _speed_, _snow_, _sleep_, _smoke_, _snake_, _sneeze_, _skate_. The number of words read correctly across the five trials was scored. Scores ranged from zero to 40 correct. Only accurate first responses were counted as correct, to minimize guessing effects. A second measure was also scored: the number of words read correctly plus the number of incorrect readings that shared at least two sounds with the written word.

Delayed Posttest

Segmentation Task

Fourteen words that consisted of trained and untrained sounds were selected. The words were: _aid_, _tame_, _knee_, _bowl_, _leave_, _seed_, _toe_, _made_, _beef_, _goat_, _sleigh_, _glee_, _oats_, _fleet_. Directions for administering the test were the same as for the pretest and the immediate posttest, with one exception. If the child correctly executed the first segmentation example, then s/he was not given any further examples. Segmentation responses were scored to yield two measures: the number of words segmented correctly (14 maximum), and the number of individual sounds segmented correctly (40 maximum).

Invented Spelling Task

The spelling test consisted of the same seven words given in the pretest and the immediate posttest. The same procedures were followed. Spelling responses were scored to yield the number of sounds spelled phonetically correctly (33 maximum).

Sight Word Learning

This test consisted of two parts. First the experimenter showed the child the sight words learned earlier during the immediate posttest and pointed to each word printed on an index card and asked the child to read it. The child had 5 seconds to read it. No feedback was given. The child's responses were recorded (eight words maximum).

The second part of the test comprised eight new words constructed out of sounds used in the training. All words started with the sound /f/ as a singleton consonant or consonant cluster. Words were either four or five letters long and included the target vowels (long a, e, o). The same procedures used previously were adapted. The words learned were: feet, fold, feel, flame, float, feast, fake, flake. Sight word learning responses were scored to yield the number of words read correctly across five trials (40 maximum). A second measure was also scored: the number of words read correctly plus the number of incorrect readings that shared at least two sounds with the written word.

Section VII

The Study - Part II: Results

Summary of Study

The purpose of the present study was to assess the benefits of two types of phonemic segmentation training, one involving articulatory cues referred to as the mouth treatment, and the other involving cues detected by listening to sounds referred to as the ear treatment. Kindergartners were assigned to one of three groups, either the two treatment groups or a no-treatment control group. To assess effects of training, two series of posttests were given, the first a day after training, and the second a week after training.

To determine whether subjects who received phonemic segmentation training outperformed subjects who received no training, and whether one form of training was superior to the other form, analyses of variance were conducted. The independent variable was treatment group with three levels: training with mouth pictures vs. training with blocks marked with an ear vs. no training. An additional independent variable included in some of the analyses was time of the posttest: immediate vs. delayed. The dependent variables were measures taken from the various tasks. Post-hoc Tukey pairwise comparisons were performed whenever main effects of training group were detected in the ANOVAs.

Characteristics of Participant Groups

The assignment of students to treatment conditions was conducted by forming triplets whose scores matched as closely as possible on pretest measures of correctly segmented sounds, number of preprimer words read, scores on the PPVT-R, and enrollment in the same school. Members of triplets were randomly assigned to conditions. ANOVAs revealed that the groups did not differ on pretest measures. As evident in Table 1, the groups were very similar in age as well as in mean performances naming letters, reading preprimer words and words on the Boder test, and identifying the meanings of words on the PPVT. Also the groups performed similarly on the measures of phonemic segmentation, nonsense word reading, and spelling (all p's >.05). These findings verify that the groups did not differ in their literacy skills prior to training.

From mean scores in Table 1, it is apparent that students included in the groups were able to name most if not all of the 17 target letters but were novices in their ability to read real words, and possessed little if any ability to read nonsense words. The proportion of the sample of 45 students who were unable to read any nonword was 85%, indicating that most students lacked any word attack skill.

Participants in two of the three groups received several sessions of phonemic segmentation training. The total number of minutes spent in training was summed for each student. As shown at the bottom of Table 2, the length of training did not distinguish the two groups. This indicates that training with mouth pictures did not consume more time than training with ear pictures, even though students had to acquire more information in the former condition.

At the end of training a segmentation exit task was

Table 2. Mean performances on the segmentation posttests and length of training as a function of training group

Dependent Measures	Training Group: Mouth (N=15) M (SD)	Ear (N=15) M (SD)	No Training (N=15) M (SD)	Tukey Test	F-stat (df=2,42)
Phonemic Segmentation Sounds					
Posttest 1 (43 max)	24.6 (6.1)	24.5 (6.3)	15.1 (4.5)	M=E>C	13.54***
Posttest 2 (40 max)	24.5 (7.8)	23.6 (6.3)	16.0 (5.1)	M=E>C	5.58**
Posttest 1 (15 max)	4.3 (2.1)	4.3 (3.0)	1.2 (1.3)	M=E>C	9.64***
VC/CV (3 max)	1.9 (.9)	1.6 (.9)	.8 (.8)	M>C	5.39**
CVC (8 max)	2.0 (1.5)	2.3 (1.9)	.3 (.8)	M=E>C	7.64***
CCV/VCC/CCVC(4 max)	.6 (1.1)	.7 (.9)	.0 (.0)	M=E>C	3.21*
Posttest 2 (14 max)	4.5 (3.6)	4.2 (2.6)	1.0 (1.1)	M=E>C	6.23**
VC/CV (3 max)	1.9 (.9)	1.8 (.9)	.6 (.8)	M=E>C	7.41***
CVC (7 max)	2.2 (1.5)	1.7 (1.9)	.4 (.8)	M>C	4.21*
CCV/VCC/CCVC(4 max)	1.0 (.9)	.6 (.6)	.0 (.0)	M=E>C	9.30***
Length of Training (minutes)	84.8 (26.7)	72.5 (27.8)			1.53 n.s.

Note. There were 15 students in each group given Posttest 1; there were 13 students in the mouth group and 14 students in the ear group in Posttest 2.
n.s. = not signficant; * $p < .05$; ** $p <. 01$; *** $p < .001$

given to verify that students had acquired this skill. The task consisted of six words (three CVC and three CCVC). To indicate that they had learned to segment, students had to achieve a perfect score in this task. Five children in the mouth condition and seven children in the ear condition did not reach criterion the first time the task was given and were provided with more training. Despite the extra training, all of these children failed to reach criterion the second time the segmentation exit task was given. Although they failed to segment all six words correctly, they were able to segment all three CVC words and at least one CCVC word correctly.

Results of Hypotheses

The first hypothesis, that children in the mouth condition and children in the ear condition would do better on the immediate posttest measure of segmentation than children who received no treatment, was supported because students in both training conditions performed significantly better than students who received no treatment.

The second hypothesis, that children in the mouth condition would do better on the immediate posttest measure of reading nonwords than children in the ear condition, was not supported, because there was no difference in their performances.

The third hypothesis, that children in the ear condition would do better on the immediate posttest measure of reading nonwords than children who received no treatment, was not supported, because there was no difference in their performances.

The fourth hypothesis, that children in the mouth condition would do better on the immediate posttest measure of spelling than children in the ear condition, was not supported, because there was no difference in their performances.

The fifth hypothesis, that children in the ear condition would do better on the immediate posttest measure of spelling than children in the no treatment condition, was supported, because children in the ear condition performed significantly better than children in the no treatment condition.

The sixth hypothesis, that students in the mouth condition would do better on the immediate posttest measures of learning to read sight words over five trials than children in the ear and the no treatment conditions, and that children in the ear condition would do better than children in the no treatment condition, was partially supported because children in the mouth condition performed significantly better than children in the no treatment condition, but not better than children in the ear condition and children in the ear condition performed no better than children in the no treatment condition when the total number of words read correctly included words sharing at least two sounds with the target words.

The seventh hypothesis, that children trained in the ear condition would do better on the immediate posttest measure of learning to read sight words over five trials than children who received no treatment, was not supported, because there was no difference in their performances.

The eighth hypothesis, that children trained in the mouth condition and children trained the ear condition would do better on the delayed posttest measure of segmentation than children who received no treatment, was supported, because children in both trained conditions performed significantly better than children who received no treatment.

The ninth hypothesis, that children in the mouth condition would do better on the delayed posttest measure of spelling than children in the ear condition, was not supported, because no difference in their performances was found.

The tenth hypothesis, that children in the ear condition would do better on the delayed posttest measure of spelling than children in the no treatment condition, was supported, because children in the ear condition performed significantly better than the children who received no treatment.

The eleventh hypothesis, that children in the mouth condition would remember how to read more words learned in the immediate posttest when asked to do so during the delayed posttest than children in the ear condition, was not supported, because no difference was found in their performances.

The twelfth hypothesis, that children in the ear condition would remember how to read more words learned in the immediate posttest when asked to do so during the delayed posttest than children in the no treatment condition, was not supported, because no difference in their performances was found.

The thirteenth hypothesis, that students in the mouth condition would do better on the delayed posttest measures of learning to read sight words over five trials than children in the ear and children in the no treatment conditions, and that children in the ear condition would do better than children in the no treatment condition, was partially supported, because children in the mouth condition performed significantly better than children in the no treatment condition, but not better than children in the ear condition and children in the ear condition performed no better than children in the no treatment condition when the total number of words read correctly included words sharing at least two sounds with the target words.

The fourteenth hypothesis was that children trained in the ear condition would do better on the delayed posttest measure of learning to read sight words over five trials than children who received no treatment, was not supported, because no difference was found between the two groups' performances.

Gains in Segmentation Skill

From mean performances in Table 2, it is apparent that the two groups who completed segmentation training possessed superior segmentation skill to the group that received no training. Trained subjects were better able to segment individual phonemes in words correctly as well as to segment entire words into phonemes correctly. Post hoc procedures using Tukey's pairwise comparison test revealed that mean performances of each of the trained groups exceeded mean performances of the control group on both the immediate and the delayed posttests. In addition, the Tukey tests revealed that the two trained groups did not differ from each other in their segmentation performance. There were no significant interactions between training group and time of posttest (all p's >.05).

During the immediate segmentation posttest students were asked to segment 15 words: three VC/CV words, eight CVC words, and four words containing consonant clusters. The total number of words correctly segmented and the number of words correctly segmented for each word type by students in the three conditions was analyzed. One-way ANOVAs revealed main effects of condition in all four analyses (see Table 2). The mouth trained subjects significantly outperformed the control group in the segmentation of VC/CV words and both mouth and ear subjects outperformed the control group in the segmentation of CVC words and words containing consonant clusters.

During the delayed posttest, students were presented with 14 words to segment. ANOVAs revealed main effects of condition in the segmentation of total words, VC/CV words, CVC words, and words containing consonant clusters (see Table 2). Post hoc comparisons using Tukey's pairwise comparisons indicated that students in both the mouth and ear conditions outperformed children in the control group in the segmentation of VC/CV words and words containing consonant clusters. Children in the mouth condition outperformed children in the control group in the segmentation of CVC words.

No child in the control group was able to segment any words containing consonant clusters correctly in either posttest, whereas 33% of the children in the mouth condition segmented at least one consonant cluster word correctly in the immediate posttest and 47% of children in the ear condition did so. The percentages climbed to 62% (mouth) and 57% (ear) during the delayed posttest.

In sum, analyses of performances on the segmentation task revealed that both forms of training enhanced students' ability to segment words into phonemes. Trained students did much better on the posttests than on the pretest, and they outperformed the untrained control group. However, trained subjects fell far short of perfection in their ability to segment. On the more immediate posttest, they segmented an average 58% of the sounds correctly but only 29% of the words correctly, indicating that training was more effective at teaching students to segment words partially into sounds than to analyze words completely. Performance was weakest on the words containing consonant clusters, indicating that segmentation training exerted the least impact on the hardest words.

One reason why training failed to transfer fully may involve the change in segmentation procedures. During training, students were taught to segment words by placing blocks in a frame as they pronounced the sounds. The frame specified how many blocks to set out. In contrast, during the posttests, students segmented words by simply pronouncing the separate sounds in the words without manipulating any blocks or counters and without being told the number of sounds to find in words.

Gains in Spelling and Reading

Of primary interest in the present study was whether phonemic segmentation training would transfer and facilitate performance on various literacy tasks. Although the segmentation training that students received did not include the manipulation of letters to represent the phonemes being segmented, it was thought that transfer might occur. One reason is that students selected to receive training were those who were able to name most if not all the target letters that represented phonemes in the literacy tasks. Another reason was that all the target letters had names containing the relevant phonemes that were represented by letters in the literacy tasks.

The dependent measure in the nonsense word decoding task was the number of CVC nonwords read correctly out of five. Students were given credit for assigning either long or short vowel pronunciations. As evident in Table 3, performance on the posttest was very poor. In fact, 64% of the students

Table 3. Mean performances on the reading and spelling posttests as a function of training group

Dependent Measures	Training Group: Mouth (N=15) M (SD)	Ear (N=15) M (SD)	No Training (N=15) M (SD)	Tukey Test	F-stat (df=2,42)
Reading Nonsense Words					
Posttest 1 (5 max)	1.0 (1.5)	.5 (1.0)	.5 (.8)	.80	n.s.
Spelling Sounds in Words					
Posttest 1 (33 max)	18.9 (5.8)	17.7 (5.7)	13.0 (4.5)	M>C	4.95*
Posttest 2 (33 max)	18.0 (6.1)	18.3 (6.3)	12.4 (5.8)	M=E>C	4.38*
Reading Sight Words					
S-Words correct					
Posttest 1(40 max)	11.1 (5.8)	9.3 (6.9)	7.8 (4.7)	1.20	n.s.
Posttest 2 (8 max)	1.7 (1.9)	2.0 (1.5)	1.7 (1.2)	.20	n.s.
F-Words correct					
Posttest 2 (40 max)	7.5 (5.3)	7.0 (4.2)	4.6 (4.2)	1.57	n.s.
Sounds correct[a]					
S-Words (40 max)	25.3 (5.1)	20.0 (7.5)	17.9 (6.1)	M>C	3.53*
F-Words (40 max)	24.9 (4.6)	19.6 (4.8)	15.8 (5.0)	M>C	5.43**

Note. There were 15 students in each group given Posttest 1; there were 13 students in the mouth group and 14 students in the ear group in Posttest 2.
n.s. = not signficant; * $p < .05$; ** $p < .01$; *** $p < .001$.
[a] This measure included words read correctly combined with incorrect readings sharing at least two letters and sounds with the word.

failed to read any nonwords correctly. The 16 students who read one or more nonwords correctly were almost evenly distributed among the three groups. One reason why performance may have been poor is that the CVC nonwords were short vowel spellings (i.e., tek, nuf, bav, mod, zil) yet long vowels were taught during training. Although long vowel pronunciations were accepted as correct, students may have been aware that spellings having a CVC structure are not pronounced this way. Another possible reason for poor performance is that the training procedures did not include teaching students to blend the sounds in words, a skill which is needed to read nonwords effectively.

To examine the contribution of segmentation training to spelling performance, the numbers of phonetically spelled sounds produced during the immediate and the delayed posttests were examined. The dependent measure was the number of phonetically correct sounds spelled across six words. The same words were presented in both posttests and consisted of one or two syllables and one or two consonant clusters. For the immediate posttest, a one-way ANOVA revealed that the main effect of treatment group was significant (see Table 3). Post hoc comparisons using Tukey's pairwise comparisons indicated that the mouth group outperformed the control group. For the delayed posttest, a one-way ANOVA showed a significant main effect of treatment. Post hoc comparisons using Tukey's pairwise comparisons indicated that both treatment groups performed comparably and that each outperformed the control group. This indicates that both types of segmentation training were effective in facilitating spelling performance in students. Trained students spelled 55% of the sounds correctly whereas controls spelled 36% correctly, indicating that students improved in their detection of partial phoneme-grapheme cues in words.

To determine whether the two types of segmentation training boosted performance on a task requiring subjects to learn to read words, performance on the word learning tasks were subjected to ANOVAs. Two different sets of words were taught, a set of words all beginning with S in the immediate posttest, and a set of words all beginning with F in the delayed posttest. The dependent measure was the total number of words read correctly across the five learning trials (40 maximum). In addition, students were presented with the previously learned S-words to read again on the delayed posttest. The dependent measure here was the number of words read correctly (eight maximum). Mean performances are reported in Table 3. Although the means were in the expected direction, the main effects of treatment group fell short of significance.

Inspection of mean values in Table 3 reveals that students did not learn to read the words very well. One problem was that they confused similarly spelled words. To incorporate this into the measure of word reading, a second measure was created: the number of words pronounced that shared at least two sounds with the printed words being read. This measure included words that were read correctly combined with incorrect readings that shared at least two sounds with the written word for example, misreading _safe_ as _skate_, _feet_ as _feel_. A one-way ANOVA on immediate posttest scores revealed a main effect of treatment group, $p<.05$. Post hoc tests using Tukey pairwise comparisons revealed that mean performance of the mouth trained group exceeded mean performance of the control group. Similarly, a one-way ANOVA on delayed posttest scores revealed a main effect of treatment group, $p<.01$, with the mouth trained subjects signficantly outperforming the control group. In these same analyses, performances of the ear group did not differ either from the mouth group or from the control group. These findings indicate that training in articulatory mouth movements facilitated children's ability to process partial grapheme-phoneme cues in learning to read words when compared to children receiving no training.

To further check for differences, errors made by subjects while learning to read the S-words and F-words were examined and are reported in Table 4. Error Type A, confusing the word with another word on the list, for example reading _snow_ instead of _sleep_, was the most common. Almost all

Table 4. Mean errors made in Posttests 1 and 2 by students given mouth training, ear training and no training in the word learning task

Dependent Measures		Training Group: Mouth (N=15)	Ear (N=15)	Control (N=15)	F Statistic (df=2,42)	
Posttest 1						
Error Type A	M	14.6	15.0	16.0	.21	n.s.
	SD	4.7	6.7	7.4		
Error Type B	M	4.6	8.6	7.8	1.49	n.s.
	SD	4.6	8.8	6.0		
Error Type C	M	0.1	0.6	0.2	1.56	n.s.
	SD	0.3	1.2	0.4		
Posttest 2						
Error Type A	M	14.7	14.9	14.9	0.4	n.s.
	SD	4.8	5.5	6.6		
Error Type B	M	7.0	10.4	12.7	1.76	n.s.
	SD	6.0	9.2	8.0		
Error Type C	M	0.1	0.3	0.4	1.88	n.s.
	SD	0.2	0.4	0.4		

Error Type A: words on the same list,
Type B: extraneous words,
Type C: words with connected meanings to target words.

Notes. There were 15 students in each group given Posttest 1; there were 13 students in the mouth group and 14 students in the ear group in Posttest 2.
n.s. = not signficant; * $p < .05$; ** $p < .01$; *** $p < .001$.

children across the conditions produced at least one instance (i.e., 43 out of 45 children). The second most common error was error Type B, reading words having neither a phonetic nor a semantic connection with the printed words, for example, reading robin instead of speed. Error Type C, confusing the word with a totally different word having a connected meaning, for example, reading winter for snow, or roller blades for skates, was less common. Two students in the mouth training condition, seven students in the ear training condition and seven students in the control condition made this type of mistake.

To examine whether the types of mistakes made by the students during the task differed depending on the treatment they received, the numbers of errors of each type were compared. The dependent measure was the number of mistakes made by each student in the three groups. For the immediate posttest, one-way ANOVAs revealed no main effect of treatment group for any of the errors, although differences among the groups in errors B and C almost reached significance, with the mouth group reading fewer totally extranoeus words and using the semantic connection less than the other two groups. A list of the type C mistakes is given in Table 5.

To summarize, training in phonemic segmentation improved students' performances in some of the literacy tasks. Both mouth and ear training increased the number of sounds students spelled in words. Mouth training improved the use of partial cues to remember how to read words. However, training did not facilitate nonword reading or sight word learning, tasks which proved more difficult for all the students.

Performance During Training

Children in the mouth and the ear conditions received training that lasted from three to six sessions. During their first session, children received correspondence training and during the following sessions they learned to segment.

All the children in the mouth condition were highly interested and motivated during both the correspondence training and the segmentation training. Only one child out of

Table 5. Type C mistakes made by students given mouth training, ear training and no training in the word learning tasks

	Correct Word	Word Read
Mouth training		
	SNOW	WINTER
	SNOW	FLAKE
Ear training		
	SNOW	WINTER
	SLEEP	BED*
	SNAKE	APPLE (3 times)
	FLAME	FIRE
	FEAST	FOOD*
	FEET	TOE
	FLOAT	BOAT*
No training		
	SNOW	WINTER
	SNOW	WHITE
	SLEEP	BED*
	SPEED	RACE
	SPEED	ROLLER BLADES
	FLAKE	SNOW
	FEET	SOCKS* (2 children)
	FLOAT	BOAT*

* These words were present in defining sentences spoken to students during the first study trial in the word learning tasks.

15 (6%) refused to use the mirror during correspondence training. The rest were highly cooperative and compliant. Several students used the mirrored surface during correspondence training, without having to be reminded that they could do so by the experimenter. Mouth students were never restless or distracted, although some showed signs of fatigue during the segmentation training phase, especially when it took place in the afternoon. None had problems learning how to pick up the correct mouth picture when asked to do so during the correspondence phase, although some (33%) had difficulty distinguishing between the pictures representing alveolar sounds and those representing velar sounds during segmentation training. A smaller number of children (20%) exhibited similar difficulties involving the pictures representing the vowel sounds /ā/ and /ē/ during segmentation training.

In contrast to the absence of off-task behaviors among mouth-trained students (except for the one student refusing to use the mirror), children in the ear condition exhibited several off-task behaviors: 6% left their seats without permission; 26% played with the blocks, either using them to build towers and houses, or pretending they were cars forming a train; 6% threw the blocks on the floor; 13% talked about extraneous topics; 6% interacted with others in the room; 13% refused to continue, but were persuaded to finish the training. The percentage of ear-trained children who produced at least one of these off-task behaviors was 87%. The screen which had been prepared to isolate children from distracting noise in the room was needed solely by children in the ear condition.

The most frequently encountered segmentation problems exhibited by children were: not remembering the word the researcher had just pronounced, even with the picture of the object in front of them, or saying the wrong word, for example, repeating monkey instead of ape, or cereal instead of eat; leaving out the vowel sound in CVC words; including an additional block to represent the schwa sound after a consonant and before the vowel; altering the order of sounds in words, for example segmenting /o//l//f/ for the word loaf, or c//a//l/ for the word clay; leaving out the sound of the second consonant in a consonant cluster, especially when it was /l/, for example, being able to segment stove, but not globe; leaving out the vowel after a consonant cluster, for example, segmenting /k//l//n/ for clean); omitting the final sound of a word, for example, segmenting /t//a//s/ instead of /t//a//s//t/ for taste; and failing to concentrate.

In general, children in both training conditions did not have problems learning to segment VC/CV words or CVC words, but several needed extra training to complete eight correct sequences in the CCV and CCVC lists of words and four children (three in the ear group and one in the mouth group) could not segment eight words in sequence even with extra training.

An exit task assessing segmentation ability at the end of training was given to both groups. Sixty-seven per cent of the children in the mouth condition and 53% of the students in the ear condition were able to segment all six words correctly in this task. The remaining children received additional training on these items and still failed to pass the test, although they improved their performances. The most common problem in this task was not remembering the word steep and not being able to segment it correctly (43% of all the trained children failed this item).

Section VIII

The Study - Part II: Discussion

Summary of Results

This study was conducted in order to compare the effect of two types of phonemic segmentation training, one referred to as mouth training, which taught students to monitor their articulatory movements in pronouncing words, and the other referred to as ear training, which taught students to detect sounds in words. Children attending kindergarten classes were assigned to one of the two treatment groups or to a control group which received no training. Performances on two posttests, one given immediately after the training and the other given a week later, were examined to determine whether students in the two training groups outperformed students in the control group and whether either training method was superior in facilitating the acquisition of phonemic awareness, the ability to decode nonwords, the ability to invent spelling, and the ability to learn to read a set of similarly spelled words.

Children who received segmentation training clearly outperformed children who received no training in the posttest segmentation tasks. Not only did they learn to segment individual phonemes better, but also they learned to segment whole words better. The effect was still strong one week after the training had ended. This indicates that both methods, the mouth training and the ear training, were equally effective in teaching children phonemic segmentation skills.

It is however interesting to note that the segmentation scores of students in the control group also increased between the pretest and the immediate posttest. Such an increase in scores from pretest to posttest was apparent only in the segmentation task, not in the spelling and nonword reading tasks where scores did not change. Because only one week separated pretest from posttest and because teachers did not give invented spelling or segmentation training at least for the duration of the study, the improvement is likely to have resulted from control students' experience with the pretest as well as the posttest, both of which gave them corrective feedback following each response.

The ability to invent spellings of words was also enhanced in both trained groups: students in the mouth condition and students in the ear condition outperformed the control group in the immediate as well as in the delayed posttests. This demonstrates that invented spelling can be significantly facilitated by both segmentation training methods.

The effect of segmentation training on remembering how to read words was limited. Children in all three groups had difficulty learning to read words correctly, and trained students did not outperform controls. However, when the measure of word learning was modified to include correctly read words as well as misreadings which shared at least two sounds with the written words, students in the mouth training condition were found to outperform students in the control condition. This indicates that articulatory training helped students detect and utilize more letter-sound correspondences in their word learning than untrained students.

Not surprisingly, segmentation training exerted little effect on students' ability to decode nonsense words. Students found this task extremely difficult. Very likely the reason why training was ineffective is that neither training method included instructions on how to blend sounds together.

Acquisition of phonemic awareness

Previous phoneme segmentation training studies have taught students to segment words into phonemes using tokens or letters to represent phonemes (Ball & Blachman, 1991; Bradley & Bryant, 1983; Lundberg et al., 1988). Very few studies have taught phonemic segmentation by increasing children's awareness of speech gestures in words.

The present study revealed that teaching children to focus attention on how words are articulated to detect phonemic segments compared favorably with training requiring children to focus attention solely on sounds, although articulatory training did not prove to be more effective than sound segmentation training.

Another study which did not find significant differences between training with articulatory components and training with nonarticulatory components (Wise et al., 1997) used - for the articulatory components - the Lindamood and Lindamood (1975) ADD program adapted for computer presentation to enhance phonological awareness in older students with reading disabilities. The nonarticulatory components included manipulation of syllables, rhymes and phoneme position in words. During the articulatory awareness training, students first worked in groups and learned to feel sound-producing articulations and to associate the feelings with sounds, pictures, letters and labels. Later students worked individually with four computer programs, the PAL (phonological analysis with letters), the Non (nonword reading program), the Spello (English spelling patterns), and the ROSS (reading with orthographic and speech support). The study included nine hours of small group instruction and 21 additional hours practicing with the computers. Students in both treatments made gains, with children lowest in phonological awareness benefitting more from the articulatory training and children with higher skills in phonological awareness benefitting more from the nonarticulatory training.

In the present study success in enhancing phonemic segmentation skill was achieved by both training methods, despite the short period of time spent in training. Students in both conditions were trained for a minimum of three to a maximum of six sessions, each lasting no more than 20 minutes, spread over one week. This is a very limited time compared to other training studies. For example, Hatcher, Hulme, and Ellis, (1994) taught children individually for 40 sessions, each lasting 30 minutes, spread over 20 weeks. Similarly, Torgesen and Davis (1996) trained kindergarten children four times a week in 20-min sessions for 12 weeks. Torgesen and Davis devoted substantial time also to instructor training: six 2-hour sessions spread over three weeks. In contrast, results of the present study suggest that lengthy training of neither children nor instructors is necessary to improve phonemic awareness.

Another possibly encouraging aspect of the present study is that the materials used to train the children were relatively simple and inexpensive, especially when compared to studies using computers (Wise et al., 1997). In the present study, materials consisted only of wooden blocks with colored mouth pictures, a large mirror with a card-holder lip and a small hand mirror.

Although all students were very eager to participate in the training, often showing their disappointment at not being selected for a session, children in the mouth condition were particularly enthusiastic about the training and never showed signs of being bored. Quite the opposite of boredom was evident. Mouth students remained focused and on task during the entire session. They never complained and seemed to be genuinely sorry to leave at the end of their period. Some of the ear students were very curious about "the other blocks" and wanted to use the mirror that was set aside on the table. Although children had been told not to talk to their friends about the training, mouth students might have mentioned the mirrors and the pictures of the mouth.

Why was mouth training more interesting and engaging than ear training? Various possible reasons can be identified. The materials were more varied and interesting in that they included mirrors and mouth pictures. The task of discovering how one's mouth moves in pronouncing words was more novel and challenging. This task may have made the discovery of sound segments more accessible than the ear method. It is possible however that even the ear students may have ended up with the same awareness as mouth students. Ear students might in fact actually have received the same emphasis on articulatory gestures as the mouth students when they were asked to segment the sounds in the correspondence and the segmentation trainings and in the two posttest segmentation tasks. This is exemplified by ear students' behavior during the immediate posttest. One student exaggerated his mouth gestures when asked to repeat words for both the spelling and the segmentation tasks, almost as if somebody had taught him to do so and another probed with her fingers around her mouth when she had to segment words. It was also observed that several children in all three conditions closely observed the experimenter's mouth when she pronounced the words to be segmented, spelled, or read. However the discovery process for the students in the ear and the control groups may have been more confusing and less clearcut, reflected in ear students boredom and susceptibility to distraction.

Although children in both training conditions outperformed children in the control condition, their performances on the segmentation posttests were not perfect. Theoretically, if children had learned to segment words correctly during segmentation training, they should have been be able to segment correctly in the posttest which was a slightly different task. One reason why performances fell short on posttests might lie in the fact that when students learned to segment words, they used markers and frames to help them distinguish and remember the number of component sounds to be found in the words. Students in the mouth condition had blocks with pictures of the mouth articulating the target sounds, and children in the ear condition had blocks with pictures of the ear. Students in both groups had carboard frames with two, three or four squares in front of them to remind them of the exact number of sounds they had to identify. The frames were of considerable help. For example, one child consistently put the first and the last sound on the first and last square of the frame when segmenting CVC words, and then took her time to find the middle sound, by rehearsing the word in memory. In contrast to the support provided by training materials, the segmentation posttests included no markers or frames. Students segmented words by simply pronouncing the separated sounds. One child who had received training was observed to mark each sound by bouncing his flat hand on the table. Another child held her index finger up and used it to count the sounds. One child asked whether she could use the blocks, and used a pencil instead when she was told she could not. However most students did not use any tools. This may explain why the mean numbers of correctly segmented whole words and partial words in the segmentation posttests were not higher in the groups who had undergone training.

Another factor observed to influence performance in the segmentation tasks was working memory. It became apparent during segmentation training, particularly on the criterion task given at the end of training, that many children had difficulty remembering the words and the sounds in words even when they had a picture depicting the word's meaning in front of them. Not surprisingly CCVC words were the most difficult to remember, although even some VC, CV, and CVC words caused difficulties. The last sound in the word was usually the hardest to remember. An alternative explanation is that some children might not have pronounced the last sound in some of the words. For example one child said <u>tase</u> for <u>taste</u> and repeated <u>tase</u> even after feedback. Perhaps some words were hard to remember because students were unfamiliar with their meaning. Vocabulary scores of some students (PPVT scores) were below their expected age levels.

In the present study, 40% of the students failed to reach criterion in learning to segment words into phonemes, mainly due to difficulty segmenting consonant clusters. This indicates that some kindergarten children cannot be successfully trained in phonemic awareness, at least in the short period of time provided. Other researchers have reached the same conclusion. Liberman and Shankweiler (1985) found that normal preschool children performed poorly in tasks involving phoneme counting. They concluded that awareness of phoneme segments is more difficult to learn than awareness of syllable segments and might not be achieved at all. Torgesen and Davis (1996) concluded that reading-disabled children benefit only minimally from phonemic awareness training.

Although all students in the present study successfully completed segmentation training, not all students succeeded in the criterion segmentation task at the end of training. One reason for the discrepancy is that during segmentation training, children only had to repeat the words pronounced by the researcher and then find their corresponding mouth or ear blocks. If they forgot the word or spoke another word, the experimenter could repeat the correct word for them at any time. In contrast, during the criterion task students had first to identify and remember the word they had previously memorized, then find its component sounds and finally place them in the correct order on the frame which indicated the number of segment to find. The experimenter was not allowed to repeat the word for them as they segmented it. This was to preclude the possibility of cueing students about the segments to find. Under these circumstances, students were observed to forget the words when they began segmenting them, indicating that the extra step of having to remember the word interfered with their ability to segment it.

Ability to Invent Spellings

Although the principal focus of this study was on the transfer of phonemic segmentation skill to reading, spelling was also examined. Both the mouth and the ear methods of training enhanced students' invented spelling in equal measure. This is particularly interesting because these students had not yet started using invented spelling in their regular class work. Several children at first refused to write words because they had never written them before and had to be encouraged to do so. They were hesitant and did not want to make mistakes.

Some researchers have argued that reading and spelling develop partially independently and that phonological interventions are more involved in learning to spell that in learning to read (Goswami & Bryant, 1990). Results from the present study lend some support to this position, as training in phonological awareness exerted stronger effects upon spelling than upon reading. Whereas trained students outperformed controls on the number of sounds spelled correctly in words, trained and control students performed equivalently in reading nonwords, with most students reading few if any nonwords correctly. Moreover, on the sight word learning task, means were in the expected direction favoring trained students, but differences fell short of significance.

It was only when the criterion of success was relaxed to include not only correctly read words but also misreadings that shared letters with the correct words that one of the trained groups, the mouth group, outperformed the control group.

Stronger effects of training on spelling than on reading revealed in the present study agree with earlier findings by Lundberg et al. (1988). Their longitudinal study of Danish preschool children showed that phonemic awareness training impacted spelling but not reading measures during the first year of training, and only revealed its effect on reading the following year.

Interestingly, the two literacy transfer measures revealing an advantage of phonemic segementation training were measures that focused on children's use of sounds, either in spelling words or in remembering how to read words. This is consistent with Ehri's notion of partial cues used by novice beginners to read and to spell words. According to Ehri (1996), when children begin learning about the alphabetic system and using it to read and spell, they process partial letter-sound cues in words. She calls this the partial alphabetic phase of word learning which is more advanced that the pre-alphabetic phase but less advanced than the full alphabetic phase. It appears that children in the present study were operating as partial alphabetic readers and spellers. Trained students spelled on average 55% of the sounds in words but they spelled very few of the words fully by representing all of their sounds.

Ehri and Wilce (1987a) found that children taught to create phonetic spellings of words also learned phonemic segmentation. Similarly, Tangel and Blachman (1992) showed that children who were given repeated opportunities to use invented spelling increased their phonemic awareness in the process. It is interesting to note that children in this study had not been exposed to invented spelling in their classrooms, and their phonemic awareness on the pretest was very limited. From Table 1 it is apparent that not only trained students but also control students improved dramatically from pretest to posttest. It is possible that the pretest spelling task combined with the pretest phonemic segmentation task provided some training in phonemic awareness for all three groups of children, since even the children in the control group improved their phonological awareness from pretest to posttest, although not as much as the children in the training conditions.

It is important to remember that children in the two training groups did not receive letter sound instruction as part of their segmentation instruction. However they had already learned to name most the target alphabet letters, so this knowledge was expected to be available. It has been suggested that making the connection between sounds and printed letters explicit helps invented spelling (Ball & Blachman, 1991; Ehri & Wilce, 1987a; Tangel & Blachman, 1992). Present findings indicate that children will make the connection even without having it spelled out for them.

<u>Ability to Read Sight Words</u>

Contrary to expectations, results of the present study uncovered few effects of phonemic awareness training on word reading skills. Although the means were in the expected direction, children in the two training groups did not significantly outperform children in the control group.

Although students selected to receive training were those who were able to name most target letters that represented phonemes in the literacy tasks, training did not include the manipulation of letters representing the phonemes being segmented. If it had, we might have observed stronger effects in reading. Hatcher et al. (1994) found that interventions to boost phonological skills needed to be integrated with the teaching of reading if they were to be maximally effective in improving literacy skills.

Another capability needed for reading that we did not teach was training in blending. It was evident from their errors in the word and nonword reading tasks that even though children could sound out letters, they could not blend them into whole words. Torgesen, Morgan, and Davis (1992) found that only children who received training on both analytic (segmentation) and synthetic (blending) phonological tasks showed positive transfer on a word learning task.

As noted previously, children who participated in this study received instruction for a limited period of time, for a few short sessions during a single week. It was therefore encouraging to find that the mean number of whole words read correctly was in the expected direction favoring the trained students. Even more encouraging was the fact that when the total number of words read was recalculated to include words preserving partial letter-sound relations, statistical significance was obtained.

Students used several strategies, either alone or in combination, to learn to read words. Several children named the printed letters; 18 students sounded out the printed letters (7 in the mouth condition, 5 in the ear condition and 5 in the no treatment condition) but were not able to blend them into words; a few were able to sound out and blend words successfully; some guessed, for example, by repeating the latest word on the list or by repeating the same word over and over until it matched the printed word; some students used meaning and read words in a logographic way (e.g., misreading snow as winter). Most student memorized two or more of the letters and used them as cues for remembering the words they read. The latter strategy is an example of phonetic cue reading discussed by Ehri (1994).

An analysis of the mistakes made by these students in the sight word reading task supplies additional evidence that most students, control group included, were in effect doing phonetic cue reading, although the children in the training conditions made more use of it than children in the control group. During phonetic cue reading, according to Ehri and Wilce (1985, 1987a, 1987b), beginning readers store in memory partial representations of letter-sound correspondences they notice in words. The phonemic sounds detected in the word serve as slots which are filled by the image of the graphemes seen in the word. At the very beginning, the reader might remember only the first sound and the first grapheme in the word; later, when s/he encounters the word a second time, the first and the last sounds and graphemes might be remembered. As an example, one child in this study commented "I remembered /p/ at the end" when she was reading sleep; and "I remembered /k/" when she was reading snake.

Two other interesting findings emerged in the analyses of mistakes made by the students during the sight word reading tasks. Fewer children in the mouth training condition read totally extraneous words than children in the other two conditions. Only two students in the mouth condition used this type of strategy to remember how to read words, with a total of 4 mistakes, compared to seven students in the ear condition with a total of 13 mistakes and seven students in the control condition with a total of 10 mistakes. It is possible that focusing on the correct position of tongue, teeth, and lips while producing individual, segmented sounds helped children in their reading task by giving them a more sophisticated strategy. In particular, one student trained during the pilot study made a smooth transition in the immediate posttest word learning task, when she started out by spelling each letter aloud for the first few words; continued by sounding each letter aloud in the following set of words and finally read correctly all the words presented. It is interesting to note that this child began as a nonreader as indicated by the fact that she did not read any word in either the preprimer, the Boder or the nonsense word lists in the pretest.

Two potentially influential variables which were not taken into consideration in the present study were the effect of vocabulary knowledge and the effect of memory on learning to read. It was obvious during the reading task that some children did not know the meanings of the words they were learning to read, and hence could not remember them, although every word was introduced by a defining sentence containing it. One student, confronted with the word float asked: "What is it when don't go down in the water?"

Also memory very likely influenced students' ability to learn to read sight words. Phonological analysis skills have been found to contribute to reading independently of verbal working memory ability (Bradley & Bryant 1985). Hansen and Bowey (1994) found that both phonological analysis and verbal working memory accounted for unique variation in three reading measures in second-grade children. The easiest word to remember how to read in the immediate posttest was <u>snow</u> which was read correctly by 39 students out of 45. The second easiest word was <u>snake</u> which was read correctly by 38 students. This seems to contradict other studies such as the one by Treiman (1985) who found that students recognized more easily a target like /s/ when it was the first consonant of a CVC syllable like /san/ than when it was the first consonant of a CCV syllable like /sna/. The word <u>safe</u> was read only by 23 students. The most difficult words were <u>speed</u> (read by only 18 children) and <u>sneeze</u> (read by 16 children). The easiest words in the delayed posttest were <u>float</u> and <u>feet</u> (read correctly by 26 and 25 students respectively). It should be noted however that the word <u>feet</u> had inadvertently been included also in the criterion task given at the end of training. The most difficult words were <u>flame</u> and <u>feast</u> read correctly by only nine students. A difference in the difficulty of words in the two sets might be one reason why students in all conditions performed better on the immediate posttest (S-words) than in the delayed posttest (F-words). Another reason might be that some forgetting of the skill taught might have taken place between immediate and delayed posttests.

Ability to Decode

Performance on the nonword reading task was very poor in both posttests. This is not surprising in view of the fact that students did not receive instruction in either letter-sound correspondence or blending. Several studies have concluded that phonological training alone is not as powerful a tool in teaching children to read as training which combines phonological and reading skills (Byrne & Fielding Barnsley, 1989; Hatcher, et al. 1994). Children in this study were taught to break words apart, but they were not taught to put them back together, although they were instructed to put blocks together on a frame while segmenting the words.

The strategy children used the most to try to read nonsense words was sounding out, although some children limited themselves to naming the component letters. Very few students correctly blended the sounds together. Some children produced the correct sounds associated with letters, but blended them incorrectly into words. Nuf was the nonsense word read correctly most often (10 students decoded it correctly: three in the mouth condition, three in the ear condition and four in the no treatment condition) perhaps because of its similarity to enough. Other nonsense words read correctly were tek and zil (decoded by seven students), whereas bav and mod were read by only four students. Another strategy observed was lexicalizing nonwords, that is, reading them as real words, for example reading bad for bav or ten for tek.

Study Limitations

The present study had its share of shortcomings. The number of participants was limited to 45 students. The 30 children randomly selected to receive mouth or ear training were seen for a very short period of time, and conditions were not always conducive to learning. In addition, three other shortcomings may have worked against the detection of stronger training effects. The first involved the need of keeping students' attention focused during training. This was a bigger problem in the ear training condition than in the mouth condition. The second involved the difficulty of teaching students to segment words containing consonant clusters. The third shortcoming involved weaker than expected transfer effects from segmentation training to posttest segmentation performance.

Although students did not exhibit attentional problems during the pretest and the two posttest sessions, several were restless and bored during the ear training sessions. Other researchers have increased motivation by rewarding children with tokens to be exchanged for small prizes (Wise et al., 1997). This technique had been tried during the pilot study, but it was not repeated because trained children showed the stickers they had received to children who did not participate in the study and soon all children in the lower grades were clamoring for stickers. In addition, only children in the ear training condition were bored and restless, not children who received mouth training. One way to enhance interest during training might be to vary the color of the blocks and the color or the design of the ear. For example, the ear could be drawn with different types of earrings, and children could be taught to pick different earrings for different sounds in words. Another way to increase their interest might be by turning the training session into a game. A bright student in the mouth condition called his training the "writing game" and was very eager to play it. The participating student would gain one point for each correctly segmented word and win a token for eight consecutive correct responses. The token would be exchanged for a prize only at the end of training, when all children in the classroom, even the ones who did not participate in the study, could be rewarded. Of course, present findings support an alternative solution. Because effects of ear and mouth training were similar, and because mouth training was inherently interesting to students, the alternative is to adopt mouth training procedures and drop attempts to fix the ear training approach.

Although children in both trained conditions outperformed children in the control group in segmenting and spelling words containing consonant clusters, their performance failed to reach expected levels. One solution is to devote less trainig time to VC/CV words, which most children mastered without much difficulty, and to spend more time teaching words containing consonant clusters. Children could also be taught to segment with letters attached to the blocks. This might facilitate their learning to detect consonant clusters. For this study however letters were not used because the researcher was interested in investigating the effect of phonemic awareness by itself and not in combination with letters.

As noted previously, children in both groups had cardboard frames in front of them during segmentation training. These frames reminded them about the number of sounds they had to segment. In contrast, during the two posttests, they had to segment words without being told how many segment to find and without using any markers. To improve performance on such a posttest, a transitional step could be added to the training in which children were taught to segment words without using a frame or blocks.

Summary and Implications

During the course of this study, two different training techniques were employed to enhance Kindergarten children phonemic awareness, one focusing attention on articulatory features, the other focusing attention on sounds. Results indicated that both techniques equally enhanced participants' phonemic awareness and facilitated students' ability to invent spellings of words to the same extent compared to an untreated control group.

These results can be interpreted in two different ways. The first interpretation is that articulatory gestures do not have special significance and do not enhance phonemic awareness more than traditional training based on sound listening techniques. The second interpretation is that articulatory gestures were acquired by both groups and accounted for their equivalent success on posttests. Although only the mouth group received explicit training in the selection of mouth pictures to distinguish the sequence of articulatory gestures, both groups were required to articulate the separate sounds in words during segmentation training. For example, both groups had to pronounce the separate sounds in bake, /b/ - /e/ - /k/, as they placed blocks in the frame. It may be that this response training provided students in the ear condition with the knowledge about articulatory gestures that they needed to perform as well as the mouth-trained group. It is true that students in the mouth condition had to make finer discriminations because they had to select and pick up different blocks for different sounds, whereas the students in the ear condition only had to pick the same nondescript ear block for all the sounds. On the other hand the response the ear students had to supply was the same as the mouth students. Having to produce the separate sounds in words may have provided the ear students with unintended training in articulatory gestures. Evidence to support this second interpretation was detected in the behavior of two children in the ear condition, one who exaggerated his mouth movements when he was asked to segment words and another who put her fingers around her mouth when she had to do the same. Both of these behaviors suggest that ear students did learn about articulatory gesture in words.

Present findings carry developmental implications. Both types of segmentation training significantly enhanced Kindergarten students' ability to segment CV/VC and CVC words. However, training was less effective in helping students segment consonant clusters in words, indicating that detection of the second sound in consonant clusters might have been beyond their developmental capabilities.

Neither type of segmentation training enhanced students decoding and reading skills. According to Ehri (1994) when beginners learn to read, they first rely on nonalphabetic visual cues, but as soon as they acquire some phonemic awareness and some knowledge of letter names or sounds, they shift to <u>phonetic cue</u> reading, which involves forming access routes between some of the letters seen in spelling and their sounds. The children who participated in this study appear to be just starting to cross the bridge from visual cue reading to phonetic cue reading. Trained students had very weak or non-existent decoding skills as demonstrated by their very poor performance in the nonword reading task administered during the immediate posttest. Some students utilized nonalphabetic semantic cues in learning to read sight words during the immediate and the delayed posttests. For example, three students misread <u>snake</u> as <u>apple</u>, possibly traceable to lessons about Adam and Eve. Several other students indicated use of partial alphabetic cues when they misread words on the basis of phonetic similarities, for example when they read <u>snake</u> for <u>safe</u>. They also used partial phonetic cues when they learned to read the words correctly. Two children in the mouth condition and seven children in the ear condition exhibited both visual and phonetic cue reading, indicating that phase boundaries may overlap.

Both types of segmentation training improved students' spelling skill. Only one student exhibited the earliest precommunicative stage (Ehri 1989) in which spellings do not bear any correspondence to sounds in words. When this child was asked to spell volcano he drew a very tiny mountain, complete with smoke. Most trained and non trained students exhibited spellings at the next stage, the semiphonetic stage, in which knowledge of letter names or sounds is utilized to spell words, for example, writing SDMBT for steamboat. Only few students were approaching the next stage, the phonetic stage, in which children produce spellings that contain letters for all of the sounds in words, for example, writing FLESC for fleesk.

A longer period of training might have yielded better results. On the other hand, children in the study might not have been developmentally ready to fully benefit from training. Since performance on segmentation and spelling of consonant clusters did not significantly improve, training at this stage of cognitive development might be more appropriate if limited to CV/VC and CVC words in both segmentation and spelling.

It is important to note that the two methods differed in their effects on students in two respects. One was that the group trained with mouth pictures exhibited some advantage in the word learning task over the group trained with ear pictures. More importantly, segmentation training with the mouth blocks was much more attractive to children than segmentation training with the ear blocks. Children were eager to use the blocks, they made comments about the pictures and they readily picked up the mirror without being encouraged to do so in order to check their own mouth movements during pronounciation. In contrast, children given training with unmarked blocks exhibited boredom with the task, and it was more difficult to maintain their attention and keep them on task. One of the most difficult parts of learning to read involves learning how to segment words into constituent phonemes, particularly among children at risk for reading disability. It is important to employ a training method that is highly motivating as well as effective in teaching segmentation skill to beginners. The articulatory training procedures employed here appear to be most suitable for this purpose. In contrast to other methods used in teaching phonemic awareness to beginner readers, the mouth block method is relatively simple to learn and teachers do not need any special training to adopt it in their classrooms. At a time when instruction in phonemic awareness is gaining favor in the classroom, it is particularly important to adopt methods of teaching that are interesting, exciting and pleasant for the very young students, as well as as efficient and affordable, and the mouth picture method certainly proved to be such a method.

Appendix A

Please sign and return this sheet to your child's teacher as soon as possible.

CONSENT TO PARTICIPATE IN THIS RESEARCH STUDY

Title of Study: How Beginners Learn to Read Words

Investigator: Maria Laura Castiglioni

Date________________________

I grant permission for my

child__________________________________

to participate in this research project. I have read the description of the study. I understand and am agreeable to all the terms and conditions.

____

(Signature of Parent)

____

(Birth date of Child)

Appendix A

To: Parent/Guardian of Elementary Student
From: Dr. Linnea C. Ehri, Professor of Educational Psychology
Maria Laura Castiglioni, Research Assistant
Re: Written Parental Permission to Participate in a Research Project on How Beginners Learn to Read Words.

I am Dr. Ehri's research assistant at the Graduate School, City University of New York and will be conducting a study on how students in kindergarten and first grade learn to read words and what types of instruction might strengthen their learning. I wish to obtain your written permission to include your child in my study.

The purpose of my project is to study how beginners can be taught to detect sound in words and relate them to letters. I will work with one child at a time during school hours in a quiet room. Each child will be seen four or five times on successive days. Each session will last about 25 minutes. During the first session, I will give students some tasks to determine how far along they are in learning to read and write. During the following two or three sessions, children will be taught to divide words into sounds. During the last session, I will give some reading tasks to see whether my teaching helped them do better in this task.

The tasks given to the students will be like those they perform in school as part of reading instruction. Students who participate in our study will benefit by learning to read some new words. We have found that students enjoy the individual attention they receive as they work with the assistant to complete the tasks.

In order for your child to participate in our study, written parental permission is required. If you are agreeable, please complete and sign the attached permission form and return it to your child's teacher as soon as possible.

You should know that any child who participates is free to withdraw from the study at any time for any reason without any 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, if you have no objection. No one else will have access to this information without your written consent. Results of the study will be reported to other researchers in an educational journal such as Reading Research Quarterly. The identity of all participants will remain anonymous.

If you would like to talk with me about the study or if you have any questions, feel free to call me at 212-642-2382. My office is in the Department of Educational Psychology at 33 West 42nd Street. If you have any questions concerning your child's rights as a participant in this study, you may call the Office of Sponsored Research, City University of New York at 212-642-2059. Thank you for considering this request.

Appendix B

Complete Instructions

<u>Testing schedule</u> (may require adjustment according to how long tasks take)

Day 1: Give pretests

Day 2: Training

Day 3: Continue training

Day 4: Give posttest - immediate

Day 5: One week later - delayed posttest

If children cannot complete tasks on this schedule within 30 minutes, stop and continue during the next session.

Note: any child is free to discontinue testing if s/he wishes. Be sensitive to anxiety, frustration, or boredom. Terminate a session early and continue the next day if necessary to keep a child in the study. If a child is discontinued, record on data sheet why. Be sure to record testing dates and beginning and ending times for each session on data sheets. Write START (time), STOP (time) at points where start and stop.

While waiting between subjects, go over data sheet tallying correct responses, listen to tape recording to verify recordings, clear up uncertainties.

Recording responses of participants

- Record check mark or other standard mark or circle item if correct response is given; make sure mark cannot be mistaken for V or other letter; be consistent in symbols used
- sc encircled for self-corrected response, after error
- nr encircled to indicate no response
- record specific responses that are errors
- record comments indicating strategies or problems (these sometimes prove helpful later on in explaining behavior)
- during word learning test trials, 1st response in reading each word must be correct to count as a perfect trial; this is because there is 1 in 5 chance of guessing correctly.
- use phonetic alphabet to symbolize responses.

Stockr responses

"We will stop here a minute" (Pauses between tasks, etc.)

"What do you think?" (If child asks about a correct answer)

"Thank you very much for trying hard. You are doing a good job"

(At end of session) "I will be back tomorrow to work with you again"

(If more sessions to come) "You did a great job the last time we worked together. Last time you were reading some words for me. We will continue doing that today"

(Beginning of session in which task is being resumed.)

Pretest

Introduction

"Hi. My name is Mrs. Spalten. What is your name? I am going to work with you today. I will ask you to do some reading and writing. I will show you some words to read. I will have you name letters for me. You may not be able to do some things because your teacher hasn't taught you yet. That is okay. Don't worry. Just try hard and do the best you can. Your teacher will be proud of you for doing your best. Will you work with me? (Elicit child's consent.) Good."

1. Name Writing

I need to put your name on this sheet. Would you write if for me on this line? (Point to line on sheet.) Thank you.

(You write name on paper if child can't do it or if name is illegible or incomplete. Do it non-obviously. Note which is child's writing, which is your writing.)

1b. Name Letters.

Now I will show you some letters. They are all mixed up. I want you to point to each letter and tell me its name. If you don't know its name, tell me its sound. Do the best you can. Guess if you aren't sure.

(Show sheet, point to first letter.) Start with this letter and name it. Go across the row and point to each letter as you name it. Then go across the next row. (Point as you say this.) "You can use this card to hold your place."

(Give child 5 sec.to respond. Record response on data sheet,

- If child gives name, circle letter.
- If chid gives sound, write letter between /__/ also circle if correct.

- Record letter given if incorrect.

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

(Drop child if names fewer than 13 out of 17 target letters.)

2. Yopp Segmentation Task (modified)

"Now we are going to play a word game. I'm going to say a word, and I want you to break the word apart. You are going to tell me each sound in the word in order. For example, if I say OLD, you will say o-l-d. Let's try a few words together."

* RIDE, r/i/d.* Now you say r-i-d. (C R)

(If response is correct) That's right

(If response is wrong) That was a good try. Now listen again. Repeat from * to *

GO, g/o. Now you say g/o (C R)

MAN, m/a/n. Now you say m/a/n (C R)

Proper test

"Now I say another word and you will break it apart: DOG (C R)

(If correct) That's right.

(If wrong) Listen: DOG, d/o/g/. Now you do it. DOG (C R)

Follow with other words. Score as correct only words child responds to accurately on his/her own. Scores have a range from 0 to 8 correct words, 21 component sounds.

Word list

Aid, tame, knee, bowl, leave, seed, toe, dope.

3. Reading Nonsense Words

"Now I am going to show you some words that you have never heard or read before. I have made them up. They don't have any meanings but you can say them. Let me show you. Here is a silly word." (Present card and point to letters.) "It has a sound but doesn't mean anything. I will look at the letters and say their sounds. I will put the sounds together to say the word. These letters say zowd (rhymes with cloud). Now you read the silly words I show you. 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. 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).

(Say at end:) You did a good job. Thank you for trying hard.

Drop criteria: If child reads more than 1 nonword correctly)

<u>Word list</u>

Tek, nuf, bav, mod, zil.

<u>4.Preprimer Words Mixed with Pictures; Target Words</u>

"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 he can't read at all, say:) "Some children think they can't read but sometimes they can. You 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 about 5 sec. to respond.)

(If no R after 5 sec. say) "Try the next one."

(Record response on data sheet.)

(Give Preprimer Words to all)

Stop word reading task if child can't read any of first 11 words. Give Boder words only to children who read 4 or more preprimer words.

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

5. Boder Word Reading

Use separate data sheet.

"Now I am going to have you read some more words on cards. Do the best you can. If you can't read a word, that's okay. Some are hard. You can guess or tell me you don't know.

The words are listed down the page. Here is a card to slide under each word as you read it. This will help you keep your place. Be sure to read each word correctly, and say it quickly as soon as you know it."

Routine

(Present list.) "Begin at the top" (Record Rs)

(Give child about 5 sec. to respond to each word.)

(If no R after 5 sec., say:) "Try the next one."

Stop the task at end of list if child reads fewer than 11 words correctly flash or untimed on that list.

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

Drop if child reads >10 words at primer level on Boder.

6. Invented Spelling Task

(Equipment: lined paper, pencil)

"Have you ever tried to write words using letters? I would like you to use letters to write some words for me. If you know how the words are spelled in books, write those letters. If you don't, listen to the sounds and then write the sounds you hear."

Routine

1. The first word is______. (Give sentence.)

2. You say________ and write the sounds you hear.

3. Watch me do it. (Model first word only.)

(Drop children who spell phonetically)

Spelling words list (same for pretest, immediate and delayed posttests)

1.	(model) COAST	We leave on the East Coast
2.	BLAMED	The man was blamed
3.	SLEEVES	Roll up your sleeves
4.	PLAYMATE	The children are playmates
5.	STEAMBOAT	The steamboat floats
6.	FLEESK	Fleesk is a funny word
7.	SPOAFT	Spoaft is another funny word.

(If letters are not clear) "I am having trouble reading this letter. Can you name it for me?"

7. PPVT

"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 for trying hard."

PHONEMIC SEGMENTATION TRAINING

I. (A) Correspondence training - with mouth pictures

(Equipment: 32 pictures of the mouth, on 3 x 3in. square blocks:

four #1 for letters p b m

four #2 for letters t d n L

four #3 for letters k g

four #4 for letters f v

four #5 for letters s z

four #6 for letter e

four #7 for letter a

four #8 for letter o

1 hand mirror).

"Today I would like to play a game of sounds with you. Do you know how sounds are made when you speak? (C R) Put you hand in front of your mouth and tell me your name (C R). The air coming out of your mouth when you said your name is what makes word-sounds. Air is pushed out through your mouth or nose. Different sounds are made by using different parts of your mouth in different ways. I have a picture of the inside of your mouth. Do you want to look at it? (C R) Here it is. When you breath you take air in; when you speak you push the air out and make sounds, as 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 all are made pushing air through mouth, tongue, lips, teeth, roof of the mouth and throat. Show me where your tongue is in the picture (C R)." (Point to body after picture)

"Good. Now show me your lips, teeth, the roof of your mouth, your throat. Very good."

FORMAT: <u>Study Trial</u> SET 1 (sounds /p/ /t/ /f/ /a/)

"Now I am going to say some sounds and show you pictures of your mouth making those sounds. Your job will be to remember which picture goes with each sound.

- This picture shows your mouth saying /p/

/p/. Now you say /p/ over and over and look in the mirror to see your mouth when you say it. Your lips are closed together and then you push the air through. Put your hand in front of your mouth and feel the air coming out (C R)

- This picture shows your mouth saying /t/

/t/. Now you say /t/ over and over and look in the mirror to see your mouth when you say it. The tip of your tongue lifts up and touches the roof of your mouth. Open your mouth and see your tongue hit the roof of your mouth (C R)

- This picture shows your mouth saying /f/

/f/. Now you say /f/ over and over and look in the mirror to see your mouth when you say it. You see that your upper teeth touch your lower lip. Put your hand in front of your mouth and feel the air coming out (C R)

- This picture shows your mouth saying /a/.

/a/. Now you say /a/ over and over and look in the mirror to see your mouth when you say it. Your mouth is open and you can see your tongue (C R)

FORMAT: Test Trial SET 1

Now I will say each sound and you point to its picture. If you aren't sure you can look at your mouth in the mirror.

- Show me the picture of /t/

- (If correct) That's right
- (if wrong, repeat study format)
- Show me the picture of /a/
- (If correct) That's right
- (if wrong, repeat study format)
- Show me the picture of /f/
- (If correct) That's right
- (if wrong, repeat study format)
- Show me the picture of /p/
- (If correct) That's right
- (if wrong, repeat study format.)

Repeat different orders to a criterion of 2 correct in a row.

FORMAT: <u>Study Trial</u> SET 2 (sounds /b/ /d/ /v/ /e/)

Now I am going to say other sounds and show you pictures of your mouth making those sounds. Your job will be to remember which picture goes with each sound.

- This picture shows your mouth saying /b/

/b/. Now you say /b/ over and over and look in the mirror to see your mouth when you say it. Your lips are closed together and then you push the air through. Put your hand in front of your mouth and feel the air coming out (C R)

- This picture shows your mouth saying /d/

/d/. Now you say /d/ over and over and look in the mirror to see your mouth when you say it. The tip of your tongue lifts up and touches the roof of your mouth. Open your mouth and see your tongue hit the roof of your mouth (C R)

- This picture shows your mouth saying /v/

/v/. Now you say /v/ over and over and look in the mirror to see your mouth when you say it. You see that your upper teeth touch your lower lip. Put your hand in front of your mouth and feel the air coming out (C R)

- This picture shows your mouth saying /e/

/e/. Now you say /e/ over and over and look in the mirror to see your mouth when you say it. You see that your lips are smiling wide (C R)

FORMAT: <u>Test Trial</u> SET 2

Now I will say each sound and you point to its picture. If you aren't sure you can look at your mouth in the mirror.

- Show me the picture of /b/

- (If correct) That's right

- (if wrong, repeat study format)

- Show me the picture of /v/

- (If correct) That's right

- (if wrong, repeat study format)

- Show me the picture of /e/

- (If correct) That's right

- (if wrong, repeat study format)

- Show me the picture of /d/

- (If correct) That's right

- (if wrong, repeat study format.)

Repeat different orders to a criterion of 2 correct in a row.

FORMAT: Study Trial SET 3 (sounds /m/ /L/ /k/ /s/)

Now I am going to say other sounds and show you pictures of your mouth making those sounds. Your job will be to remember which picture goes with each sound.

- This picture shows your mouth saying /m/

/m/. Now you say /m/ over and over and look in the mirror to see your mouth when you say it. Your lips are closed together (C R)

- This picture shows your mouth saying /L/

/L/. Now you say /L/ over and over and look in the mirror to see your mouth when you say it. The tip of your tongue lifts up and touches the roof of your mouth. Open your mouth and see your tongue hit the roof of your mouth (C R)

- This picture shows your mouth saying /k/

/k/. Now you say /k/ over and over and look in the mirror to see your mouth when you say it. This sound is harder to see but you can feel it in the back of your mouth. The back of your tongue hits your throat and makes a scraping noise. Open your mouth so you can see your tongue pulling back and hitting your throat (C R)

- This picture shows your mouth saying /s/

/s/. Now you say /s/ over and over and look in the mirror to see your mouth when you say it. 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 coming out (C R)

FORMAT: <u>Test Trial</u> SET 3

Now I will say each sound and you point to its picture. If you aren't sure you can look at your mouth in the mirror.

- Show me the picture of /L/
- (If correct) That's right
- (if wrong, repeat study format)
- Show me the picture of /k/
- (If correct) That's right
- (if wrong, repeat study format)
- Show me the picture of /s/
- (If correct) That's right
- (if wrong, repeat study format)
- Show me the picture of /m/
- (If correct) That's right
- (if wrong, repeat study format.)

Repeat different orders to a criterion of 2 correct in a row.

Format - <u>Study Trial</u> SET 4 (sounds /z/ /n/ /g/ /o/)

Now I am going to say other sounds and show you pictures of your mouth making those sounds. Your job will be to remember which picture goes with each sound.

- This picture shows your mouth saying /z/

/z/. Now you say /z/ over and over and look in the mirror to see your mouth when you say it. 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 coming out (C R)

- This picture shows your mouth saying /n/

/n/. Now you say /n/ over and over and look in the mirror to see your mouth when you say it. The tip of your tongue lifts up and touches the roof of your mouth. Open your mouth and see your tongue hit the roof of your mouth (C R)

- This picture shows your mouth saying /g/

/g/. Now you say /g/ over and over and look in the mirror to see your mouth when you say it. This sound is harder to see but you can feel it in the back of your mouth. The back of your tongue hits your throat and makes a scraping noise. Open your mouth so you can see your tongue pulling back and hitting your throat (C R) - This picture shows your mouth saying /o/

/o/. Now you say /o/ over and over and look in the mirror to see your mouth when you say it. You round your lips to make a circle (C R)

FORMAT: <u>Test Trial</u> SET 4

"Now I will say each sound and you point to its picture. If you aren't sure you can look at your mouth in the mirror.

- Show me the picture of /o/
- (If correct) That's right
- (if wrong, repeat study format)
- Show me the picture of /z/
- (If correct) That's right
- (if wrong, repeat study format)
- Show me the picture of /g/
- (If correct) That's right
- (if wrong, repeat study format)
- Show me the picture of /n/
- (If correct) That's right
- (if wrong, repeat study format.)

Repeat different orders to a criterion of 2 correct in a row.

End: You learned those sounds and pictures very well. I am proud of you for trying so hard.

ROUTINE - Study trial with mouth pictures

"Now I am going to say some sounds and show you pictures of your mouth making those sounds. Your job will be to remember which picture goes with each sound. This picture shows your mouth saying / /

Now you say / / over and over and look in the mirror to see your mouth when you say it"*

*for p b m Your lips are closed together and then you push the air through.

*for t d l n The tip of your tongue lifts up and touches the roof of your mouth.

*for f v You see that your upper teeth touch your lower lip.

*for k g This sound is harder to see but you can feel it in the back of your mouth. The back of your tongue hits your throat and makes a scraping noise. Open your mouth so you can see your tongue pulling back and hitting your throat.

*for s z You hold your teeth together and push air through to make a hissing sound.

*for <u>a</u> Your mouth is open and you can see your tongue.

*for <u>e</u> You see that your lips are smiling wide.

*for <u>o</u> You round your lips to make a circle.

<u>Routine</u> - Test trial with mouth pictures

"Now I will say each sound and you point to its picture. If you aren't sure you can look at your mouth in the mirror.

- Show me the picture of / /

- (If correct) That's right

- (If wrong, repeat study format)

II (A) <u>Segmentation training - with mouth pictures</u>

(Equipment: mouth pictures on blocks displayed in a row; frames with number of blocks to be found, 2, 3, or 4 on mirrored board; set of pictures)

Now we will play a game with pictures on cards. We will name the picture on the card. Then we will figure out what our mouth does to say that name. Let me show you.

Here is ABE. (Show card) Hid name has 2 sounds so I need to find 2 pictures (set out frame, point to two boxes)

I say "ABE" and look in the mirror to see what my mouth does to say those sounds. (Say "ABE", look in mirror).

The first sound in "ABE" is /a/. Here is the picture of /a/ (place in 2-block frame on left)

The next sound in "ABE" is /b/. Here is the picture of /b/. (Place next in frame.)

That's how to play the game. You will say the words and find pictures of the sounds. (Put blocks back in display row.)

Okay, now you say "ABE" and figure out what your mouth does to say that word, just like I did. (Guide child in doing this, provide corrective feedback, have him/her look in mirror, describe sounds, make sure the child can see him/herself in mirror.)

Now you will do some more words.

FORMAT:

1. (Present card) This is a ________. You say it (C R)

2. (Display frame) Find the mouth pictures in "________" and put them here. Say the sounds for each picture. (Record response)

3. (Feedback)

(If sounds spoken and pictures correct) That is right.

(If wrong) That was a good try.

(Leave child's mouth picture on frame) Point to the blocks and let me see that they say____.

- Let me show you how to find all the sounds. "The first sound in ____ is /__/ Here is the picture of /__/ (Place picture block over child's block, so that s/he can notice the difference). "The next sound in ______ is /__/. Here is a picture of /__/" (Place next over child's block). Continue for all sounds in word.

- Now you do it just like I did.

(At the end of the session say:) "Thank you for working so hard. We will play again tomorrow".

(When resuming a session) "Do you remember the game we were playing yesterday? I said a word, then you said it and you picked up all the pictures of your mouth saying the sounds in the word. Let me see if you remember which picture goes with which sound. I say a sound and you point to the picture. I say___ You say it. Point to the figure. That's right. (If wrong) "That was a good try. This is the picture for____. Ok, now we will play the word game again.

General instructions

1. Begin with 2-sound words. Continue until child segments 8 correct in a row. Recycle through words if necessary.

2. When criterion reached, shift to 3-sound words. Continue until child segments 8 correct in a row.

3. When criterion reached, shift to 4-sound words. Continue until child segments 8 correct in a row.

III. Criterion test at end of training

"Now I am going to show you some new pictures. Each picture goes with a word. I will tell you about the picture and point when I say the word naming the picture. Then you say the word that names the picture."

Routine to learn names of pictures

- (Present picture)

- (Say sentence, stress target word and point to picture when you say word)

- "Now you say the word when I point to the picture."
- (Repeat sentence, but when you come to target word, don't say it, just point to picture and have child say word; then you complete rest of sentence.)

"The fingers_______(CR) the eyes"

"The_____(CR) is wagging"

"The_____(CR) have no shoes"

"The mountain is ____(CR)"

"Chocolate has a good ____(CR)"

"The_____(CR) is flying".

(Repeat routine until child can say names of all pictures.)

Okay, now I will show you each picture. You say its name. Then use these blocks to show me all the sounds in the name.

ROUTINE

1. (Present picture)

"Name the picture" (Experimenter should not say the name in isolation.)

Prompts: "What did the fingers do?" (CR)

"Good. Set out the blocks and say each sound for me"

What is wagging?

What have no shoes?

The mountain is too what?

The what is flying?

<u>Word list and sentences</u>

Poke	The fingers poke the eyes
Tail	The tail is wagging
Feet	The feet have no shoes
Steep	The mountain is too steep
Taste	Chocolate has a good taste
Plane	The plane is flying.

If unable to segment all items, return to training. Repeat once.

I (B) <u>Correspondence training - with ear pictures</u>

(Equipment: blocks with ear pictures pasted on them.)

"Today I would like to play a game of sounds with you. Do you know how sounds are heard? Put your hand in front of your mouth and say your name. Did you feel air coming out? (C R) Let me show a picture of the inside of your ear. The 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. What do you think a dog sounds like? (C R) Yes, that's right. What do you think a snake sounds like? (C R) Yes, that's right."

If child cannot make the sound, model it for him/her.

"Now I would like to play a game of sounds with you. I say /p//p/. * I can hear the same sound twice: /p/,/p/. I pick up one ear block, and I bounce it twice, once for each sound I hear (stand blocks on thin end). The blocks have ears drawn on them to show that these are the sounds you hear. Now you do it. Say /p/p/ and pick up the block and bounce it once for every sound you hear * (C R).

(If correct) That is right.

(If wrong) This was a good try.

- Let me show you how (repeat from * to *).

Repeat to a criterion of 2 correct in a row.

"I say /p//t/. * You can hear two different sounds:

/p/,/t/. I pick up two ear blocks. One for /p/, one for /t/. Now you do it. Say /p/t/ and pick up a different block for every different sound you hear * (C R).

(If correct) "That is right."

(If wrong) "This was a good try. Let me show you how" (repeat from * to *).

Repeat to a criterion of 2 correct in a row.

"I say /p//t///f/. * You can hear three sounds: /p/,/t/,/f/. I pick up three ear blocks. One for /p/, one for /t/ and one for /f/. Now you do it. Say /p//t//f/ and pick up one different block for every different sound you hear * (C R).

(If correct) "That is right."

(If wrong) "This was a good try. Let me show you how." (repeat from * to *).

Repeat to a criterion of 2 correct in a row.

<u>At the end</u> "You learned to hear sounds very well. I am proud of you for trying so hard. Now I would like to play a word game with you."

II (B) <u>Segmentation training - with ear pictures</u>

(Equipment: blocks with ear drawn on each, displayed in row; frames with number of blocks to be found - 2, 3, or 4; set of pictures.)

"Now we will play a game with pictures on cards. We will name the picture on the card. Then we will figure out what sounds we hear in that name. Let me show you. Here is a picture of ABE. (Show card). There are two boxes to fill (set out frame, point to two boxes) so I need to listen for 2 sounds in the word. As I say "ABE" I listen for changes in the sounds. Then I say each sound and set out a block for that sound. Watch.

"ABE", /a/,/b/ ("I pull out a block as I say each sound, placing in frame from left to right").

"That's how to play the game. We name the picture, then you say each sound in the name and pull out a block for that sound. (Put blocks back in display row). Okay, now you say "ABE" and then tell me the sounds and pull out a block for each sound, just like I did." (C R)

(Guide child, provide corrective feedback. Do not talk about mouth movements; refer only to sounds you HEAR in the words).

Now we will do some more words.

FORMAT:

1. (Present card) This is a ________. You say it.

2. (Display frame) Find the sounds in "_______' and put a block for each sound here. Say the sounds for each block. (Record response)

3. (Feedback)

(If correct number of blocks and sounds for each) "That is right."

(If wrong) "That was a good try. Let me show you how to find all the sounds. I say "______" and listen for changes in the sounds. Watch me."

- (Say word. Say each sound, pull out block as you say it)

- (Put pictures back in display row)

- Now you do it just like I did."

General instructions:

1. Begin with 2-sound words. Continue until child segments 8

correct in a row. Recycle through words if necessary.

2. When criterion reached, shift to 3-sound words. Continue until child segments 8 correct in a row.

3. When criterion reached, shift to 4-sound words. Continue until child segments 8 correct in a row.

When resuming a session briefly refresh child's memory on how to play the game.

Posttest - immediate

1. Yopp phonemic segmentation task

"Now we are going to play a word game we played before. I'm going to say a word, and I want you to break the word apart. You are going to tell me each sound in the word in order. For example, if I say OLD, you will say o-l-d.(If response is correct) That's right (If response is wrong) That was a good try. Now listen again.

Proper test

"Now I say another word and you will break it apart: DOG (C R)

(If correct) "That's right."

(If wrong) "Listen: DOG, d/o/g/. Now you do it. DOG (C R) Follow with other 15 words. Score as correct only words child responds to accurately on his/her own. Scores have a range from 0 to 15 correct, 0 to 43 individual sounds.

Word list

Aid tame knee bowl leave seed toe dope fate bean nose flay eeks old steak.

2. Reading Nonsense Words

"Now I am going to show you some silly words. They don't have any meanings but you can say them. Let me show you. Here is a silly word. These letters say "ZOWD". Now you read the silly words I show you. Do the best you can. If you can't read a words, 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 7 sec. to respond.

- (Record responses on data sheet. 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).

(Say at end:) You did a good job. Thank you for trying hard.

3. Invented Spelling Task

"Now I will say some words. I would like you to listen to the sounds you hear in the words and write letters for those sounds. Do the best you can.

FORMAT:

- (Give each word in a sentence)
- The word to write is _______. You say it.
- Watch me do it. (Model first word only).
- Write it here. Write all the sounds you hear.

END: You did very well. Thank you for trying hard.

Spelling words

1.	(model) COAST	We leave on the East Coast
2.	BLAMED	The man was blamed
3.	SLEEVES	Roll up your sleeves
4.	PLAYMATE	The children are playmates

5. STEAMBOAT The steamboat floats

6. FLEESK Fleesk is a funny word

7. SPOAFT Spoaft is another funny word.

(If child does not remember a letter, show it on page one of red book.)

(If letters are not clear:) "I am having trouble reading this letter. Can you name if for me?"

3. Sight Word Learning

"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."

FORMAT: Study Trial

1. (Give sentence. Show word on card.)

2. This word says ______. You say it.

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."

FORMAT: Subsequent Test Trials

1. (Present word. If no response after 5 sec.) "Try to read

it." (Record R)

2. (If correct). "That is right."

(If incorrect) "This word says ______. You say it."

(Give child 5 test trials to read words or terminate after a criterion of 2 perfect trials.)

End: You did very well remembering how to read those words. Thank you for trying so hard.

<u>Word list</u>

SAFe	Your money is safe in the bank.
SPEED	Cars should not speed.
SNOw	Snow covers the ground.
SLEEP	You sleep in a bed.
SMOKe	The fire made lots of smoke.
SNAKe	A snake is a long, skinny animal.
SNEEZe	Cover your mouth when you sneeze.
SKATe	Can you ice skate?

<u>Posttest - delayed</u>

1. <u>Sight Word Reading</u> (one trial only)

"Now I will show you the words you learned to read last week.

Look at each one and remember how I told you to read them."

FORMAT ONE TRIAL ONLY

1. (Present word. If no response after 5sec.) "Try to read it." (Record R)

2. (If correct) "That is right."

(If incorrect) "This word says ______. You say it."

Word list (sentence as above)

SNEEZe SAFe SLEEP SNOw SKATe SMOKe SNAKe SPEED

2. Yopp phonemic segmentation task

"Now we are going to play a word game we played before. I'm going to say a word, and I want you to break the word apart. You are going to tell me each sound in the word in order. For example, if I say OLD, you will say o-l-d."

Proper test

"Now I say another word and you will break it apart: DOG (C R)

(If correct) "That's right."

(If wrong) "Listen: DOG, d/o/g/. Now you do it. DOG" (C R)

Follow with other 14 words. Score as correct only words child responds to accurately on his/her own. Scores have a range from 0 to 14 correct words, 0 to 40 individual sounds.

Word list

Aid tame knee bowl leave seed toe made beef goat sleigh glee oats fleet.

3. Invented Spelling Task

"Now I will say some words. I would like you to listen to the sounds you hear in the words and write letters for those sounds. Do the best you can."

FORMAT:

- (Give each word in a sentence)
- The word to write is _______. You say it.
- Watch me do it. (Model first word only).
- Write it here. Write all the sounds you hear.

End: "You did very well. Thank you for trying hard."

Word list

1.	(model) COAST	We leave on the East Coast
2.	BLAMED	The man was blamed
3.	SLEEVES	Roll up your sleeves

4. PLAYMATE The children are playmates

5. STEAMBOAT The steamboat floats

6. FLEESK Fleesk is a funny word

7. SPOAFT Spoaft is another funny word.

(If child does not remember a letter, show it on page one of red book.) (If letters are not clear:) "I am having trouble reading this letter. Can you name it for me?"

4. Sight Word Learning

"Now I am going to teach you how to read some NEW words. I will give you practice so you can get better at it. First I will tell you how to read words."

FORMAT: Study Trial

1. (Give sentence. Show word on card).

2. This word says ______. You say it.

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."

FORMAT: Subsequent Test Trials

1. (Present word. If no response after 5sec.) "Try to read

it." (Record R)

2. (If correct) "That is right."

(If incorrect) "This word says ______. You say it."

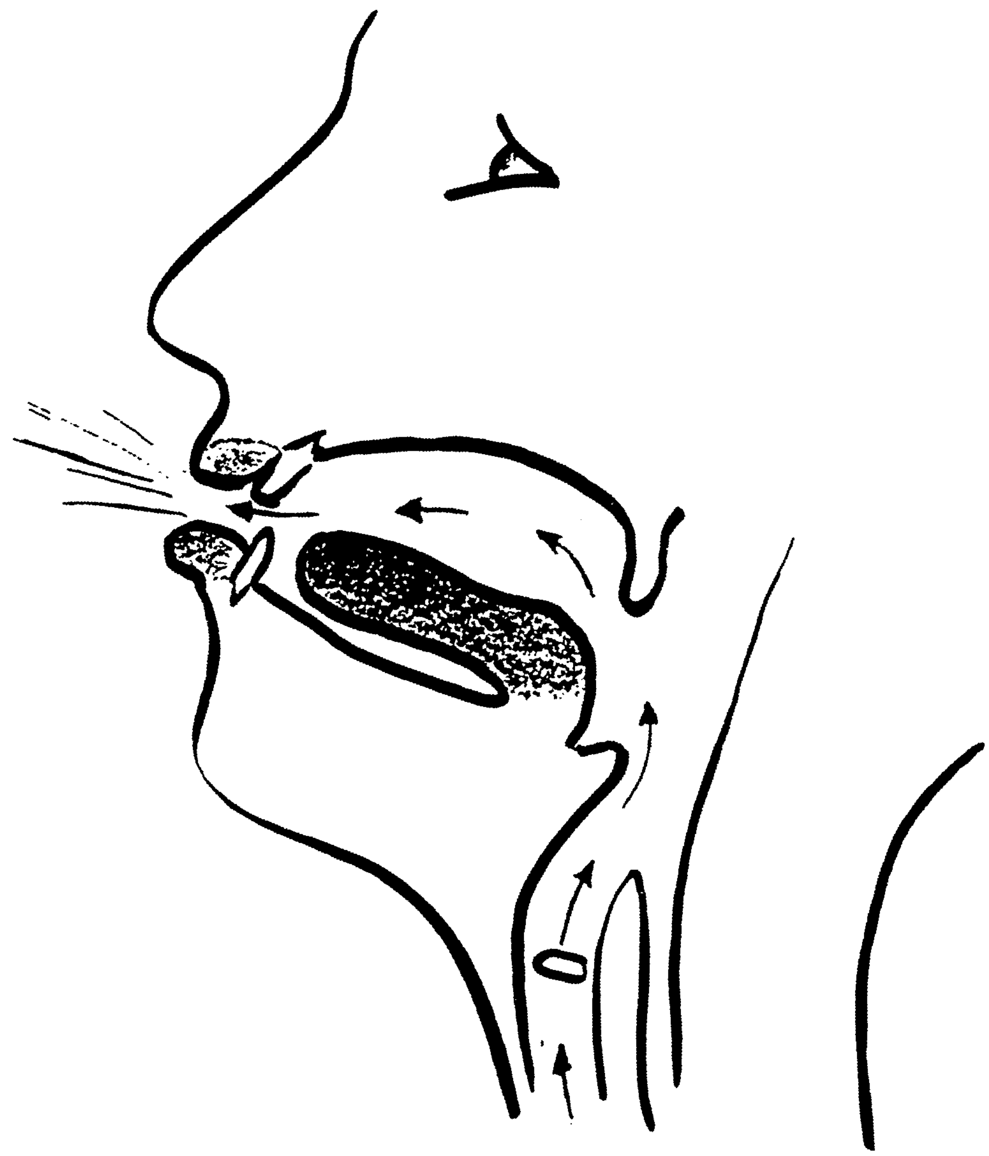
(Give child 5 test trials to read words or terminate after a criterion of 2 perfect trials.) End: "You did very well remembering how to read those words. Thank you for trying so hard."

Word list

FEET	You put socks on your feet.
FLAMe	A match has a flame.
FLOAT	Boats float on the water.
FEAST	There is food at a feast.
FOLD	Fold the paper in half.
FEEL	Feel the kitty's fur.
FAKe	The money was fake.
FLAKe	A flake of snow fell.

Appendix C

Drawing of the Mouth Cavity



Appendix D

List of Segmentation Training Words: 2 Sounds

ABE, GO, APE, EIGHT, SEA, OAL, AIM, ACHE, MAY, DEE, PO, EAT, BOW, VEE, DOE, OAF, EEN, NO, ZEE, EVE, KEY, SO, OAZ, FAY, EEL, OAT.

3 Sounds CVC

BAKE, VOTE, LOAF, BEAK, POSE, BEES, VASE, PEAK, SOAK, TEASE, FAME, PHONE, CAPE, LEAF, SAVE, GAZE, SEEK, MAIL, BOAT, MEAN, PEEK, CAVE, DAYS, FEED, SOAP, NEESE, SAIL, COMB, FOAM, NOAB, DEET, TOAD.

3 Sounds CCV, VCC

STAY, FLEE, SLOW, SNEE, CLAY, SKI, SPOA, OAFT, SMOA, FLAY, GLOW, OASK, FLEA, BLOW, FLO, AIN'T, EAST.

4 Sounds CCVC

PLACE, CLEAN, BLEED, CLOSE, SPOAF, BEAST, GLOBE, STOVE, DOANT, BLAZE, STEAL, TOAST, PASTE, SCALE, TEAMS, PAINT, PLEASE, PLATE, SPEAK, BLADE.

SEGMENTATION CRITERION TEST

POKE, TAIL, FEET, STEEP, TASTE, PLANE.

Appendix E

Drawing of the Ear

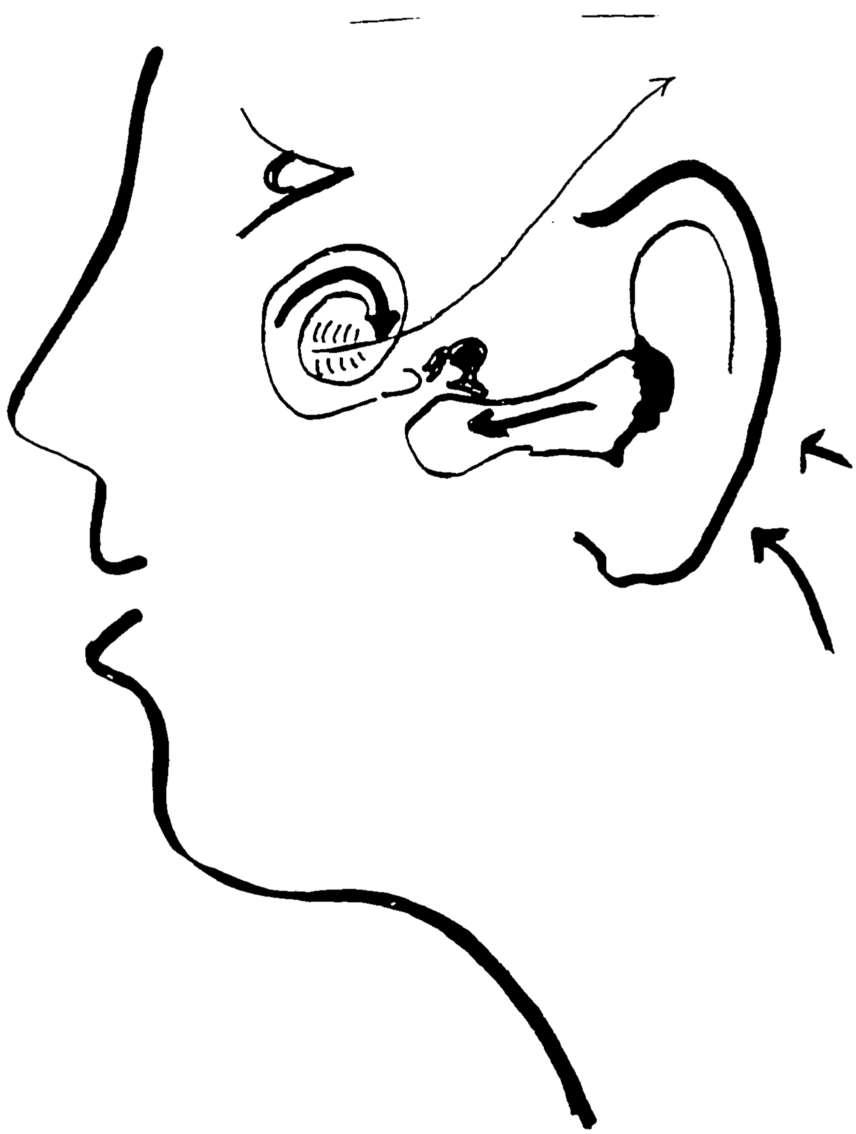


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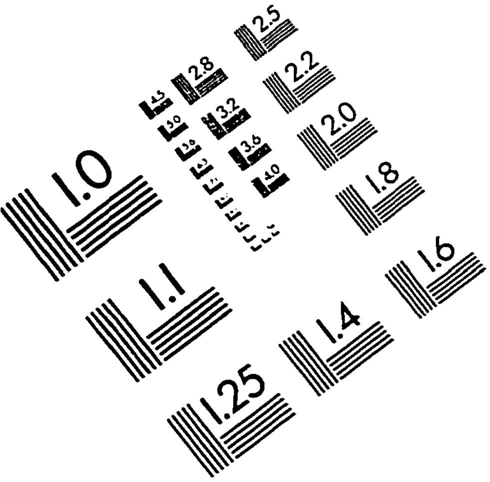
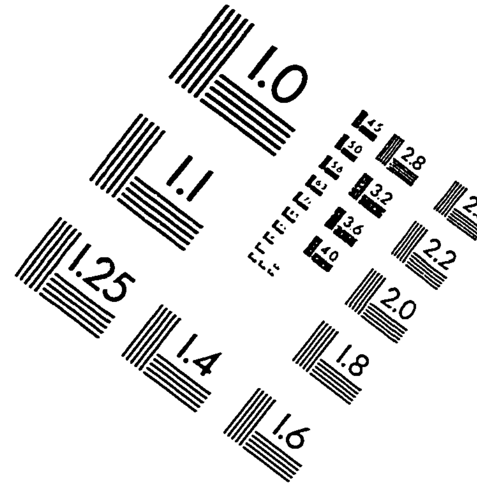
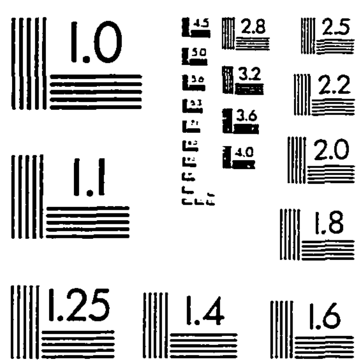
IMAGE EVALUATION TEST TARGET (QA-3)







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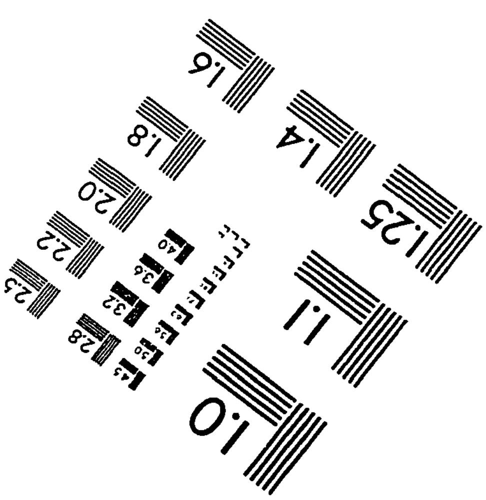

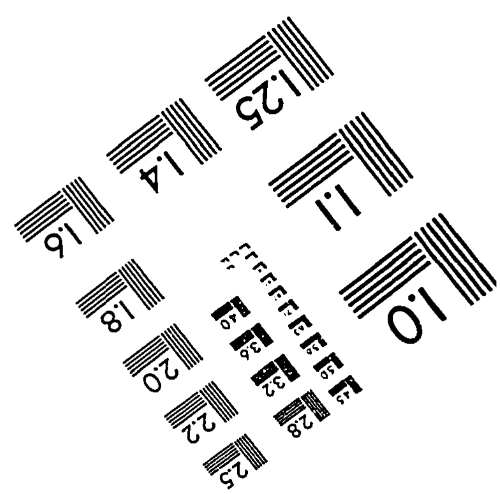

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