Chapter 6

The Role of Phonemic Awareness in Learning to Read

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When educators discuss the contents of effective programs to teach beginning reading, phonemic awareness (abbreviated PA) receives substantial attention, and for good reason. Research has shown that PA is one of the leading school-entry predictors of how well children will learn to read in kindergarten and first grade (Share, Jorm, Maclean, & Matthews, 1984), and researchers conducting controlled experiments have shown that teaching PA significantly improves beginners' success in learning to read (Bus & van IJzendoorn, 1999; Ehri, Nunes, Willows, Schuster, Yaghoub-Zadeh, & Shanahan, 2001; National Reading Panel, 2000). The purpose of this chapter is to help teachers understand what PA teaching involves and what the evidence shows.

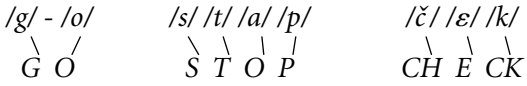
What Is Phonemic Awareness?

Phonemic awareness is a term that is often misunderstood. Some teachers believe PA is the same as letter-sound knowledge or phonics instruction. Although these concepts are related, they are not the same. Phonemes are the smallest units that make up spoken language. English consists of approximately 41 to 44 phonemes, depending on the dialect. Phonemes combine to form words. A few words have only one phoneme, such as *a* or *oh*. Most words consist of a blend of phonemes, such as *go* with two phonemes, *stop* with four phonemes, or *check* with three phonemes. Throughout this chapter, individual phonemes are represented with International Phonetic Alphabet (IPA) symbols. The Appendix on page 139 includes a complete list of phonemes in Standard American English and their IPA symbols.

Phonemes are different from the letters that are used as written units symbolizing phonemes in the spellings of words (Venezky, 1970, 1999). Letters that perform this function are called graphemes. Graphemes may

consist of one letter, for example, *P*, *T*, *K*, *A*, *N*, or multiple letters, such as *CH*, *SH*, *TH*, *-CK*, *EA*, *-IGH*, each symbolizing one phoneme.

Graphemes and phonemes combine to form words. In the examples that follow, the top row shows pronunciations divided into phonemes, with each represented by its IPA symbol between slashes. The bottom row shows spellings with capital letters depicting graphemes. Spaces separate adjacent graphemes and phonemes. Lines depict the connections linking graphemes to phonemes:



If you find it difficult to distinguish the separate phonemes in words, this is because there are no boundaries in speech marking where one phoneme ends and the next begins. Rather, phonemes are folded into each other and coarticulated to produce seamless speech.

One helpful way to identify separate phonemes is to monitor the changes that occur in your mouth as you pronounce words. For example, there are three phonemes in *pot* and these are reflected in three successive gestures: your lips closing for */p/*, your lips opening for the vowel, and then your tongue tapping the roof of your mouth for */t/*. Acoustic cues that you hear also are useful for distinguishing some phonemes in words, such as the hissing of */s/* or the buzzing of */z/*.

Another reason people may have difficulty discerning the phonemes in words is that phonemes often do not correspond to the number of letters in a word's spelling. When asked to count phonemes in words, people sometimes count letters, probably because these are easier to distinguish as separate units (Tunmer & Nesdale, 1982).

Phonemic awareness refers to the ability to focus on and manipulate phonemes in spoken words. Various tasks have been used to examine people's ability to do this:

1. Phoneme isolation, which requires recognizing individual sounds in words, for example, "Tell me the first sound in *paste*." (*/p/*)
2. Phoneme identity, which requires recognizing the common sound in different words, for example, "Tell me the sound that is the same in *bike*, *boy*, and *bell*." (*/b/*)
3. Phoneme categorization, which requires recognizing the word with the odd sound in a sequence of three or four words, for example, "Which word does not belong? *Bus*, *bun*, or *rug*." (*rug*)

4. Phoneme blending, which requires listening to a sequence of separately spoken sounds and combining them to form a recognizable word, for example, "What word is */s/ /k/ /u/ /l/*?" (*school*)
5. Phoneme segmentation, which requires breaking a word into its sounds by tapping out or counting the sounds, or by pronouncing and positioning a marker for each sound, for example, "How many phonemes in *ship*?" (three: */š/ /I/ /p/*)
6. Phoneme deletion, which requires stating the word that remains when a specified phoneme is removed, for example, "What is *smile* without the */s/*?" (*mile*)

The difficulty of some of these tasks depends on the properties of the words and phonemes to be manipulated (Stahl & Murray, 1994). Initial sounds are easier to manipulate than noninitial sounds in words. In a segmentation task, the easiest words to divide are two-phoneme words beginning with a vowel, for example, *age* and *eat*. These are easier than two-phoneme words beginning with a consonant, such as *tea* and *go* (Uhry & Ehri, 1999). Words with two phonemes are easier to segment than words with three or more phonemes. Initial and final phonemes are easier to segment than phonemes in the middle of words. Consonant-vowel blends (e.g., */b-o/* in *boat*) are easier to segment than consonant clusters (e.g., */s-t/* in *stop*, */m-p/* in *jump*).

In a blending task, stop consonants are considered more difficult to combine than continuant consonants. If you pronounce the sounds of the following graphemes,

p, b, t, d, k, g, ch, j

m, n, f, v, s, z, th, sh, l, r

you will find that the phonemes in the first row, all stop consonants, are difficult to pronounce without adding the vowel *uh*. In contrast, phonemes in the second row of consonants, called continuants, can be pronounced without an *uh* and can be held in speech (e.g., *sssssssss*) without altering or terminating the sound. This property is believed to make continuants easier to blend. For example, the three continuant sounds */m/ /ae/ /n/* combine smoothly to form *man*. In contrast, when stops are blended, the process is not smooth. Sounds pronounced in isolation must be dropped when the blend is formed. For example, *tuh /ae/ puh* must be blended to form *tap*, not *tuhapuh*. When selecting words to teach phonemic awareness, curriculum designers begin with the easiest words and phonemes.

How Phonemic Awareness Is Distinct From Similar Concepts

It is important to recognize how PA differs from similarly labeled concepts. Whereas PA is a specific skill that involves manipulating sounds in speech, *phonics* is a method of teaching reading. Phonics programs may or may not include explicit instruction in PA. Typically, phonics programs teach students how to use grapheme-phoneme correspondences to decode or spell words.

Phonemic awareness is also different from *phoneme discrimination*, which refers to the ability to recognize whether two spoken words are the same or different, for example, recognizing that *tan* sounds different from *Dan*. Phoneme discrimination is simpler than PA, because it requires neither conscious awareness of phonemes nor phoneme manipulation.

Furthermore, PA is different from *phonological awareness,* which is a more encompassing term. Phonological awareness refers to various types of awareness, not only PA, but also awareness of larger spoken units such as syllables, onsets, and rimes. To assess phonological awareness, students might be asked to generate words that rhyme, or to segment polysyllabic words into syllables. They might be asked to delete syllables from words (e.g., What is *cowboy* without *cow*?), or they might be asked to segment one-syllable words into their onsets and rimes. Onsets consist of the single or multiple consonants that precede the vowel, and rimes consist of the vowel and following consonants, for example, *j-ump*, *st-op*, and *str-ong*. Dividing single-syllable words into these units is easier than dividing the words in other places, for example, after the vowel (Treiman, 1985). Generally, tasks that require students to manipulate spoken units larger than phonemes are simpler for beginners than tasks requiring phoneme manipulation (Liberman, Shankweiler, Fischer, & Carter, 1974). Often, programs that teach PA begin by teaching children to analyze larger units in words before progressing to the phonemic level.

The term *phoneme* is used by linguists to refer to the smallest unit in speech that signals a difference in meaning to a listener who knows the language. In contrast, the term *phone* refers to a linguistic sound with specified acoustic and articulatory properties. To distinguish among phonemes, a speaker uses categories that were set up in the mind when he or she acquired a particular language, whereas to distinguish among phones, one identifies physical properties of speech. Phonemes are broader categories that may include several phones. Although phones

within a phonemic category differ in their articulatory features, the speaker/listener perceives them as the same phoneme. For example, the initial sounds in *chop* and *shop* are articulated differently, so they are two different phones. To an English speaker, they are also different phonemes, because substituting one for the other signals a different word. However, to a speaker of Spanish, the two different phones are processed as the same phoneme. The change in articulation does not signal a different word in Spanish. The speaker either fails to notice the difference or perceives it as a slightly different way of pronouncing the same word. Another example is when Chinese and Japanese speakers process /*l*/ and /*r*/ as the same phoneme in English words (e.g., *lice* as opposed to *rice*).

The distinction between phonemes and phones is important. If teachers have students who are learning English as a second language, they need to realize that their students are likely to misperceive some English phonemes, because the students' linguistic minds are programmed to categorize phonemes in their first language, and this system may conflict with the phoneme categorization system in English. Their confusion will be apparent when they segment English words into phonemes and write letters representing the phonemes. If their first language was Spanish, they may select *SH* when they should use *CH*. If their first language was Japanese or Chinese, they may select *L* when they should write *R*.

The Importance of Phonemic Awareness in Learning to Read

Phonemic awareness measured at the beginning of kindergarten is one of the two best predictors of how well children will learn to read during their first 2 years of school. In a longitudinal study by Share et al. (1984), kindergartners were assessed on many measures when they entered school, including phonemic segmentation, letter-name knowledge, memory for sentences, vocabulary, father's occupational status, parental reports of reading to children, television watching, and others. These researchers examined which measure best predicted how well the children were reading 1 and 2 years later. Results showed that PA was the top predictor, along with letter knowledge. Phonemic awareness correlated 0.66 with reading achievement scores in kindergarten and 0.62 with scores in first grade.

Why is PA so important in learning to read? It has to do with the structure of the English writing system and how beginners use this system when

they learn to read and write words. English script is an alphabetic system. Spelling regularities exist at the level of words and at the level of phonemes. Words have prescribed spellings, and these spellings are systematic because they consist of graphemes that symbolize phonemes. Phonemic awareness skills help children learn to read words in various ways (Ehri, 1991). To decode new words, beginners must know how to blend phonemes. To remember how to read individual words, beginners must be able to segment words into the phonemes that match up to graphemes so that they can compute connections between graphemes and phonemes and store them in memory (Ehri, 1992, 1999). Phonemic segmentation skill is essential for constructing probable spellings as well as remembering correct spellings of words (Griffith, 1991). In fact, all the processes involved in learning to read and write words require PA (Ehri, 1994).

Phonemic awareness is also a potent predictor of future reading skill because it is not easy for beginners to acquire. As indicated previously, there are no breaks in speech signaling where one phoneme ends and the next one begins. Therefore, discovering these units is not a straightforward process, so many students require explicit instruction to learn how the system works. This is underscored by research showing that people who have not learned to read and write have difficulty performing PA tasks (Morais, Bertelson, Cary, & Alegria, 1987). Likewise, people who have learned to read in a script that is not graphophonemic, such as Chinese, have difficulty segmenting speech into phonemes (Mann, 1987; Read, Zhang, Nie, & Ding, 1987).

Studies on the Teaching of Phonemic Awareness

Many studies have reported strong relationships between PA and learning to read. In correlational studies, researchers measure children's ability to manipulate phonemes as well as their reading ability. Typical findings show that students who have superior PA are better readers than students with low PA. However, such findings are insufficient to show that PA was the underlying cause enabling some students to read better than others, because the finding does not rule out other causal explanations for the relationship (Ehri, 1979). The correlation may have been observed because cause operated in the reverse direction; that is, learning to read improved students' PA, or perhaps a third factor operated as an underlying cause boosting both PA and reading, for example, vocabulary size, memory, or general intelligence. To show that PA is a direct cause in helping children learn to read, we need evidence from experimental studies with treatment and control groups.

A well-designed experiment would include the following steps:

1. Pretesting students before they receive any instruction. Pretests help in selecting participants who can profit from instruction because they have weak PA. Also, pretests assessing PA verify that treatment and control groups do not differ before instruction. Comparing pretest to posttest performance on PA and reading measures reveals whether gains have resulted from the instruction.
2. Randomly assigning students to experimental and control groups. The experimental group receives instruction in PA. A treated control group receives another type of instruction involving equal time but no PA instruction. An untreated control group receives no special instruction beyond that provided in the children's classrooms at school. By randomly assigning students to these groups, the likelihood is increased that the groups do not differ systematically in any way that would explain outcome differences following instruction. This step helps to establish that the treatment, rather than some other factor, was the cause of superior gains in outcomes by the experimental group.
3. Posttesting students following instruction. Phonemic awareness posttests show whether PA-trained groups made greater gains than control groups, indicating that instruction was effective. Reading posttests reveal whether PA instruction improved students' reading abilities.
4. Monitoring students' literacy skills during subsequent years as they receive regular instruction at school but no further specialized PA instruction. This step indicates whether the contribution of PA instruction to reading lasts beyond the end of training and for how long.

Several PA instruction studies with treatment and control groups have been conducted. In describing a sample of these studies, we will pay special attention to the kind of PA instruction students received.

Phonemic Awareness Taught to Preschoolers and Kindergartners

Most children in preschool or beginning kindergarten have not yet learned to read. They may know some letter names and sounds, but their PA is weak. They cannot decode words, although they may have memorized

how to read a few words by sight. The purpose of PA instruction with prereaders is to move them closer to reading.

Lundberg, Frost, and Petersen (1988) examined the effectiveness of an 8-month kindergarten program, referred to as the Lundberg program. Classroom teachers in Denmark taught children to attend to and manipulate sounds in speech through games and exercises. The sound manipulations increased in difficulty as the year progressed. The program began with easy listening activities followed by rhyming exercises. Then, the children learned to segment sentences into words and to focus on the length of words in speech. Following this, words were analyzed into syllables. For example, children listened to a troll that spoke peculiarly, syllable by syllable, and they figured out what he said. Then, phoneme analysis was introduced by having children detect phonemes in initial positions of words, mainly continuants and vowels. The teacher helped the children by stretching or repeating the initial sound, for example, "*Mmmmark*," or "*T-T-T-Tom*." The children also practiced adding and deleting phonemes from words. In the fifth month of the program, phoneme segmentation and blending were introduced, first with *VC* and *CV* words, and then followed by more complex words. The study included a control group that received the regular kindergarten program, which included no instruction in PA. Neither kindergarten program taught about letters or how to read.

The short-term effectiveness of the program was evaluated at the end of kindergarten when PA instruction ended. Children trained in PA were found to segment, blend, and delete phonemes more accurately than the children in the control group, verifying that the PA instruction was effective. The long-term effects of instruction also were assessed. In the seventh month of first grade, PA-trained children were able to spell more words than control children, but the two groups did not differ in how many words they could read. However, in the seventh month of second grade, the PA-trained group outperformed the control group on both reading and spelling tasks. These findings show that teaching PA to young children before they begin formal reading instruction boosts their success in learning to read and spell during the next 2 years in school.

Other researchers have replicated the Lundberg et al. (1988) findings in different languages: Korkman and Peltomaa (1993) in Finnish; Kozminsky and Kozminsky (1995) in Hebrew; and Schneider, Kuspert, Roth, Vise, and Marx (1997) in German. In the Schneider et al. experiment, 22 kindergarten teachers implemented the Lundberg program in

their classrooms. However, only nine taught the program consistently and correctly to the end. When PA-trained groups and control groups were compared the following year (grade 1), only students of those nine teachers performed better in reading and spelling than control students. These results underscore the importance of teachers' adhering to a program for it to be effective.

In Schneider et al.'s (1997) second PA instruction study, adjustments were made to better fit the teachers' schedules, more exercises were added at the phonemic level, and implementation of the program was better supervised. At the end of instruction, PA-taught students identified, segmented, and blended phonemes better than controls. They also outperformed control students in reading and spelling tests at the end of grades 1 and 2. This provides further evidence of the short- and long-term benefits of Lundberg's program.

Whereas a variety of PA skills were taught in the Lundberg program, Byrne and Fielding-Barnsley (1991) designed a preschool program called Sound Foundations that focused on one type of phoneme manipulation, phoneme identity. Grapheme-phoneme instruction also was included. In this program, children were taught to recognize instances of the same sound in both initial and final positions across different words. Nine continuant consonants and vowels received primary attention. Children were shown several large posters covered with pictures of objects. They were instructed to pick out from a larger set the objects having targeted beginning or ending sounds, for example, *sea*, *seal*, *sailor*, and *sand*. Children also selected from an array of pictures on worksheets or cards those depicting targeted sounds. In each session, one phoneme in one position was taught. The letter representing the phoneme was introduced as well.

In this study, preschoolers averaging 4.5 years in age received either the PA instruction described or control instruction that focused on story listening and semantic activities with the same posters and worksheets. Children were trained in groups of 4 to 6 and received one 30-minute lesson per week for 12 weeks. At the end of instruction, children in the PA-trained group were able to identify substantially more initial and final phonemes in words than control students. They demonstrated superior skill identifying not only sounds they had practiced, but also unpracticed sounds, indicating that phoneme identity skill transfered to untaught phonemes. These researchers also gave students a simplified word-reading task in which children were shown a word and asked to

identify it from two spoken choices (e.g., "Does this [*sat*] say *sat* or *mat*?"). Trained students read more words than control students, indicating that PA instruction improved preschoolers' word recognition skill.

These researchers investigated the long-term impact of their PA program as well (Byrne & Fielding-Barnsley, 1993, 1995). Children were tested during the next 3 years in school. At the end of kindergarten, trained children were only slightly superior to control children in PA, indicating that learning to read had narrowed the gap in PA between the two groups. At the end of each successive grade, the PA group was able to read more novel words than the control group (i.e., artificial words such as *ap*, *sut*, and *besk*), indicating that PA instruction improved children's decoding skills. At the end of second grade, there was a marginal difference in reading comprehension favoring the PA-trained students. However, the groups did not differ in reading real words or in spelling words on any of the long-term tests. One possible reason why long-term effects were not stronger in this study may be that formal reading and spelling instruction was sufficiently effective to make up for the early advantage provided by instruction in PA.

Alternative Methods for Teaching Phonemic Awareness

The effectiveness of different ways of teaching PA has been investigated. O'Connor, Jenkins, and Slocum (1995) studied whether PA instruction has to be broad rather than focused to be most effective. They selected at-risk kindergartners with low PA and randomly assigned them to one of three instructional conditions. In the comprehensive treatment, children performed a variety of sound manipulation activities that included isolating, segmenting, blending, and deleting phonemes; segmenting and blending syllables and onset-rime units; and working with rhyming words. In the focused treatment, children were taught to segment and blend onsets, rimes, and phonemes only. Instruction extended over 10 weeks, consisting of two 15-minute sessions per week for a total of 5 hours of instruction. Beginning the fifth week, letter-sound associations were taught for the sounds being practiced orally in both groups. However, children were not taught how to use letters to manipulate phonemes in the PA activities. (Note that lack of letter manipulation instruction in this study was done for theoretical reasons. As will be shown later, teaching children to manipulate phonemes using letters

improves the effectiveness of PA instruction.) The third treatment, a control condition, received only the letter-sound instruction.

Comparison of PA following instruction showed that the treated groups performed equally well and both outperformed the control group, indicating that both types of instruction were equally effective in teaching PA. To measure transfer to reading, a simplified word-learning task was devised. After children learned to associate four letters and sounds, they were given practice learning to read five words comprised of the letters and sounds: *am*, *at*, *mat*, *sat*, and *sam*. Each word was taught by saying, "This is *aaaaat*, *at*." The results showed that only the focused group learned to read the words in fewer trials than the control group. This suggests that concentrating instructional time on segmenting and blending may contribute more to beginning-level reading skill than dividing attention among many PA activities.

Several studies (Davidson & Jenkins, 1994; Fox & Routh, 1984; Torgesen, Morgan, & Davis, 1992) have compared the contributions of segmentation and blending instruction to reading acquisition. Davidson and Jenkins gave kindergartners with low PA one of four types of instruction. In the segmentation treatment, each word was pronounced and the children were taught to say its separate sounds. In the blending treatment, the children listened to the separate sounds and learned to blend them into words. In the segmentation and blending treatment, the children learned first to segment, and then to blend the words. In the control condition, the children listened to stories. Children in each group were taught to a criterion of mastery. The words and nonwords analyzed during instruction were 10 two-phoneme words formed out of continuant consonants and long vowels (e.g., *my*, *vo*, *low*, *way*). At the end of instruction, all students were taught eight letters for the sounds that the treatment groups had practiced. Then, two literacy tests were given in which children practiced and received feedback in learning to read and learning to spell two-phoneme words. These words were formed from the same letter sounds, but they had not been taught during instruction.

Results showed that the groups learned the PA skill that they were taught but performed poorly on the untaught skill. This indicates that teaching students either segmentation or blending does not improve their performance in the other skill. On the measures of reading and spelling, both the segmentation and combination groups performed similarly and outperformed the control group. However, the blending group did not exceed the control group. This indicates that teaching

beginners to segment is as effective for learning to read words as teaching beginners to segment and blend. In contrast, teaching beginners only to blend is not effective. Torgesen et al. (1992) replicated these findings in a similar study.

Although blending made a poor showing in these studies, Reitsma and Wesseling (1998) reported more success in a study with kindergartners in The Netherlands. They used a computer to teach kindergartners how to blend three-phoneme Dutch words (e.g., *lief*, *geit*, *met*). No limits were placed on the variety of phonemes in the words. All phoneme manipulations were conducted in speech without any letters. First, children were taught a set of vocabulary words, and these were used in various blending exercises. In one exercise, children listened to a sequence of segmented sounds and then clicked on the picture corresponding to that word. In a second exercise, children listened to two successively segmented words and clicked "same" or "different." In another exercise, children listened to words, either pronounced as wholes or segmented, and then had to find which of several boxes on the screen contained the other form of the word. If a whole word was heard, they had to find its segmented form. If a segmented word was heard, they had to find its whole form. In all these exercises, the incorrect word choices differed by several phonemes from the correct choice for some items but only by one phoneme for other items, making processing in the latter case more difficult. In the control group, children completed vocabulary exercises on the computer.

At the end of kindergarten, PA posttests of children's ability to blend and to segment words revealed superior blending performance by the trained group compared with the control group, but no difference in segmentation performance. Thus, the effects of instruction were limited to blending, which was the skill targeted by instruction. Blending instruction did not facilitate segmentation skill even though some of the exercises involved analyzing segments in words.

The following year, in first grade, children's ability to read words was examined. Long-term effects of the blending exercises were evident. Trained children read more words than control children, indicating that extensive instruction to develop blending skill does benefit reading acquisition. Blending is believed to contribute to reading by enabling children to decode new words they have not yet learned to read. However, no effects on spelling were detected, perhaps because phonemic segmentation is central to spelling and this PA skill was not enhanced by the instruction.

Researchers have focused on segmentation and blending in their programs because these are the forms of PA that relate most closely to reading and spelling processes. Williams (1980) created a PA instruction program that not only taught students to segment and blend in speech, but also incorporated letters into these processes. Referred to as the ABDs program, she tested its effectiveness with classes of learning disabled (LD) students, aged 7–12 years, and their teachers.

Williams's (1980) program began by teaching children to segment spoken words into syllables and to represent them with wooden squares. Then, two-phoneme words were segmented with squares, followed by three-phoneme words. Words were formed from seven consonants (*B /b/*, *M /m/*, *P /p/*, *S /s/*, *C /k/*, *G /g/*, and *T /t/*) and two vowels (short *a /ae/* and short *o /a/*). Children then learned to blend phonemes to form the same words. Letter-sound correspondences were taught next for the nine phonemes. Then, children used wooden squares now printed with letters to learn to decode, that is, to sound out and blend two- and three-phoneme words. In addition, they learned to spell, that is, to segment words into phonemes and select letters for each. All possible combinations of the seven consonants and two vowels were practiced. Then, six additional letter-sound correspondences were taught and used to decode words (*F /f/*, *H /h/*, *L /l/*, *N /n/*, *R /r/*, and short *i /I/*). Words with four and five phonemes including consonant clusters then were decoded. Finally, two-syllable words were decoded. Thus, children were taught all the basic processes needed to read and spell novel words.

Children received instruction in small groups. Each unit of the program began with an interest-arousing story read by the teacher portraying characters who demonstrated the skills to be mastered in that unit. The program was highly structured with scripts for teachers to follow. After children decoded or blended words, they listened to or read their meanings in sentences. Words with no meanings were identified as nonsense words. Worksheets were developed and games such as Go Fish and Concentration were adapted to give children further practice acquiring the skills.

The program was evaluated with two different samples of LD children, each sample compared to a control group of LD children with comparable skills at the beginning of instruction. The control groups received no special instruction. Although classroom teachers were expected to teach the entire 12-unit program, they completed only part of it, 8 units on average over a 26-week period in one sample, and 6 units

on average over a 19-week period in the other sample. Results showed that at the end of instruction, PA-trained students decoded more words than control students. However, 6 months later, trained students performed only marginally better on a decoding test than untrained children. These findings indicate that LD children can benefit from PA instruction that covers both blending and segmentation and incorporates letters into learning.

The lack of strong long-term gains from the program was disappointing. This may be explained by several factors. First, students were not taught the whole program. Also, during the 6 months following instruction, trained children showed no further improvement in their decoding skills or PA skills. Conversations with two teachers who continued to have these children in their classes after the program ended suggested a possible explanation for this (Williams, 1979). The teachers said that because the children had improved so much in decoding, they were no longer spending as much time with these children on these skills. This may have halted the children's growth. In addition, it may be particularly difficult to remediate the reading problems of LD children. These children may require more extensive, long-term remediation that gives special help not just with PA and decoding, but also with other reading processes such as building a sight vocabulary, developing fluency, and acquiring comprehension strategies.

Benefit of Letters in Teaching Phonemic Awareness

As was evident in the studies already described, programs to teach PA have differed in whether letters were incorporated into instruction. Moreover, the role that letters played in phoneme manipulation differed. In some studies, children were taught to manipulate letters as they identified phonemes in words, for example, segmenting *cat* into its phonemes by saying each phoneme and selecting its letter from a set of letter tiles. In other studies, letters were simply exposed after the phonemes were identified, for example, segmenting *cat* by saying each phoneme and then lifting a window to view the letter for that sound. Effects of instruction on reading were detected in studies in which children manipulated letters (Ball & Blachman, 1991; Bradley & Bryant, 1983, 1985; Ehri & Wilce, 1987; Tangel & Blachman, 1992), but not in studies in which they were exposed passively to letters (Kerstholt, van Bon, & Schreuder, 1994, 1997).

Bradley and Bryant (1983, 1985) conducted the first experiment to provide evidence for a causal connection between PA instruction with letters and reading acquisition. They selected 5- to 7-year-old children with low PA and gave them instruction over a 2-year period. Children in the PA condition were taught to categorize words on the basis of common sounds, initial sounds first, then final sounds, then middle sounds. Children in the PA-plus-letters condition received the same sound categorization instruction. However, during the second half of instruction, plastic letters were added. Children were taught to generate spellings for a succession of similarly pronounced words, for example, spelling *cat* and then *hat* by replacing the *C* with *H*. Children in the control group clustered words by conceptual categories, such as animals. Results at the end of instruction showed that only the PA-plus-letters group statistically outperformed a control group on standardized reading and spelling tasks, not the PA group. In this study, PA instruction required the assistance of letters to facilitate learning to read.

To teach PA with letters, Blachman and her colleagues (Ball & Blachman, 1991; Blachman, Ball, Black, & Tangel, 1994; Tangel & Blachman, 1992) developed the "say-it-and- move-it" activity. Children were taught to move a blank tile from the top half to the bottom half of a card as they pronounced each phoneme in a word. The words progressed from single phonemes to two and three phonemes. After children practiced segmenting words with blank tiles, they were taught letter-sound associations and practiced moving letters as they pronounced phonemes to segment the words. Findings of the Blachman studies showed that kindergartners receiving say-it-and-move-it instruction outperformed control children on word reading and spelling tasks, indicating the value of this letter-added form of PA instruction.

Whereas some studies show that PA instruction facilitates learning to read and spell, other studies show that learning to read and spell enhances children's PA skills. It is important to recognize that the relationship between acquiring PA and acquiring literacy is interactive and reciprocal. Having some PA helps children grasp the alphabetic system and apply it to read and spell words. However, beginners commonly have trouble detecting phonemes that are buried in spoken words such as medial sounds and consonant clusters. If beginners know letter-sound correspondences, then seeing spellings of words can call attention to the presence of hard-to-detect sounds in speech, just as learning how an unfamiliar name is spelled often clarifies sounds that escaped notice when the name was

spoken. In this way, print and PA function reciprocally to enhance each other's acquisition (Ehri, 1984; Ehri & Wilce, 1980, 1986).

Enriching Beginning Reading Instruction With Phonemic Awareness

In many PA experiments, the instructional context is not considered. However, there are some exceptions. Iversen and Tunmer (1993) incorporated PA into Clay's (1985) Reading Recovery (RR) program to examine whether systematic instruction in PA would make the program more effective. First-grade, at-risk readers were assigned to one of three groups: a group receiving standard RR instruction, a group receiving modified RR instruction, and an alternative, non-RR intervention group. In the modified RR treatment, after children had learned most letters, they manipulated magnetic letter forms to make, break, and build new words having similar spellings and pronunciations, for example, reading *and* and then changing it to *hand*, *sand*, and *band*. Teaching progressed from initial sounds to final sounds and then to medial sounds. Children added, deleted, and substituted letters in their manipulations, and also read the changed words. Later, the task became a writing task rather than a manipulation task. Findings showed that both traditional and PA-modified forms of RR enabled children to reach prescribed reading levels that qualified them to exit this remedial program. However, children who received modified RR attained prescribed levels faster than children receiving the standard program. This indicates that adding PA instruction improved RR by increasing its efficiency.

Hatcher, Hulme, and Ellis (1994) also examined whether adding PA instruction to a RR program would improve its success. They compared three instructional conditions: (1) RR by itself; (2) RR with PA added; and (3) PA by itself. Of interest here are the first two groups. The PA instruction that was added to RR involved teaching children to perform different types of PA, including segmentation, blending, deletion, substitution, and transposition of phonemes. Children also practiced linking letters to phonemes in various spelling and writing tasks. To assess effects at the end of instruction, performance of each treatment group was compared to an untreated control group both immediately and 9 months later. The participants were 7-year-old poor readers. Results showed that, following instruction, the RR plus PA group outperformed the untreated control group on five different reading measures. In contrast, the RR-only group outperformed the control group on only one

reading measure. Long-term effects on reading measures were evident for the RR plus PA group, but not for the RR-only group. This is further evidence for the benefits of adding PA instruction to the RR program.

Castle, Riach, and Nicholson (1994) examined the contribution of PA instruction to reading acquisition in a whole language program. Kindergartners with low PA were assigned to treatment and control groups. Phonemic awareness instruction included segmentation, blending, substitution, and deletion. Letters were incorporated into the PA activities later in the program. Two control groups were included, one receiving an alternative, unrelated treatment and the other receiving no treatment other than the whole language instruction provided to all participants in their classrooms. Results showed that the PA-trained group spelled more words and decoded many more pseudowords than the two control groups. However, the groups did not differ in reading real words or in reading connected text. These findings indicate that adding PA instruction to a whole language program enhances students' decoding and spelling skills but not their other reading skills.

Meta-Analysis of Phonemic Awareness Instruction Studies

Now that some of the many PA instructional experiments reported in the literature have been considered, it is legitimate to wonder how representative these studies and their findings are. To address this concern, a meta-analysis is needed to determine whether the majority agree in showing that PA instruction is effective for teaching PA skills and for helping children learn to read.

The National Reading Panel (NRP) conducted such a meta-analysis. The Panel located 52 experiments that compared groups of children receiving PA instruction to control groups who received either an alternative form of instruction or regular classroom instruction (Ehri et al., 2001; National Reading Panel, 2000). The meta-analysis made it possible to combine the results of these studies and apply statistical tests to reach conclusions about the general effectiveness of PA instruction for teaching PA skills and for helping children learn to read and spell. Also, this procedure made it possible to select subsets of studies from the larger pool and examine whether effects of PA instruction were positive under specific conditions, for example, specific grades or specific ways of teaching PA.

From the 52 published experiments that were located, 96 comparisons of treatment and control groups were derived. More comparisons than studies existed because some experiments included more than one type of PA treatment or control group or more than one grade level. All experiments measured reading as an outcome of instruction. Most studies measured PA to verify that instruction was effective, and some measured spelling as an outcome as well. The experiments differed in several ways, however:

1. The participants differed. Some studies investigated preschoolers and kindergartners who had not yet learned to read. Some focused on special populations of children, either kindergartners or first graders at risk for developing reading difficulties, or children in second grade or above who were already having reading difficulties. Some studies examined children of low socioeconomic status, others examined children of middle socioeconomic status. Studies were conducted in different countries in different languages.
2. The instructional procedures and activities differed. In some studies, a specific form of PA was taught, for example, segmentation, whereas in other studies the instruction was more comprehensive, covering several PA skills. Instruction was delivered to individuals, small groups (two to seven students), or entire classes. Some studies taught students to manipulate phonemes in speech, whereas others taught phoneme manipulation with letters. The duration of instruction varied from several hours to an entire school year.
3. The instructors differed. Some studies used classroom teachers, whereas others used credentialed teachers given special instruction, research assistants, or computers.
4. The experimental designs differed. Some studies adopted a true experimental design and randomly assigned students to the treatment and control groups. In other studies, random assignment was not possible, for example, when existing classrooms were used or when teachers were assigned nonrandomly to instruct a treatment or a control group. Some studies compared performance of the trained group to performance of a control group receiving another unrelated treatment. Some employed a control group that received no special treatment beyond that received by all the students in the school. Some studies checked to make sure that instructors

followed prescribed procedures, whereas other studies did not assess fidelity to treatment. Studies also varied in the number of participants, which ranged from 9 to 383 students.

5. The literacy tests given at the end of instruction differed. Some researchers used standardized tests, whereas others devised their own tests. Most often word and pseudoword reading was measured, but sometimes text comprehension and spelling were assessed as well. Tests given to preschoolers or kindergartners having minimal literacy were simple word choice or word learning tests or invented spelling tasks rather than tests assessing conventional, unsupported reading or writing.
6. Studies differed in whether they assessed long-term as well as short-term effects of instruction. Some studies monitored how well participants learned to read in school 1 to 2 years after the PA instruction ended, whereas other studies only assessed effects right after instruction.

The statistic that was used to compare the performance of PA-instructed groups and control groups across studies was effect size, which measures how much the mean of the PA-instructed group exceeded the mean of the control group on the outcome measure in standard deviation units. An effect size of 1.00 indicates that the treatment group mean was one standard deviation higher than the control group mean. An effect size of 0 indicates that the means did not differ at all, showing that the instruction produced no effect. To judge the strength of an effect size, values suggested by Cohen (1988) are commonly used. An effect size of 0.20 is considered small; a moderate effect size is 0.50; an effect size of 0.80 or above is large. Translated into percentiles, an effect size of 0.20 indicates that the treatment moved a child from the 50th to the 58th percentile. An effect size of 0.50 indicates that the treatment moved a child from the 50th to the 69th percentile. An effect size of 0.80 indicates that the treatment moved a child from the 50th to the 79th percentile. The effect size statistic is valuable because it allows one to convert outcomes from very different studies to one metric so that average effect sizes can be calculated and compared under various conditions.

In the analysis of effects of PA instruction across studies, the following outcomes were of interest: whether trained students acquired superior PA compared with control students, and whether trained students could read and spell better than control students. Statistical tests were

applied to see whether mean effect sizes were significantly greater than zero, indicating a positive effect of PA instruction, and whether effect sizes for contrasting conditions differed significantly from each other.

Figures 6.1 through 6.4 depict mean effect sizes for some of the outcomes and conditions in the meta-analysis. The bar depicts the size of the effect. The number to the right of the bars indicates the number of comparisons contributing to each effect. Not all studies contributed effect sizes to all analyses because some did not assess those particular outcomes. Effect sizes are statistically greater than zero unless marked n.s. (not significant). (For more complete findings, see Ehri et al. [2001] or the National Reading Panel report [2000]. For results of a similar meta-analysis, see Bus & van IJzendoorn [1999].)

Figure 6.1a shows that PA instruction was effective in teaching PA, with a large mean effect size $d = 0.86$. Effects on PA did not decline much on the follow-up tests administered after a delay. Phonemic awareness instruction boosted reading significantly at the end of instruction, $d = 0.53$, and also spelling, $d = 0.59$. Effects on reading and spelling declined, but were still statistically greater than zero following a delay of 2 to 15 months (Follow-up 1) and 7 to 30 months (Follow-up 2). These findings verify that PA instruction is very effective in helping students learn to read and spell.

Figure 6.1b displays effect sizes for various types of reading tests. Phonemic awareness instruction helped children learn to read real words and pseudowords on standardized as well as experimenter-devised tests. It boosted children's reading comprehension as well. However, it exerted no impact on performance in math, indicating that the contribution of PA instruction was limited to literacy and also that no halo effect was operating to boost scores of the treatment groups in general.

Figure 6.2a shows that PA instruction significantly improved reading performance in three types of readers: children progressing normally in learning to read, younger children at risk for developing reading difficulties, and older children with a reading disability. Also, PA instruction contributed significantly to reading acquisition in preschoolers, kindergartners, and first graders. Effects were significantly stronger among preschoolers and at-risk students, who tended to have low PA when they began instruction. These findings indicate that PA instruction is especially effective for improving reading when it is delivered to younger children who lack PA.

Figure 6.1. Mean effect sizes on various outcomes at immediate and follow-up test points

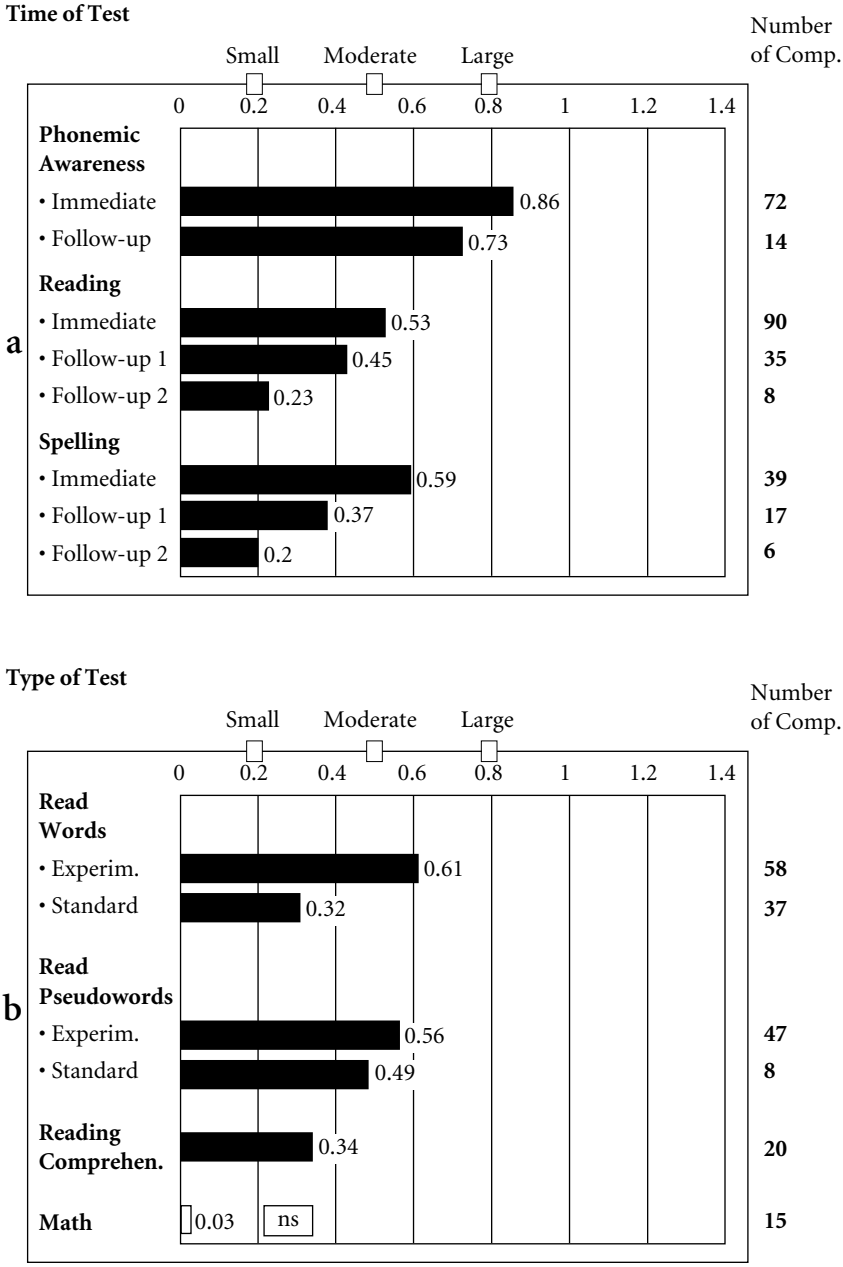
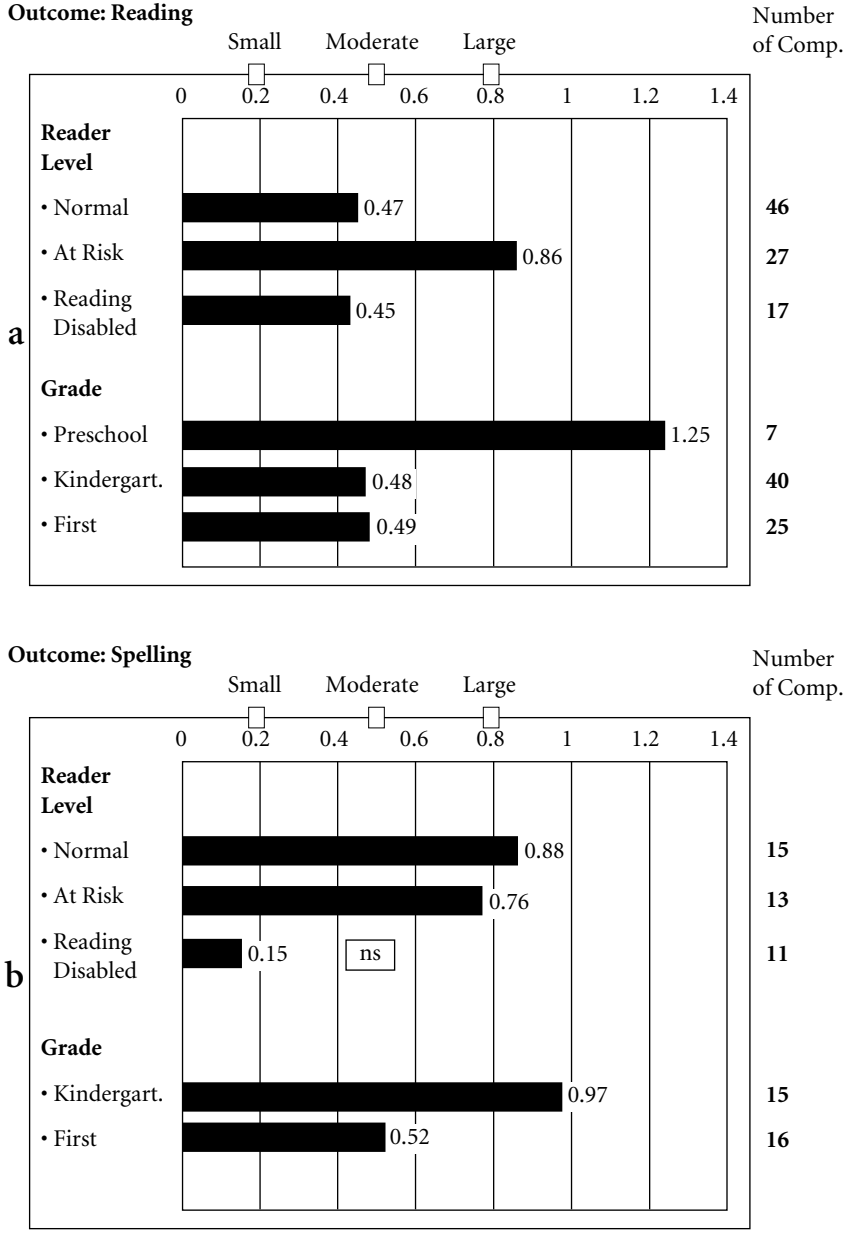


Figure 6.2. Mean effect sizes on reading (a) and spelling (b) outcomes for normal, at-risk, and disabled readers and for students in preschool, kindergarten, and first grades



Phonemic awareness instruction contributed to spelling development as well, but only among younger children. From Figure 6.2b, it can be seen that effect sizes were especially large for normal readers, at-risk readers, and kindergartners and were moderate for first graders. The effect sizes were boosted somewhat because spelling measures administered to the younger children typically gave credit for sound spellings as well as correct spellings of words. From Figure 6.2, it is apparent that PA instruction did not contribute significantly to spelling ability among older disabled readers, most of whom were in second grade or above. This may be because learning the correct spellings of English words requires knowledge of spelling patterns and word-specific memory along with PA. To become proficient, students may need explicit spelling instruction as well as PA instruction.

Figure 6.3 shows that PA instruction contributed significantly to students' reading ability whether it was taught to individuals, small groups, or whole classes. Surprisingly, small-group instruction produced a statistically larger effect size than individual tutoring. Perhaps this occurred because small groups provide opportunities for observational learning or they enhance learners' motivation. However, such findings are correlational. There may be some other hidden factor explaining why the 42 comparisons in the small-group pool had larger effect sizes than the 32 comparisons in the individual pool, for example, the possibility that the hard-to-teach children were tutored whereas the easy-to-teach children were taught in small groups.

Figure 6.3 further shows that PA instruction helped children read whether researchers, classroom teachers, or computers delivered the instruction. Importantly, these findings verify that teachers teaching their own students can implement PA instruction effectively.

Studies described earlier examined the effects of using letters to teach PA. Findings of our meta-analysis confirmed that there is an advantage to incorporating letters into instruction. As is seen in Figure 6.3, teaching PA through letters produced a significantly larger effect size on learning to read than teaching children to manipulate phonemes in speech only. One reason using letters is helpful is because using letters brings children closer to the transfer task of reading, which requires attention to letters.

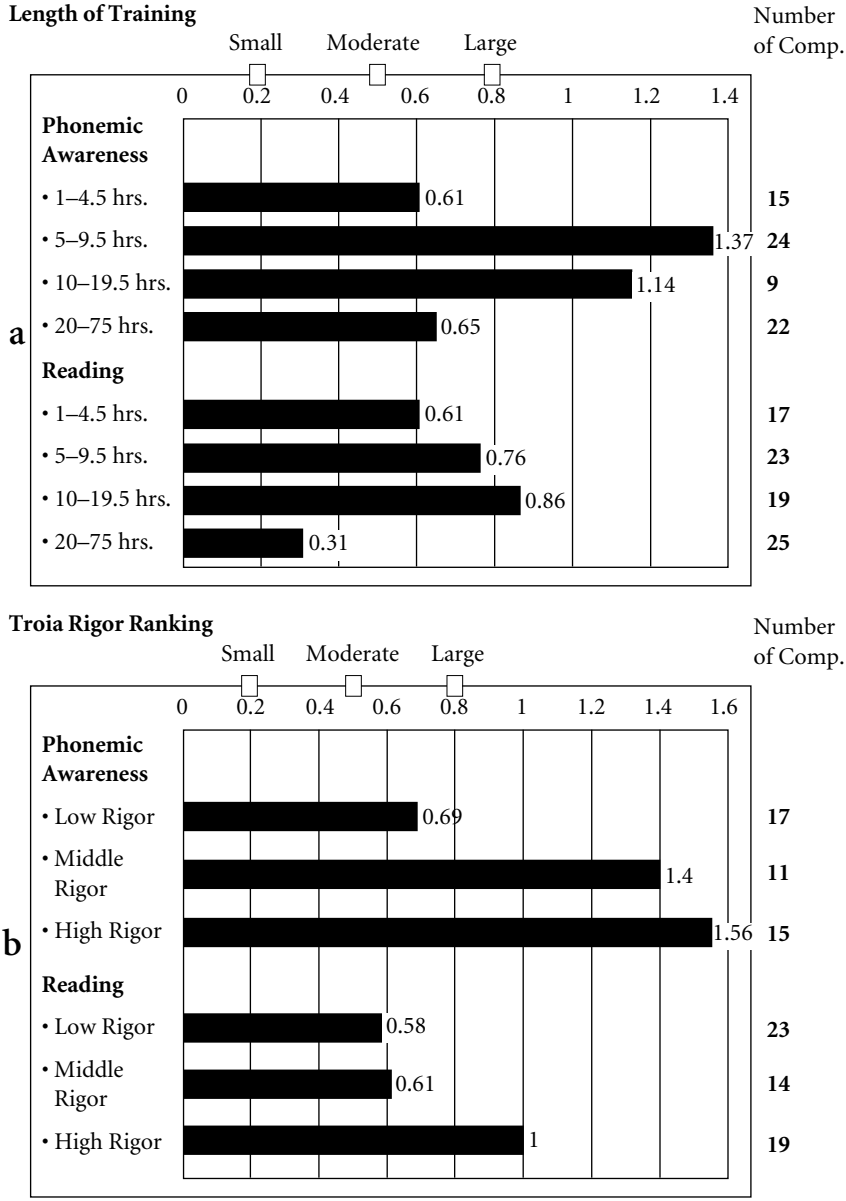
Figure 6.4a displays variations in effect sizes depending on how long the PA instruction lasted, ranging from 1 hour to 75 hours. Findings show that even the shortest durations produced significant learning of PA and transfer to reading. Surprisingly, programs lasting the longest

Figure 6.3. Mean effect sizes on reading outcomes for various types of delivery units, instructors, and usage of letters

(20 hours or more) produced significantly smaller effect sizes than programs lasting 5 to 18 hours. Although there may be a hidden factor explaining these findings, they suggest that PA instruction does not need to be lengthy to be effective.

The U.S. Congress asked the NRP to evaluate the findings of scientific research. The studies included in the NRP meta-analysis were all controlled experiments, but some were better designed than others. Of interest was whether larger effect sizes arose primarily from studies with strong or weak designs. While the report was being prepared, *Reading Research Quarterly* published an article by Troia (1999) that rated many of the studies in the database for their experimental rigor on criteria such as whether students were assigned randomly to treatment groups,

Figure 6.4. Mean effect sizes on phonemic awareness and reading outcomes for instructional programs lasting from 1 to 75 hours, and for experimental designs rated by Troia (1999) as having high, medium, and low rigor



whether fidelity of instructors to the treatment was checked, whether a representative sample of children was obtained, and so forth. Troia's ratings were adopted and used to examine effect sizes associated with studies judged to have low, medium, and high rigor. The results shown in Figure 6.4b reveal that the best-designed studies, not the weakest studies, produced the largest effect sizes.

Conclusion

Several conclusions can be drawn from the findings discussed here. Classroom teachers as well as researchers and computers can teach PA effectively. Phonemic awareness instruction helps many types of children learn to read, including preschoolers, kindergartners, first graders, younger children at risk, older disabled readers, low as well as middle-high socioeconomic status children, and children learning to read in English as well as other alphabetic languages. Phonemic awareness instruction helps beginners but not older disabled readers learn to spell. There are many effective ways to teach PA. Segmenting and blending are especially effective contributors to reading and spelling. Teaching children to manipulate phonemes using letters is more effective than teaching PA in the oral mode without letters. Letters help children learn PA as well as apply it in their reading and spelling. Phonemic awareness instruction does not have to last a long time to be effective. Thus, enough is known about the effectiveness of PA instruction to recommend it to primary teachers as a component of their literacy instruction.

In implementing PA instruction, teachers need to be cautious. Children will differ in their need for PA instruction, so pretesting is advised to assess who needs what type of instruction. PA instruction is not a complete reading program, but one foundational piece. There are other important accomplishments that must be taught as well to enable children to learn to read. Phonemic awareness is not an end but rather a means to enhance children's learning of the alphabetic system for use in their reading and writing.

Questions for Discussion

1. Design a lesson that teaches children to invent spellings of words in order to develop their phonemic awareness. What kind of scaffolding and feedback should be beneficial? How might attention to mouth movements be incorporated into this instruction?

2. Locate published lessons or programs that purport to teach PA, perhaps those included in the beginning reading program adopted by your school. Determine what types of PA are taught and whether print is incorporated into the instruction. Critique the lessons and their likely effectiveness based on your reading of this chapter. If found lacking, how might the instruction be strengthened?

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Appendix of IPA Symbols for Basic Phonemes in English

Symbols for 25 Consonant Phonemes

- Pairs of phonemes that differ in voicing (vocal cord vibration) but not place of articulation (to understand the voicing distinction, place your fingers on the lump of your throat and feel the absence of vibration for the voiceless member of each pair listed first, and the presence of vibration for the voiced member listed second):

/p/ (play), /b/ (big)	*/t/ (two), /d/ (dog)*	*/k/ (kind), /g/ (go)*
/f/ (fun), /v/ (very)	*/s/ (see), /z/ (zoo)*	*/θ/ (think), /ð/ (this)*
/š/ (she), /ž/ (measure)	*/č/ (child), /ǰ/ (just)*	*/ʍ/ (which), /w/ (witch)*

  Note: */w/* and */ʍ/* are not distinct in some dialects but rather both are */w/*.

- Nasals: */m/ (me), /n/ (not), /ŋ/ (long, sing, sink)*

  Note: In some dialects, words such as *long* may end in two consonants, */ŋ/* and */g/*, rather than one */ŋ/*.

- Liquids: */l/ (look)* , */r/ (red)*

- Glides: */y/ (yes)* , */h/ (help)* , (also */w/* and */ʍ/*)

Symbols for 16 Vowel Phonemes

- Short vowels: Short *a*: */ae/* (*can*); Short *e*: */ɛ/* (*red*); Short *i*: */I/* (*sit*); Short *u*: */ʌ/* (*but*); Short *o*: */a/* (*pot*) and */ɔ/* (*ball*)

  Note: */a/* and */ɔ/* are not distinct in some dialects but rather are both */a/*.

- Long vowels: Long *a*: */e/* (*ate*); Long *e*: /i/ (*see*); Long *i*: */ay/* (*ride*); Long *o*: */o/* (*boat*); Long *u*: */u/* (*tube*, *boot*) and */yu/* (*cute*)

  Note: The distinction here between "short" and "long" vowels is the one drawn in phonics programs. It is not the linguistic distinction referring to vowel duration.

- Diphthongs: */aw/* (*brown*), */ɔy/* (*boy*) (also the long vowels */ay/* and */yu/*)

  Note: Diphthongs are vowels combined with a glide. Articulation entails movement of the lips or tongue preceding or following the vowel.

- Schwa: */ə/* (*the*, *away*)

  Note: In many polysyllabic words, the vowel in the unstressed syllables is pronounced schwa.

- Other vowel: */U/* (*put*, *foot*)

  Note: Phonemes may vary in additional ways across dialects. In deciding whether individuals are manipulating phonemes correctly in words, it is important to examine how they pronounce those words.