

Gaining Alphabetic Insight: Is Phoneme Manipulation Skill or Identity Knowledge Causal?

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The type of phoneme awareness that supports reading acquisition has been unclear. Phoneme awareness is usually operationalized as skill in manipulating phonemes in blending and segmentation tasks. However, B. Byrne and R. Fielding-Barnsley (1990) argued that phoneme awareness is knowledge of phoneme identities (i.e., recognition of individual phonemes in spoken word contexts). In a double-blind teaching experiment, 48 kindergartners were randomly assigned to identity, manipulation, or language experience programs. Children in the manipulation program made significantly greater gains on tests of blending and segmentation. However, children in the identity program made significantly greater gains on a test of phonetic cue reading, a measure of rudimentary decoding ability. Teaching recognition of particular phonemes in word contexts may help beginners gain insight into the alphabetic principle and apply their insights in early word identification.

Phonemes are the basic vocal gestures from which the spoken words of a language are constructed (I. Y. Liberman & Liberman, 1992). Awareness of phonemes is necessary in learning to read alphabetic orthographies because symbols in these orthographies map the phoneme sequences in pronunciations. For example, the spelling *sight* directs the reader to construct a pronunciation that begins with /s/ as represented by *s*, merges into the vowel /ai/ represented by *igh*, and finishes with the stop consonant /t/ represented by *t*.¹ Learning to interpret such spelling maps requires a surprisingly elusive alphabetic insight in shifting from a search for the direct representation of meaning to recognizing the sequential representation of a pronunciation (Byrne, 1992).

For many children, alphabetic insight poses a formidable difficulty (Wallach & Wallach, 1979). Without awareness of the phonemic structure of words, spellings remain odd shapes or arbitrary symbol strings and are extraordinarily difficult to remember (Ehri, 1991). Children with little phoneme awareness usually struggle in learning to read and spell words, developing a wide achievement gulf between themselves and peers who are phonemically aware (Juel, 1988). Explicit instruction in phoneme awareness may help these children avoid reading delay by gaining an early insight into the workings of their alphabetic writing system (Stanovich, 1986).

However, the specific instructional goal for such training—phoneme manipulation skill or phoneme identity knowledge—remains unclear. Phoneme awareness programs typically focus on the manipulations of segmentation (i.e., breaking down spoken words into discrete phonemes) and blending (i.e., smoothly assembling an ordered phoneme sequence to identify a spoken word; Ball & Blachman, 1991;

Davidson & Jenkins, 1994; Fox & Routh, 1984; Helfgott, 1976; Hohn & Ehri, 1983; Lundberg, Frost, & Petersen, 1988; O'Connor, Jenkins, Leicester, & Slocum, 1993; O'Connor, Jenkins, & Slocum, 1994; Olofsson & Lundberg, 1983; Slocum, O'Connor, & Jenkins, 1993; Torgesen, Morgan, & Davis, 1992; Torneus, 1984; Williams, 1980; Wright & Beach, 1994). Lewkowicz (1980) pointed to the primacy of segmentation ability in making sense of alphabetic spellings. However, training in segmentation and blending does not always lead children to phoneme awareness (e.g., Smith, Christensen, Goodale, Ingebrand, & Steele, 1993; Torneus, 1984), and even successful programs (e.g., Lundberg et al., 1988) may be costly in instructional time and produce fairly small gains in later reading achievement.

Byrne and Fielding-Barnsley (1990) presented evidence that familiarity with the identities of particular phonemes may be initially more useful than phoneme manipulation skill in gaining alphabetic insight. In other words, acquaintance with the basic vocal gestures of spoken language, sufficient to recognize these phonemes in words, is what allows children to crack the alphabetic code. Byrne and Fielding-Barnsley suggested that the primary hurdle in gaining alphabetic insight is recognition knowledge of particular phoneme identities rather than blending and segmentation skill. However, the evidence supporting this view remains somewhat tenuous.

Comparing Phoneme Manipulation and Phoneme Identity

Manipulation

The discussion of phoneme awareness has historically been framed as questions about the manipulations of segmen-

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¹ Spellings within solidi represent pronunciations using approximations of symbols in the International Phonetic Alphabet. Vowel spellings used in this article include /ei/ as in *fate*, /i/ as in *meat*, /ai/ as in *die*, and /u/ as in *due*.

tation and blending, with primary emphasis on segmentation (Elkonin, 1973; Lewkowicz, 1980; I. Y. Liberman, 1973). If the problem of alphabetic insight is to recognize that a word's spelling maps its phoneme sequence, segmentation to perceive the phoneme sequence seems directly implicated. Learning to segment has been suggested to be the end result of a process of making increasingly fine-grained divisions of the phonological parts of spoken discourse, from utterance to word, from word to syllable, from syllable to onset and rime, from onset or rime to phoneme (Adams, 1990).

However, the term *segmentation*, with its implication of cutting or setting boundaries, may be misleading. In speech, phonemes are not acoustically discrete but overlap in their encoding (A. M. Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). For example, the spoken word *train* is heard as a single sound; if it were played in slow motion, listeners would not hear a succession of distinct phonemes /t/, /r/, /eɪ/, and /n/ but a continuous /chrein/. Because phoneme segmentation cannot be explained as a mechanical division of the acoustic signal, it is unclear how phonemes come to be recognized.

Measuring segmentation also presents a perplexing practical problem. Segmentation tasks (Yopp, 1988) usually require the respondent to articulate all the phonemes of a word in sequence (e.g., "What are the three sounds in *soup*?"). As a practical matter, this is among the most difficult of phoneme awareness tasks (Helfgott, 1976; Yopp, 1988) and is one that often stymies children well along into reading (Stahl & Murray, 1994). Young children trying to segment a word into phonemes may articulate parts larger than a phoneme, such as cluster onsets (Treiman, 1985) or consonant-vowel segments (Skjelfjord, 1987). If children can read beginning word lists and texts accurately before they can fully segment words into phonemes, it is difficult to argue that this manipulation is a reading prerequisite.

Phoneme Identification

Rather than phoneme manipulation, the critical task for attaining alphabetic insight may be learning to identify phonemes. *Identity* and *identify* are derived from the Latin word *idem*, meaning "same"; to identify a phoneme is to perceive it as the same vocal gesture repeated across different words (i.e., a familiar and recognizable entity). Recognizing phoneme identities might be analogous to learning letter identities. In each case, individual abstract entities become recognizable by learning to recognize and produce component features through studying examples and nonexamples.

Phoneme identification knowledge can be measured by tasks that reveal whether, for the child, phonemes are stable and familiar entities that can be perceived as "same" across different words. Byrne and Fielding-Barnsley (1990, 1991) and Stanovich, Cunningham, and Cramer (1984) relied on word-to-word matching, in which the respondent compares two or more spoken words for a common phoneme identified only by location (e.g., "Does *soup* start like *sand*?"). Bradley and Bryant (1978, 1983, 1985a, 1985b) used a

phonological oddity task, essentially a negative version of word-to-word matching. Sound-to-word matching simplifies the comparison by isolating the target phoneme for the respondent. For example, Wallach and Wallach (1979) told participants, "Some words start with the sound /m/, like *ma* or *mud* or *me*" (p. 200), and asked them to decide which illustrated word matched the isolated sound ("Does *man* or *house* start with /m/?"). Despite the apparent ease of this task, it effectively discriminated children who were better prepared for literacy instruction from others who were less prepared.

Research by Byrne and Fielding-Barnsley

What is known about the relative contributions of identity knowledge and phoneme manipulation skill in early reading? Byrne and Fielding-Barnsley (1989, 1990) attempted to empirically distinguish the two as part of a line of research in which they sought to specify what preliterate children need to know to accomplish phonetic cue reading, the most rudimentary form of phonological recoding (Ehri, 1991). In phonetic cue reading, beginners use initial letters in printed words to cue phonemes, allowing them to select from among words active in memory. To operationalize this ability, Byrne and Fielding-Barnsley developed a forced-choice transfer task in which translating initial letters into phonemes would allow children to identify words. For example, after learning to recognize *fat* and *bat*, and given printed pairs of words differing only in the initial consonants *f* and *b*, children with phonetic cue reading ability could subsequently point out whether *fun* is read "fun" or "bun" with above-chance consistency. Byrne's (1992) initial experiments established that preliterate children rarely induce the spelling-to-sound correspondences needed for success on the forced-choice transfer task. In other words, alphabetic insight does not seem to arrive by discovery alone. Byrne and Fielding-Barnsley (1989) later established that explicit instruction in segmentation skill, identity knowledge, and correspondences would lead children to succeed in phonetic cue reading.

However, which was more useful to children in gaining alphabetic insight: segmentation skill or identity knowledge? This question was addressed by examining whether phoneme awareness is taught more efficiently by instruction in phoneme identities or in segmentation (Byrne & Fielding-Barnsley, 1990). In the identity experiment, children were individually taught to identify four phonemes and practiced by selecting from among foils illustrated words that started with or ended with the target phoneme. Each child later was taught correspondences for the letters *s* and *m*. Children were tested using sound-to-word matching tasks and with the forced-choice phonetic cue reading task (e.g., "Is this *mow* or *sow*?"). After additional correspondence training, children were asked to distinguish words beginning with *f* and *b*, representing phonemes whose identities had not been taught. In a parallel segmentation-training experiment, children imitated a puppet model to learn to segment initial and final consonants. The same illustrated words as in the

identity experiment (composed of a limited set of phonemes) served as stimuli.

Insight into the alphabetic principle seemed closely related to success with identity measures. Children who reached a criterion on the phonetic cue reading task had the highest identity scores. Five identity-trained children also caught onto phonetic cue reading with untrained phonemes. Fewer segmentation-trained children reached criterion on the phonetic cue reading task, and these were not all among the best segmenters. Again, however, 5 children from the segmentation group reached criterion on phonetic cue reading with untrained phonemes, suggesting that they had achieved a general insight into the alphabetic principle.

In general, phoneme segmentation showed a weaker relationship to phonetic cue reading than did identity. Identity scores ($r = .49$) were better predictors of performance in phonetic cue reading than were segmentation scores ($r = .20$). Byrne and Fielding-Barnsley (1990) concluded that phoneme identity training is more successful than segmentation training in leading children toward the alphabetic insight because identity was easier to teach and led to a more stable alphabetic insight. They also informally observed that children were more comfortable with identity training, which did not require corrective feedback and seemed less frustrating.

Although tantalizing, Byrne and Fielding-Barnsley's (1990) research does not conclusively establish whether manipulation and identity teaching differ in their effectiveness. The segmentation and identity groups were not directly compared on their reading analog performances, and there is no clear indication that such a comparison would favor the identity group. Moreover, segmentation training seemed to lead to roughly equivalent levels of identity knowledge and alphabetic insight. However, it is probable that segmentation participants learned about phoneme identities because their segmentation practice was restricted to the limited phoneme set. In support of this view, their scores in phoneme identity averaged nearly as high as those of children trained in identity. By restricting examples to a limited phoneme set, the experimenters repeatedly called attention to the identities of these phonemes and provided extended opportunities to examine their articulation and to locate them in word contexts. In other words, identity and segmentation treatments were confounded. A clearer test of the relative effectiveness of segmentation and identification training would require minimizing identity instruction in the segmentation training.

Method

The Problem

Do children better learn about the phonemic structure of words through instruction in generalized manipulation skill, through instruction in particular phoneme identities, or through indirect language experiences? Do children more readily begin using the alphabet to decode when they learn to manipulate phonemes or when they learn the identities of particular phonemes?

To answer this question, I conducted an experimental study comparing the progress of preliterate children given these three

types of instruction. Prereaders were randomly assigned to three instructional programs. One group studied particular phoneme identities; a second learned generalized phoneme manipulation skills; and a third, a treated control group, worked with shared reading and the language experience approach. To control for hidden bias, I used a double-blind procedure in which neither the participants nor the posttest examiner was aware of treatment assignments. At issue were (a) the differential effects of instruction on outcome measures of phoneme manipulation ability (i.e., skill in blending, isolating, and segmenting phonemes); (b) knowledge of phoneme identities (i.e., recognition of particular phonemes in spoken word contexts); (c) ease of learning correspondences (i.e., the number of trials required to match up a set of letters and phonemes); (d) phonetic cue reading (i.e., using initial consonants to identify written words from known alternatives); and (e) decoding (i.e., identification of unfamiliar words from spellings alone). Also of interest was whether children would differ in their attitudes toward instruction in phoneme identities, phoneme manipulation training, or a language experience approach.

Participants

Kindergarten children in five classrooms in a small city in the southeastern United States participated in the study during the early part of the second semester of the kindergarten year. Three of the classrooms were in two public schools, and two were in a Catholic parochial school. The public school children represented a wide range of socioeconomic statuses, whereas the parochial school children were largely from upper-middle-class backgrounds. Sixty-one children returned signed permission forms, a condition of participation. Of these, 32 were boys (52%) and 29 were girls (48%); 20 children were Black (33%), 38 children were White (62%), and 3 were Hispanic (5%). English was the native language of all participants. The average age of the children was 5.9 years ($SD = 0.40$). Eight children were screened from the experiment during pretesting; 3 children relocated before instruction began, and 2 other children could not be matched with partners for instruction, leaving 48 participants in the treatment conditions.

Pretests

I pretested the children for word identification, oral vocabulary, alphabet knowledge, and phoneme awareness. Data were gathered in individual testing sessions in relatively quiet areas outside the children's regular classrooms.

Word identification. A preprimer word list and passage from the Basic Reading Inventory (BRI), Fifth Edition, Form A (Johns, 1991) was used to screen out children who could read more than three preprimer words. Five children were excluded on this basis. The mean BRI word recognition score for eligible children was 0.36 words ($SD = 0.84$).

The test of phonetic cue reading (TPCR), an experimenter-constructed reading analog test similar to measures used by Byrne and Fielding-Barnsley (1990), assessed ability to use initial consonant letters to distinguish words differing by only the beginning phoneme. Items were rhyming words that differed only in their initial consonant. For example, the examinee was shown a card with the printed word *SELL* and was asked, "Is this *sell* or *tell*?"

Oral vocabulary. Oral vocabulary knowledge was assessed using the Peabody Picture Vocabulary Test, Form L (PPVT; Dunn & Dunn, 1981). Three children with raw scores below 37 were excused from participation. The mean PPVT raw score for eligible children was 64.7 ($SD = 14.6$), corresponding to a standard score of 97 for children 5.9 years old.

Alphabet knowledge. An experimenter-constructed measure of alphabet knowledge was administered as a pretest. In this recognition paradigm, the 26 uppercase letters were printed in groups of 5 or 6 on laminated paper in 48-point Times New Roman font. Participants were asked to find them by name (e.g., "Show me H"). Participants proved to be highly proficient at recognizing letters using this procedure, correctly identifying a mean of 24.2 letters ($SD = 4.09$), a strong ceiling effect.

Phoneme awareness. The tests of phoneme manipulations (TPM), an experimenter-constructed measure requiring respondents to blend, isolate, and segment phonemes in spoken words, was administered both at pretest and at posttest. The TPM was adapted from measures used in earlier studies (Stahl & Murray, 1994) using puppets to make the assessment more gamelike and by including an introductory set of linguistically simple items.

The Test of Phonological Awareness (TOPA; Torgesen & Bryant, 1994), a commercially published test of phoneme identity knowledge, was modified for purposes of this study. The standard instructions for the TOPA, which require children to compare the beginnings or endings of illustrated words for common sounds without hearing the target sounds in isolation, were modified to direct the examiner to explicitly pronounce the target phoneme. For example, in the adapted version, the examiner pronounced the target phoneme for the first word (e.g., "Girl begins with the sound /g/"), named the other pictures, and told the children to "show me the picture of the word that begins with /g/ as in girl." In the first 10 items the phonemes to be matched were initial consonants (the original kindergarten-level TOPA), and in the 10 remaining items the phonemes to be matched were final consonants (the TOPA first-grade level).

No significant difference between groups was found on any of the pretests, suggesting that the groups were generally of equal knowledge and ability at the outset of the study.

Posttests

All posttests except the measures of mastery during the letter-phoneme trials were administered by a doctoral student who did not know the children's instructional assignments.

Phoneme awareness. Posttests for phoneme awareness included (a) an alternate form of the TPM and (b) the Word-to-Word Matching Test (WWMT) from Gunning (1992), modified to include additional items requiring matching of final phonemes. As an example, the examiner asked, "Which word begins like *bus* and *bun*: *book*, *fish*, or *jet*?" To parallel the construction of the TOPA, I devised a second section in which the target phoneme to be matched was the final phoneme.

Reading. Reading-related posttests included the following measures:

1. A count of trials to mastery in learning eight letter-phoneme correspondences during the final lesson, to a maximum of 20 trials. The number of perfect trials was recorded, with credit given for all trials after a mastery criterion of 2 consecutive perfect trials was met.

2. An alternate form of the TPCR.

3. An experimenter-constructed test of decoding, which featured simplified spellings of two- and three-phoneme words constructed of the eight letters whose correspondences were taught to all participants. The spellings of the words were simplified so that a simple one-to-one relationship existed between phonemes and letters (e.g., ET represented the word *eat*).

4. An experimenter-constructed attitudinal measure. Children responded to a Likert scale of images of the cartoon character Garfield (McKenna & Kear, 1990). Participants were asked to rate their school, their instructional program, the letter-phoneme corre-

spondence lesson, and the posttesting experience they had just completed.

Assignment of participants. Children were taught in pairs to increase the efficiency of instruction and to cushion the novelty of work outside the classroom with the familiarity of a classmate partner. Fifty eligible participants were matched for pretested phoneme awareness and randomly assigned to one of three groups. Matching was based on the sum of the scores on the phoneme awareness pretests. Children within each classroom were ranked on this summary measure and then paired so that the highest scoring child was paired with the lowest scoring child, the second highest with the second lowest, and so on. These pairs were then assigned to one of three instructional programs by a random drawing. Because children were to work in pairs, an even and equal number of participants were selected per group per classroom. For example, in one classroom with 12 eligible participants, two pairs of children were assigned to each of the three instructional programs. In this way, the differential effects of literacy instruction in their regular kindergarten classes were equalized across groups. Two children representing median scores within their class distributions could not be matched, leaving 48 participants. Because of the varying availability of participants within classrooms, I gave priority to assignments in the phoneme identity and manipulation groups (i.e., to the groups whose performance was most informative concerning the research hypothesis). Accordingly, the experiment proceeded with 18 participants in each of the phoneme awareness teaching groups and 12 participants in the language experience group.

Paired participants in each group were instructed in a planned series of 15 lessons for 15–20 min per day over the course of 15 consecutive schooldays, although special activities or holidays occasionally delayed the instructional programs. All lessons were taught by me. Lessons for the phoneme identity and manipulation groups were scripted to ensure uniformity of instruction. The teaching took place in quiet areas outside of the kindergarten classrooms. Children who were absent received makeup lessons to enable them to complete their programs.

Instructional Programs

The three instructional treatments in this experiment involved programs about phoneme identities, phonological manipulation, and language experience. (See Table 1 for an overview of instructional treatments and the Appendix for a more detailed description of the lessons.)

The phoneme identity treatment was designed to familiarize participants with a limited set of phonemes. The program introduced eight particular phonemes (/f/, /l/, /m/, /n/, /s/, /t/, /i/, and /ei/) with activities to make these phonemes memorable and to help children recognize the phonemes in word contexts. Participants learned an alliterative tongue twister featuring the target phoneme and then stretched words from the tongue twister to see how the isolated phoneme sounded and felt in spoken words. Identity participants looked for each target phoneme in both initial and final positions in example words. Perforce, the identity group engaged in some phoneme manipulation activities, but only to blend or segment the target phoneme. A limited admixture of blending and manipulation activities was deemed necessary to show children the identity between the isolated phoneme approximations and the coarticulated phonemes in spoken words. Manipulation activities for the identity group were included to demonstrate this identity rather than to teach blending and segmentation as skills.

The activities of the phonological manipulation group were designed to parallel the instruction in the phoneme identity group but to exclude activities that directly taught participants about the identities of particular phonemes. Children worked with a wide

Table 1
Lessons During Instructional Period

Day	Identity	Manipulations	Language
1-8	Introduce phoneme with semantic representation (Open Court sound cards)	Demonstrate alphabetic principle (locking blocks)	Odd days: Read alouds
	Learn tongue twister	Learn rhyming verse	Even days: Shared story writing
	Isolate initial phoneme in tongue twister (puppet)	Isolate phonemes in rhyming verse (puppet)	
	Stretch and explore articulation (stretchable figure)	Stretch initial phonemes (stretchable figure)	
	Isolate phoneme in final-medial position (puppet)	Isolate phonemes in final-medial position (puppet)	
9-14	Sound-to-word matching	Onset-rime segmentation	
	Blend to partial words	Onset-rime blending	
	Blending (8-phoneme set)	Blending (unrestricted phoneme set)	Odd days: Read alouds
	Segmentation (8-phoneme set)	Segmentation (unrestricted phoneme set)	Even days: Shared story writing
15	Word-to-word matching (8-phoneme set)	Word-to-word matching (unrestricted phoneme set)	
	Learn letter-phoneme correspondences (A, E, F, L, M, N, S, and T)	Learn letter-phoneme correspondences (A, E, F, L, M, N, S, and T)	Learn letter-phoneme correspondences (A, E, F, L, M, N, S, and T)

variety of phonemes found in the words of nursery rhymes. Their activities involved the manipulations of blending and segmentation, first as onset and rime activities and later using the complete phoneme sequence. The manipulation group practiced blending and segmentation as skills rather than as demonstrations of the identity of phoneme approximations with actual phonemes in word contexts. Because they were not explicitly taught about the particular phonemes they used in blending and segmentation, their manipulation activities were presumed not to be applications of identity knowledge.

The activities of the language experience group were designed to provide an equivalent amount of friendly educational attention without explicit instruction in phoneme awareness (i.e., to provide a Hawthorne control). These participants engaged in developmentally appropriate early literacy activities. They looked at the illustrations in storybooks as they were introduced, listened as the stories were read aloud, talked about the stories, and jointly composed their own stories. Their compositions were typed in a large font and presented during the next lesson as texts for cued recitation.

All participants were individually taught the letter-phoneme correspondences for eight letters that would appear in posttest materials (F, L, M, N, S, T, E, and A) in their final session (Day 15) using a paired-association method. In this lesson, which was the same across instructional groups, participants were shown cards with printed capital letters, asked to repeat a spoken phoneme approximation for each letter, and then tested with feedback until they could recite the phoneme approximation for all eight letters without error in 2 consecutive trials or until 20 trials had been completed.

Note that none of the participants studied letter-phoneme correspondences until the final instructional session. Neither phonological instructional group used letters to represent phonemes during their instructional program; their instructional conversations

were strictly oral, or occasionally in the case of the identity group, they were cued by phoneme illustrations (e.g., a picture of a flat tire to illustrate the phoneme /s/). Language experience participants, of course, were exposed to letters when composing and attempting to reread their stories, but no explicit reference was made to letter identities. Although the use of letter representations for phonemes is instructionally powerful (Adams, 1990; Bradley & Bryant, 1983; Hatcher, Hulme, & Ellis, 1994), the design here was to teach a phonological awareness program without introducing phonics instruction.

Results

Phoneme Awareness

Phoneme awareness was examined both as phoneme manipulation ability, using the TPM, and as phoneme identity knowledge, using the revised TOPA and the WWMT.

TPM. The means and standard deviations for the TPM are presented in Table 2. Because the TPM was administered as both a pretest and a posttest, I analyzed the data for the entire battery and for each subtest using a 3 (groups) \times 2 (time) analysis of variance (ANOVA), with the time factor considered to be a repeated measurement of the three treatment groups. Of particular interest for the questions guiding this research were significant interactions between instructional groups and time, which imply differential growth under the three instructional conditions. Interactions were examined using an analysis of gain scores, with Helmert orthogonal contrasts to test (a) the effectiveness of phoneme awareness treatments (identity and manipulations) versus the language experience treatment (language) and (b)

Table 2
Mean Scores by Instructional Group
on Phoneme Manipulation Measures

Test	Identity (<i>n</i> = 18)		Manipulations (<i>n</i> = 18)		Language (<i>n</i> = 12)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Pretest						
TPM total score	9.56	9.31	10.50	8.05	10.75	11.07
Blending	1.61	2.40	2.39	2.48	3.42	3.40
Isolation	6.89	6.67	6.83	5.25	5.50	6.65
Initial	4.33	3.96	4.44	3.22	4.25	4.94
Final	2.56	2.96	2.39	2.87	1.25	2.18
Segmentation						
Words	1.06	1.39	1.27	1.99	1.83	2.12
Phonemes	4.56	6.35	7.00	7.20	8.17	8.85
Posttest						
TPM total score	17.56	12.71	24.83	12.41	18.00	12.58
Blending	6.39	4.50	9.39	4.15	5.50	4.58
Isolation	9.89	7.48	12.22	5.14	10.67	6.56
Initial	5.89	3.97	7.56	3.09	7.00	3.46
Final	4.00	4.07	4.67	2.66	3.67	3.98
Segmentation						
Words	1.39	2.03	4.61	4.85	2.17	2.37
Phonemes	10.00	7.75	17.78	11.71	14.75	7.58

Note. The maximum score for the TPM was 50, broken down as follows: blending, 15 points; isolation, 20 points, broken down into initial and final, 10 points each; and segmentation (words), 15 points. Maximum points for segmentation (phonemes), a count of the number of phonemes isolated regardless of success in full segmentation, was 40. TPM = tests of phoneme manipulations.

the effectiveness of identity instruction (identity) versus generalized manipulation instruction (manipulations).

A repeated measures ANOVA of TPM total scores revealed a statistically significant Group \times Time interaction, $F(2, 45) = 4.27, p = .02$, indicating differential phoneme manipulation performance between groups. In other words, participants changed in their ability to manipulate phonemes over the course of the study depending on their instructional program. This interaction is shown in Figure 1. Helmert orthogonal contrasts, based on a separate ANOVA on gain scores computed from the pre- and posttest scores on the TPM, indicated that the mean of the combined phoneme awareness instructed groups (identity and manipulations) did not exceed that of language, $t(45) = 1.54, p = .13$, but that manipulations outperformed identity, $t(45) = -2.49, p = .02$. The TPM effect size for manipulations relative to language (the treated control group) was 0.54 *SD*, a moderately strong effect.

A repeated measures analysis of the blending subtest of the TPM showed a statistically significant Group \times Time interaction, $F(2, 45) = 7.34, p = .002$, indicating that the effects of the instructional program on blending performance were not distributed equally between the treatment groups. The interaction is shown in Figure 2. Helmert orthogonal contrasts based on a separate ANOVA on gain scores indicated that the combined phoneme awareness instructional groups significantly outscored language, $t(45) = 3.31, p = .002$, and that manipulations tended to outperform

identity, although differences only approached statistical significance, $t(45) = -1.93, p = .06$. The blending effect size for manipulations relative to language (treated controls) was 0.85 *SD*, a large effect; identity registered a small effect of 0.19 *SD*.

Although no statistically significant Group \times Time interaction was found for the TPM isolation subtest, $F(2, 45) = 1.59, p = .22$, a repeated measures analysis of the segmentation results showed a statistically significant Group \times Time interaction, $F(2, 45) = 4.97, p = .01$, indicating that instructional groups differed in full segmentation performance at posttest. This interaction is shown in Figure 3. Helmert orthogonal contrasts, using a separate analysis of gain scores, showed no statistically significant difference between the mean of the combined phoneme awareness instructed groups (identity and manipulations) and language, $t(45) = 1.41, p = .16$. However, manipulations significantly outgained identity in full segmentation, $t(45) = -2.82, p = .007$. The segmentation effect size for manipulations relative to language (the treated control group) was 1.03 *SD*, a large effect.

Tests of phoneme identity knowledge. The mean scores and standard deviations of the revised TOPA, administered at pretest, and the adaptation of the WWMT are presented in Table 3. Instructional groups did not differ significantly at pretest on the sound-to-word matching test, the TOPA, $F(2, 45) = .21, p = .81$. At posttest, no reliable differences between groups were detected on the WWMT, $F(2, 45) = 0.42, p = .66$. A repeated measures ANOVA was computed to test for differences in group gains over time after removing variation attributable to kindergarten class placement. To facilitate this comparison, I normalized scores on the TOPA and the WWMT. No statistically significant group differences were found, $F(2, 33) = 0.08, p = .92$, nor was there evidence of overall gains across time, $F(1, 33) = 0.04, p = .84$, or a Group \times Time interaction, $F(2, 33) = 1.00, p = .38$. Mean scores indicate that the WWMT was more difficult than the TOPA sound-to-word matching test. The mean scores for the entire sample were 11.40 (*SD* = 4.30) for TOPA (illustrated) and 10.52 (*SD* = 3.33) for word-to-word matching (no illustrations), even though three fourths of the sample had just completed 15 days of phoneme awareness instruction.

Table 4 shows the intercorrelations between the phoneme identity subtests, including initial and final phoneme subtests on both the TOPA (sound-to-word matching) and the WWMT (word-to-word matching). Correlations between all initial and final phoneme matching subtests across the sound-to-word and word-to-word tests were statistically significant ($p < .01$). Of particular interest was the apparent stronger correlation within locations (initial and final) across tests than the correlation of subtests within tests. The two initial-phoneme matching subtests correlated .68, and the two final-phoneme matching subtests correlated .55, stronger relationships than those between the initial and final subtests of the sound-to-word matching test (.45) and between the subtests of the WWMT (.37).

Correspondence learning. No reliable differences between groups were detected in participants' capacity for

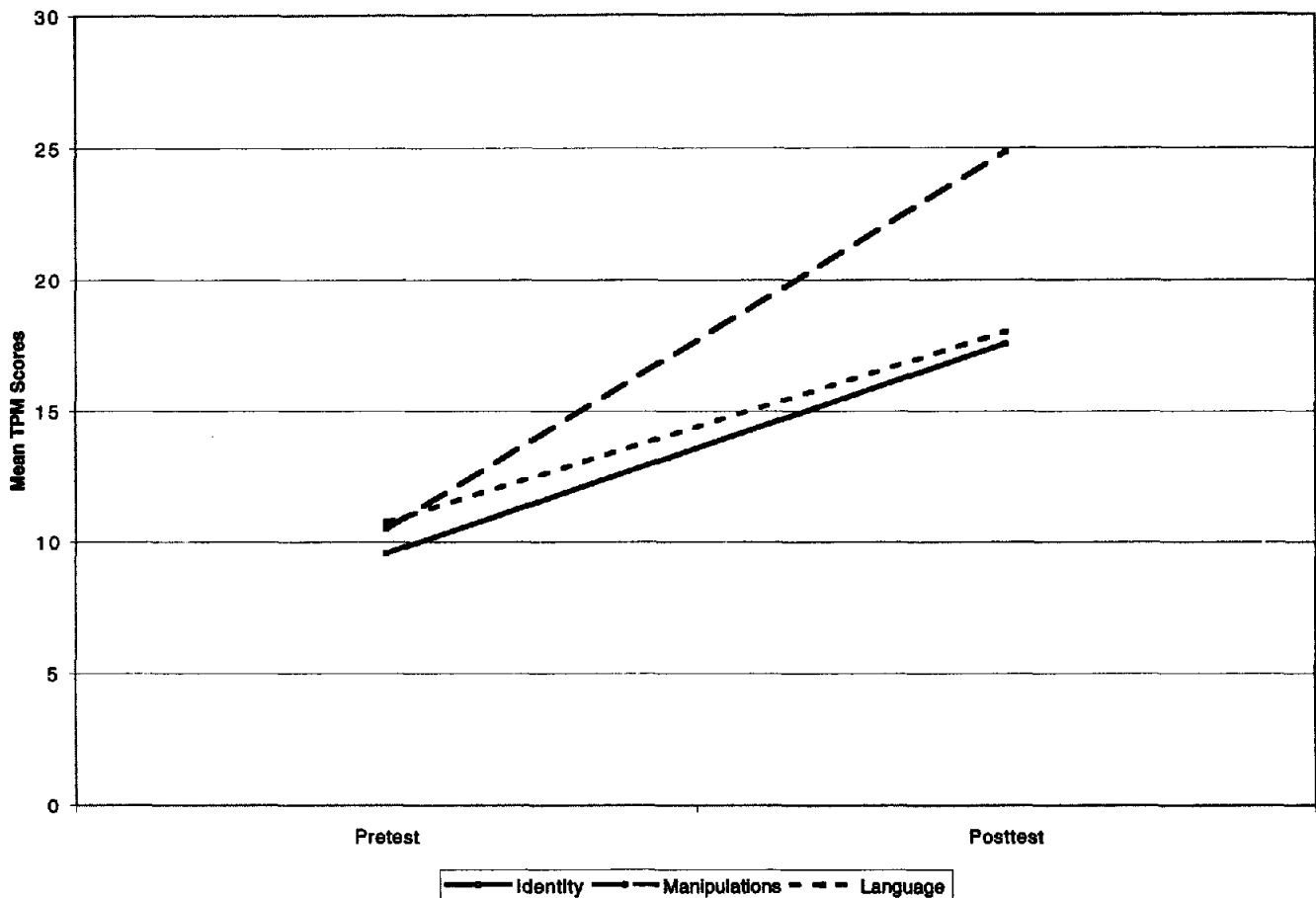


Figure 1. Change in phoneme manipulation scores by instructional group. TPM = tests of phoneme manipulations.

learning letter-phoneme correspondences. Table 5 shows the mean scores on the correspondence learning trials. Instructional groups did not differ significantly on the number of trials needed to master the eight letter-phoneme correspondences taught, $F(2, 45) = 0.01, p = .99$. Similarly, no differences were revealed when the number of correct correspondence items was considered, $F(2, 45) = 0.02, p = .98$.

Some differences in the ease of learning of particular letter-phoneme correspondences emerged from the data (see Table 6). A one-way ANOVA revealed significant differences among correspondences in their ease of learning, $F(7, 329) = 15.40, p < .01$. These data indicate that the long vowel correspondences *E* and *A*, which are the same as the letter names for the vowels, were acquired most rapidly, followed by three unvoiced consonants *S*, *T*, and *F*. The three voiced consonants *M*, *L*, and *N* proved more difficult to learn.

Word Reading

The ability to generate pronunciations of written words was measured by tests of phonetic cue reading and decoding.

The means and standard deviations for these measures are presented in Table 7.

Phonetic cue reading. Because the TPCR was administered both before and after instruction, I analyzed the data using a 3 (treatment groups) \times 2 (time) ANOVA, with the time factor considered to be a repeated measurement of the three treatment groups. No evidence was found for a statistically significant main effect of group, $F(2, 45) = 0.14, p = .87$, or of time, $F(1, 45) = 2.9, p = .10$. The Time \times Group interaction did not meet the criterion for statistical significance but revealed a strong trend in the data, $F(2, 45) = 2.49, p = .09$, displayed in Figure 4. In an analysis in which the effect of class assignment was statistically removed from the effects of instructional group, the interaction was statistically significant, $F(2, 33) = 4.13, p = .03$. Helmert orthogonal contrasts based on an analysis of gain scores on the TPCR revealed a statistically significant difference in the contrast between identity and manipulations, $t(45) = 2.01, p = .05$, indicating that identity surpassed manipulations in acquiring phonetic cue reading ability. The effect size for identity on the TPCR relative to language (the treated controls) was 0.30.

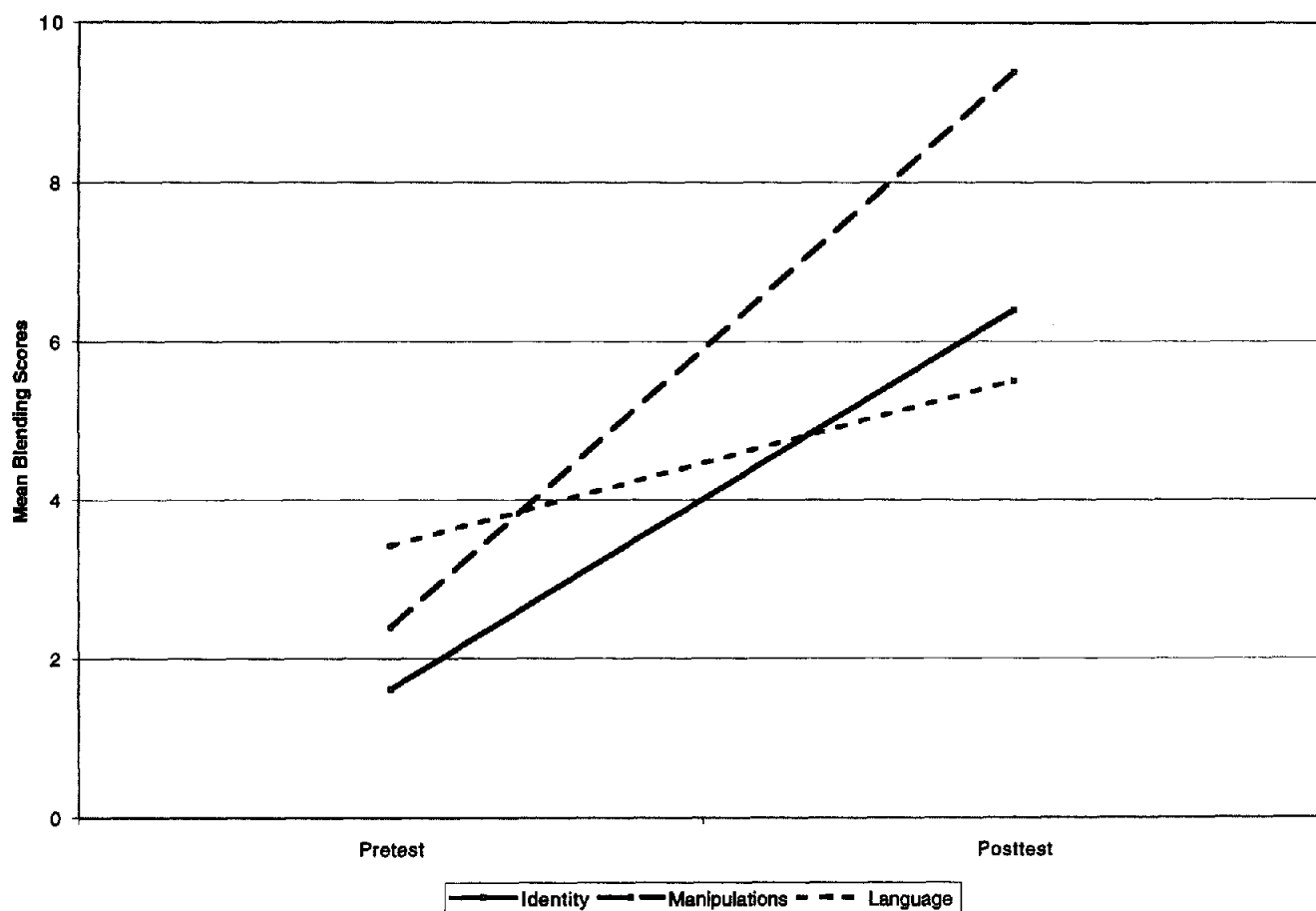


Figure 2. Change in blending scores by instructional group.

Because the TPCR offered children a forced choice between two alternatives, one could expect a score of 6 on the 12-item test by chance alone. It is interesting, then, to examine beyond-chance scores on phonetic cue reading, in which a beyond-chance score is defined by a score of 9 or more correct responses, a score that would occur by chance alone only 8% of the time. Using this criterion, 6 of the 18 identity participants moved from a chance score to a beyond-chance score; only 2 members of manipulations and 1 child in language made a similar gain. Although most children failed to score beyond chance on the phonetic cue reading task after instruction, an examination of the data revealed that participants in identity made net gains in all five kindergarten classrooms. Manipulations made gains in three classes and lost ground in two, and language registered gains in two classes and losses in three.

The distribution of scores on the TPCR appeared to depart from normality with a tendency toward bipolarity. A bipolar distribution might result from the nature of the test. Because the items required a forced choice between two alternatives, a child with no ability to use phonetic cues could still be expected to guess half the items (6 of 12) correctly. However, a child who could use phonetic cues to decide between the alternatives could be expected to answer most

or all of the items correctly, creating a second mode near the test ceiling.

Wilcoxon's matched-pairs signed-ranks test (Langley, 1970; Siegel, 1956), a nonparametric statistic, was used to compare pretest and posttest differences within each treatment group. Statistically significant pretest-posttest improvement occurred only with identity, $z(17) = -2.41, p = .016$. Pretest-posttest differences were not statistically significant for manipulations, $z(17) = -0.55, p = .58$, or for language, $z(11) = -0.24, p = .81$.

Decoding. The test of decoding required participants to decode simplified spellings of words constructed from letter-phoneme pairings taught during training. An ANOVA showed no statistically significant difference between instructional groups in their performance on the test of decoding, $F(2, 45) = 0.60, p = .55$.

Attitude Toward Instructional Program

Participants rated their instructional programs (identity, manipulation, or language) and other aspects of their participation on a 4-point Likert-type scale using Garfield images adapted from McKenna and Kear (1990). Results are shown in Table 8. ANOVAs indicated no differences be-

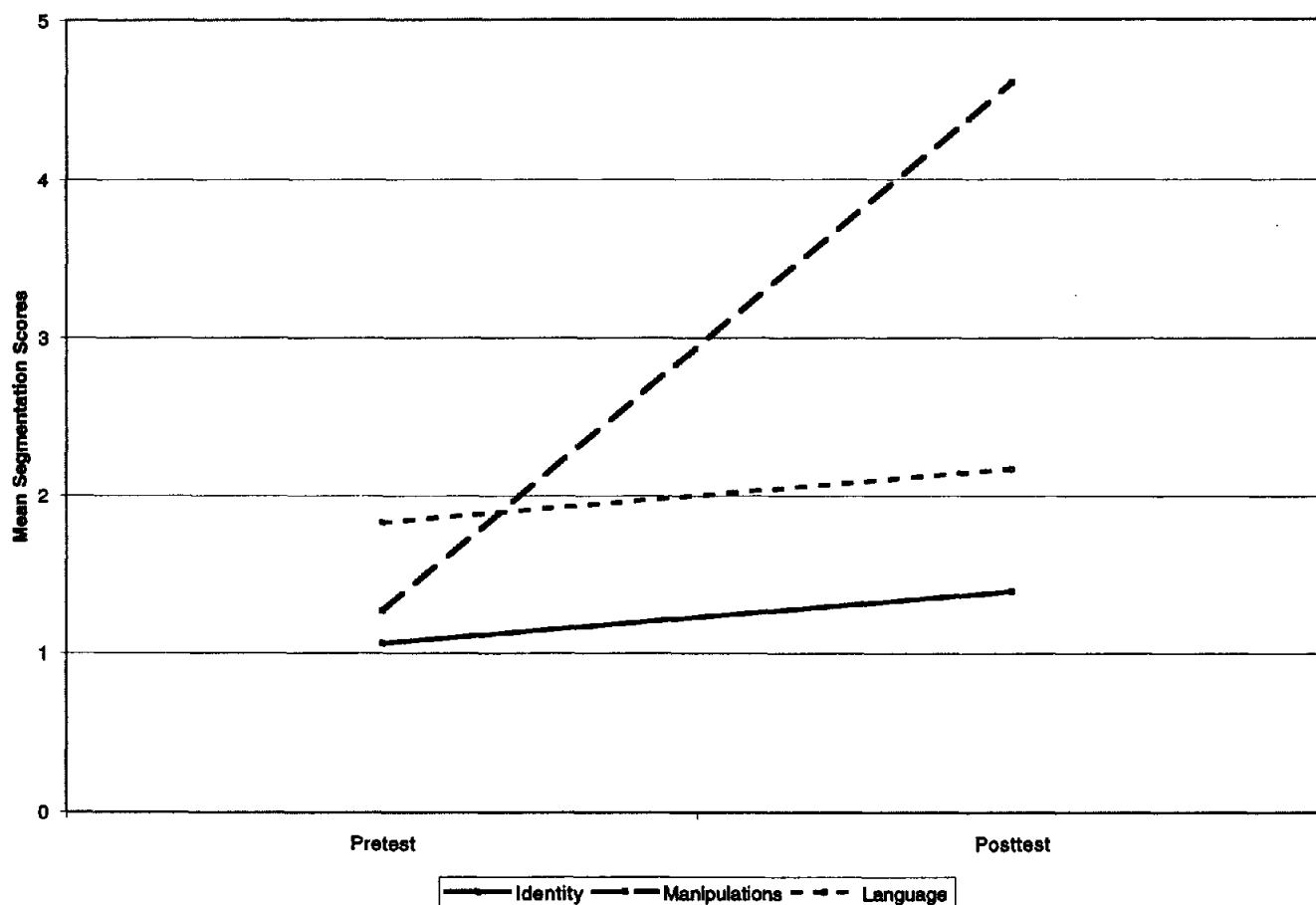


Figure 3. Change in segmentation scores by instructional group.

Table 3
Mean Scores by Instructional Group
on Phoneme Identity Measures

Test	Identity (n = 18)		Manipulations (n = 18)		Language (n = 12)	
	M	SD	M	SD	M	SD
Pretest						
TOPA sound-to-word matching (total)	11.83	3.31	10.89	4.30	11.50	5.73
Initial	7.33	2.45	7.22	2.44	6.17	3.43
Final	4.50	1.50	3.67	2.57	5.33	2.84
Posttest						
Word-to-word matching (total)	9.94	2.92	10.89	2.97	10.83	4.43
Initial	6.17	2.28	6.50	2.09	6.50	2.84
Final	3.78	1.35	4.39	1.69	4.33	2.10

Note. Maximum on each test is 20, with 10 items targeting the initial phoneme and 10 targeting the final phoneme. TOPA = Test of Phonological Awareness.

tween groups in attitude toward school, $F(2, 45) = 1.20, p = .31$, in attitude toward instructional program, $F(2, 45) = 0.14, p = .87$, in attitude toward the letter-phoneme correspondence lesson, $F(2, 45) = 0.10, p = .90$, or in attitude toward the posttest battery, $F(2, 45) = 0.79, p = .46$. Ratings tended to be uniformly high across treatment groups.

Discussion

This study was designed to determine whether insight into alphabetic writing depends on knowledge of particular phoneme identities or on skill in phoneme manipulations. These two different concepts of phoneme awareness suggest divergent paths to instruction.

Table 4
Intercorrelations Between Phoneme Identity Subtests

Subtest	1	2	3	4
1. Sound to word initial	—	.45*	.68*	.39*
2. Sound to word final		—	.49*	.55*
3. Word to word initial			—	.37*
4. Word to word final				—

* $p < .01$, two-tailed.

Table 5
*Mean Scores by Instructional Group
on Correspondence Learning*

Measure	Identity (<i>n</i> = 18)		Manipulations (<i>n</i> = 18)		Language (<i>n</i> = 12)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Trials to criterion	11.89	8.40	11.89	8.76	12.17	8.19
No. of items correct	133.67	31.7	132.44	30.9	134.67	25.9

Note. Trials ranged from a minimum of 2 to a maximum of 22. There were 160 possible correspondence items (8 items per trial \times 20 trials).

Phoneme Manipulations

Results of the TPM provide evidence for the superiority of conventional blending and segmentation instruction in improving the ability to manipulate phonemes. Participants taught to blend and segment across a range of phonemes demonstrated superior improvement in phoneme manipulation over time relative to the other instructional groups on the total TPM battery, on the blending subtest, and on the segmentation subset. These data support the commonsense explanation that when instruction emphasizes phoneme manipulations, children learn what they were taught. By contrast, teaching beginners about phoneme identities does not seem to enhance phoneme manipulation skill. This suggests that phoneme manipulation skill may be relatively independent of the knowledge of phoneme identities. Consistent with this explanation, the gains made by the manipulations group did not translate into alphabetic insight on the TPCR.

Phoneme Identity Knowledge

Whether children acquired differential knowledge of phoneme identities in this study remains unclear. No group differences emerged on the WWMT posttest. In addition, the instructional groups demonstrated no reliable performance differences on the isolation subtest of the TPM, the pretest version of which correlated strongly ($r = .75$) with the modified TOPA (Stahl & Murray, 1994). Notwithstanding,

Table 6
Mean Perfect Trials by Letter-Phoneme Correspondence

Correspondence	<i>M</i>	<i>SD</i>
A = /ei/	18.90	1.79
E = /i/	18.33	3.52
S = /s/	18.31	1.69
T = /t/	17.96	3.25
F = /f/	16.40	5.40
M = /m/	15.96	5.96
L = /l/	14.13	6.97
N = /n/	13.48	7.27

Note. The maximum number of perfect trials was 20.

Table 7
*Mean Scores by Instructional Group
on Reading Analog Measures*

Test	Identity (<i>n</i> = 18)		Manipulations (<i>n</i> = 18)		Language (<i>n</i> = 12)	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Pretest						
Phonetic cue reading	7.67	2.45	8.78	2.34	8.33	2.64
Posttest						
Phonetic cue reading	9.33	2.70	8.83	2.53	8.41	3.09
Decoding	2.28	3.58	1.67	2.40	1.67	1.64

Note. The maximum score on the test of phonetic cue reading and on the test of decoding was 12.

ability differences emerged at posttesting on the TPCR, a measure presumed to require phoneme identity knowledge.

A likely explanation is that the memory demands of the WWMT obscured learning gains in identity knowledge. On this test the examiner does not pronounce the target phonemes separately, and unlike the TOPA, there are no illustrations to support working memory. The higher mean scores on the TOPA pretest than on this posttest, despite considerable instruction, suggested that the WWMT was more difficult. The task of holding three words in memory while making mental comparisons with the phonological structure of a fourth word is probably too taxing for kindergarten children to exercise their emergent knowledge of phoneme identities. For this reason, the WWMT posttest is probably not a valid measure of phoneme identity knowledge for kindergarten children.

The failure to independently demonstrate that the identity group acquired useful knowledge of phoneme identities is a limitation of this study. I attribute this to an errant choice of phoneme identity measures at posttest and perhaps more generally to the limited progress in learning to measure phoneme awareness in a way unconfounded by reading ability. The identity treatment was designed to produce this knowledge, and identity participants revealed identity knowledge indirectly in demonstrating alphabetic insight. Nevertheless, further evidence is needed to demonstrate unambiguously that identity knowledge is causal in gaining alphabetic insight.

Correspondence Learning

Neither the number of trials required to master letter-phoneme correspondences nor the number of correctly reported correspondences during these trials differed between the instructional groups. Familiarity with phoneme identities seems to play little if any role in learning associations between isolated phoneme approximations and letter forms. The independence of letter-sound knowledge and phoneme awareness explains the common phenomenon of the child who can report the phoneme approximations of

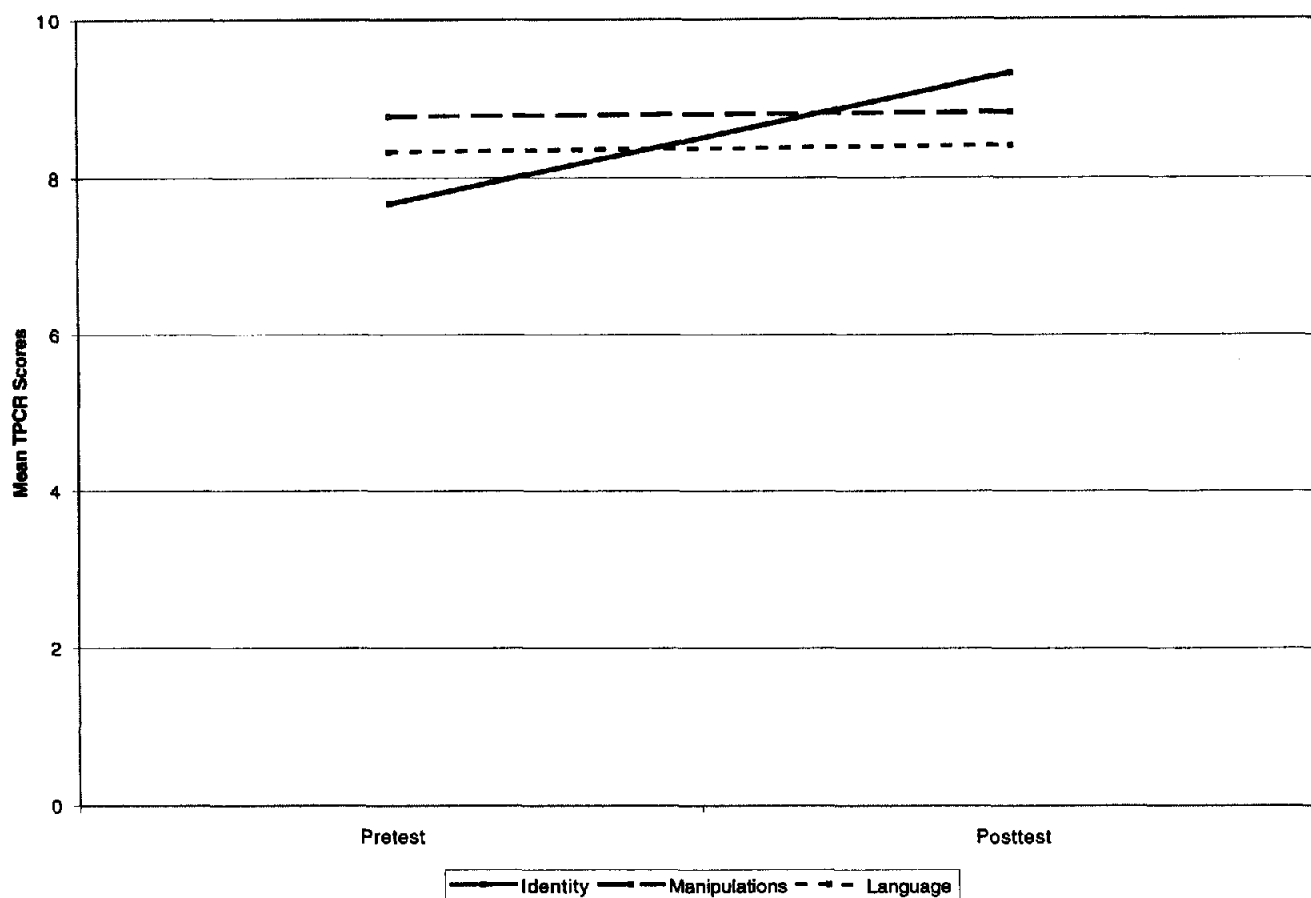


Figure 4. Change in phonetic cue reading scores by instructional group. TPCR = test of phonetic cue reading.

letters (e.g., "s says /s/'") but who is unable to make use of this knowledge in decoding words.

Phonetic Cue Reading

Results of the TPCR lend some support to the view that phoneme identity instruction enhances early application of the alphabetic principle in using initial letters to signal

phonemes to recognize partially activated words. The omnibus ANOVA showed a strong trend toward group differences in improving phonetic cue reading. Post hoc contrasts indicated a statistically significant difference favoring identity-instructed participants over manipulation-trained participants. Nonparametric analyses using Wilcoxon's matched-pairs signed-ranks test showed statistically significant pretest-posttest improvement only with the identity group. The

Table 8
Means of Participant Evaluation of Instructional Activities

Question	Identity (n = 18)		Manipulations (n = 18)		Language (n = 12)	
	M	SD	M	SD	M	SD
What do you think about school so far this year?	3.28	1.27	3.78	0.73	3.67	0.89
What do you think about the lessons you left class for every day?	3.50	1.04	3.39	1.04	3.58	0.90
What do you think about the last lesson, when you learned the sounds for letters?	3.28	1.02	3.17	0.99	3.33	1.15
What do you think about the tests you just finished?	3.06	1.39	3.28	1.07	3.58	0.69

Note. Scores ranged from 4 (most positive) to 1 (most negative).

small improvements in phonetic cue reading registered by the manipulations and language groups fell within a range that could have occurred by chance. These results suggest, but do not provide conclusive evidence, that kindergartners in the identity treatment gained an advantage in initial decoding ability.

Phonetic cue reading demonstrates insight into the alphabetic principle that letters represent phonemes and hence that the spelling of a word maps the sequence of phonemes in the pronunciation. Knowledge of phoneme identities is needed to recognize phonemes, allowing beginners to match up letters and phonemes. Children can apparently gain skill in manipulating phoneme approximations without focusing on phonemes as common word elements and thus without achieving the alphabetic insight that letters signal stable elements in pronunciations. In other words, learning phoneme identities and learning to manipulate phonemes appear to be distinct tasks for the beginning reader.

Share (1995) defined phoneme awareness as "the ability to recognize identity between learned letter names or sounds and sublexical phonological segments in spoken words" (p. 161). Share's definition of phoneme awareness is supported by the disparate success of the manipulation and identity groups in the current study. Participants in the manipulation group gained skill in manipulating phonemes, but, unlike the identity participants, they did not seem to recognize that the sounds they could manipulate were sublexical segments found in spoken words. They gained the ability to deal with letter sounds as phones (i.e., speech sounds), but not as English phonemes (the vocal gestures from which English words are composed).

Decoding

Not surprisingly, the kindergarten participants in this study showed little ability to decode simplified spellings of words. The mean score across instructional group was approximately 2 of 12 words, and 28 of 48 children were unable to decode any words. Because mean performance was so low, the few individual successes in the test of decoding were all the more remarkable. Although children were screened for word recognition and no instruction in reading words was offered to any children, 6 participants (4 in identity and 2 in manipulations) correctly decoded at least half of the words without context using only the simplified spellings. This accomplishment indicates a major breakthrough in understanding and applying the alphabetic cipher to recognize words. The ability to decode pseudowords is the strongest known correlate of word recognition ability (Jorm & Share, 1983; Rack, Snowling, & Olson, 1992; Stanovich & Siegel, 1994; Wagner & Torgesen, 1987), accounting for more than half the variance in word recognition.

Context-free decoding requires both ready access to phoneme identities and phoneme manipulation ability. Blending is implicated because to decode, a reader must activate and hold a phoneme sequence in working memory while uniting the separate vocal gestures into an approximate pronunciation sufficient for lexical access. Each of the six successful decoders were above the mean in blending.

Segmentation is probably also implicated in both skilled word recognition and spelling ability.

Attitude Toward Instructional Program

Byrne and Fielding-Barnsley (1990) suggested that children find phoneme identity instruction rewarding and generalized manipulation instruction frustrating. Language experience approaches are thought to capture children's natural interest in texts as "talk written down." However, no differences were detected between instructional groups in their evaluation of their instructional programs, with all programs receiving high marks, averaging about 3.5 on a 4-point scale. Although self-report data obtained with rating scales is a poor substitute for systematic observations of behavior, in this case there was no contradictory evidence in the informal observations of children by the researcher or by the children's classroom teachers. Children typically were delighted to be singled out for special instruction and usually responded well to whatever activities were proposed, including play with nonsensical word elements in phoneme awareness instruction.

Some Interpretative Issues

Can phoneme awareness be dichotomized into knowledge and ability? The results of this study suggest that such a theoretical distinction may help researchers better understand the nature of phoneme awareness. Lewkowicz's (1980) groundbreaking article on phoneme awareness argued persuasively that segmentation depends on recognizing the identity of the phonemes being segmented. Contrary to this view, however, children in the manipulation group in this study made decided progress on blending and segmenting phonemes, yet they showed no significant improvement in phonetic cue reading. The disparate results seem to support the relative independence of identity knowledge and manipulation ability, as surprising as this may seem given the present understanding of phoneme awareness.

Unexpected observations potentially advance the scientific study of reading acquisition. For example, I expected that knowledge of phoneme identities would help children learn letter-phoneme correspondences. Yet, there was not the slightest trend in this direction in the data. This null finding may help clarify what phoneme awareness is: familiarity with the vocal gestures of spoken language, sufficient to recognize them in the context of spoken words. Children associate letter identities with sounds that approximate phonemes but often fail to make a connection between these approximations and the actual sublexical segments. For example, a child observed in a reading clinic was unable to blend *m* to the phonogram *-ice*. Although he could produce a sound "mmm" for the letter *m*, he did not make the connection between the sound he produced and the initial consonant in *mice*. He lacked phoneme awareness.

Did manipulation and identity participants have differential experience with initial phonemes in words, thus confounding the treatments? The lessons for each group were scripted. The manipulation instruction was designed to

parallel the identity instruction in this respect, so that participants in either group received the same amount of practice with initial phonemes. However, the identity group studied the identities of the particular phonemes that would recur in the correspondence task and in the phonetic cue reading test, whereas the manipulation group worked with a nonselect group of phonemes that appeared as the initial segments of words in nursery rhymes. Knowledge of phoneme identities apparently paid off in helping identity children make use of simple correspondences in identifying words.

Phoneme Awareness and Beginning Reading

How does phoneme awareness help children learn to read? Decoding is generally learned in two phases (Ehri, 1994): phonetic cue reading and alphabetic decoding. Attainment of these phases seems to involve different types of phoneme awareness. The strategy of phonetic cue reading, selecting from among a few candidate words already active in memory by translating one or more boundary letters, leads to word identification when strong contextual support is present. Phonetic cue reading depends on knowledge of phoneme identities. For instance, a beginner may recognize the word *me* in a memorized rhyme like "pat-a-cake" by translating the letter *m* into the phoneme /m/, but only if /m/ is recognized as part of the spoken word *me*.

Alphabetic decoding also requires skill with blending and segmentation manipulations. For instance, the ability to generate a pronunciation for the word *me* without strong contextual support requires translation of both the letters *m* and *e* into the phonemes /m/ and /i/, recognition of the identities of /m/ and /i/ in spoken words, and the ability to blend their vocal gestures into a recognizable approximation of the spoken word *me*. Hence, decoding a novel word requires, among other knowledge, some skill with phoneme manipulations.

My data suggest that two levels of phoneme awareness may play different roles in learning to read words. Phoneme identity knowledge seems to be implicated in phonetic cue reading. Recognition of the identity between learned letter names or sounds and sublexical phonological segments in spoken words, when letters reliably signal that identity, appears to be critical for phonetic cue reading. Alphabetic-phase decoding using the complete spelling of a word probably requires additional phoneme manipulation ability. Other research has linked both blending and segmentation abilities with success in decoding and spelling words (e.g., Fox & Routh, 1984).

Implications for Instruction

Not all children require direct instruction in phoneme awareness. Some receive informal instruction and literacy experiences in their homes that prime them to learn to use the alphabet. Their literate tutors may guide their early attempts to read or spell words by exaggerating pronunciations to emphasize the vocal gestures spelled by certain letters. Many children acquire phoneme awareness in the

course of naturalistic encounters with alphabet books (Murray, Stahl, & Ivey, 1996), rhyming and alliterative texts (Maclean, Bryant, & Bradley, 1987), and devising invented spellings (Clarke, 1989). These children tend to learn phoneme identities informally with minimal explanation and practice, and their reading ability thus seems to emerge naturally.

Other children come to school with impoverished literacy backgrounds. Many of these children come from economically marginal homes in which preschool literacy activities give way before the pressures of survival. If schools do not provide explicit instruction in phoneme awareness to help these children gain a foothold in decoding, they may never discover the pleasure and utility of reading.

The instructional programs used in this study offer useful explanations and activities for direct teaching of phoneme awareness. The independent effects found for the identity and manipulation programs suggest that both types of instruction are valuable. After children have caught onto how letters cue the phonemes of spoken words, learning to manipulate phonemes by blending and segmentation manipulations will likely help beginners progress into sequential decoding. However, because knowledge of phoneme identities seems more helpful in gaining initial insight into alphabetic writing, instruction in phoneme identities is likely of greater value than manipulation instruction for children who have not yet demonstrated alphabetic insight. Activities focused on the identities of individual phonemes, which make these phonemes familiar and memorable, and that help children recognize their identities in words could well be incorporated into early literacy programs that contain other activities known to be helpful in preparing children to read.

References

- Adams, M. J. (1990). *Beginning to read: Thinking and learning about print*. Cambridge, MA: MIT Press.
- Ball, E., & Blachman, B. (1991). Does phoneme awareness training in kindergarten make a difference in early word recognition and developmental spelling? *Reading Research Quarterly*, 26, 49-66.
- Bradley, L., & Bryant, P. E. (1978). Difficulties in auditory organisation as a possible cause of reading backwardness. *Nature*, 271, 746-747.
- Bradley, L., & Bryant, P. E. (1983). Categorizing sounds and learning to read: A causal connection. *Nature*, 301, 419-421.
- Bradley, L., & Bryant, P. E. (1985a). *Children's reading problems: Psychology and education*. New York: Oxford University Press.
- Bradley, L., & Bryant, P. E. (1985b). *Rhyme and reason in reading and spelling*. Ann Arbor: University of Michigan Press.
- Byrne, B. (1992). Studies in the acquisition procedure for reading: Rationale, hypotheses, and data. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 1-34). Hillsdale, NJ: Erlbaum.
- Byrne, B., & Fielding-Barnsley, R. (1989). Phonemic awareness and letter knowledge in the child's acquisition of the alphabetic principle. *Journal of Educational Psychology*, 81, 313-321.
- Byrne, B., & Fielding-Barnsley, R. (1990). Acquiring the alphabetic principle: A case for teaching recognition of phoneme identity. *Journal of Educational Psychology*, 82, 805-812.

- Byrne, B., & Fielding-Barnsley, R. (1991). Evaluation of a program to teach phonemic awareness to young children. *Journal of Educational Psychology*, 83, 451-455.
- Clarke, L. K. (1989). Encouraging invented spelling in first graders' writing: Effects on learning to spell and read. *Research in the Teaching of English*, 22, 281-309.
- Davidson, M., & Jenkins, J. D. (1994). Effects of phonemic processes on word reading and spelling. *Journal of Educational Research*, 87, 148-157.
- Dunn, L. M., & Dunn, L. M. (1981). *Peabody Picture Vocabulary Test, Form L*. Circle Pines, MN: American Guidance Service.
- Ehri, L. C. (1991). Development of the ability to read words. In R. Barr, M. L. Kamil, P. B. Mosenthal, & P. D. Pearson, (Eds.), *Handbook of reading research* (Vol. 2, pp. 383-417). White Plains, NY: Longman.
- Ehri, L. C. (1994). Development of the ability to read words: Update. In R. B. Ruddell, M. R. Ruddell, & H. Singer (Eds.), *Theoretical models and processes of reading* (4th ed., pp. 323-358). Newark, DE: International Reading Association.
- Elkonin, D. B. (1973). U.S.S.R. In J. Downing (Ed.), *Comparative reading* (pp. 551-579). New York: Macmillan.
- Fox, B., & Routh, D. K. (1984). Phonemic analysis and synthesis as word-attack skills: Revisited. *Journal of Educational Psychology*, 76, 1059-1064.
- Gunning, T. G. (1992). *Creating reading instruction for all children*. Needham Heights, MA: Allyn & Bacon.
- Hatcher, P. J., Hulme, C., & Ellis, A. W. (1994). Ameliorating early reading failure by integrating the teaching of reading and phonological skills: The phonological linkage hypothesis. *Child Development*, 65, 41-57.
- Helfgott, J. A. (1976). Phonemic segmentation and blending skills of kindergarten children: Implications for beginning reading acquisition. *Contemporary Educational Psychology*, 1, 157-169.
- Hohn, W. E., & Ehri, L. C. (1983). Do alphabet letters help prereaders acquire phonemic segmentation skill? *Journal of Educational Psychology*, 75, 752-762.
- Johns, J. (1991). *Basic Reading Inventory* (5th ed.). Dubuque, IA: Kendall/Hunt.
- Jorm, A. F., & Share, D. L. (1983). Phonological recording and reading acquisition. *Applied Psycholinguistics*, 4, 103-147.
- Juel, C. (1988). Learning to read and write: A longitudinal study of 54 children from first through fourth grades. *Journal of Educational Psychology*, 80, 437-447.
- Langley, R. (1970). *Practical statistics simply explained*. New York: Dover.
- Lewkowicz, N. K. (1980). Phonemic awareness training: What to teach and how to teach it. *Journal of Educational Psychology*, 72, 686-700.
- Liberman, A. M., Cooper, F. S., Shankweiler, D., & Studdert-Kennedy, M. (1967). Perception of the speech code. *Psychological Review*, 74, 431-461.
- Liberman, I. Y. (1973). Segmentation of the spoken word and reading acquisition. *Bulletin of the Orton Society*, 23, 65-77.
- Liberman, I. Y., & Liberman, A. M. (1992). Whole language versus code emphasis: Underlying assumptions and their implications for reading instruction. In P. B. Gough, L. C. Ehri, & R. Treiman (Eds.), *Reading acquisition* (pp. 343-366). Hillsdale, NJ: Erlbaum.
- Lundberg, I., Frost, J., & Petersen, O. (1988). Effects of an extensive program for stimulating phonological awareness in preschool children. *Reading Research Quarterly*, 23, 263-284.
- Maclean, M., Bryant, P., & Bradley, L. (1987). Rhymes, nursery rhymes, and reading in early childhood. *Merrill-Palmer Quarterly*, 33, 255-281.
- McKenna, M. C., & Kear, D. J. (1990). Measuring attitude toward reading: A new tool for teachers. *The Reading Teacher*, 43, 626-639.
- Murray, B. A., Stahl, S. A., & Ivey, M. G. (1996). Developing phonological awareness through alphabet books. *Reading and Writing: An Interdisciplinary Journal*, 8, 307-322.
- O'Connor, R. E., Jenkins, J. D., Leicester, N., & Slocum, T. A. (1993). Teaching phonological awareness to young children with learning disabilities. *Exceptional Children*, 59, 532-546.
- O'Connor, R. E., Jenkins, J. D., & Slocum, T. A. (1994, April). *Transfer among phonological tasks in kindergarten: Essential instructional content*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.
- Olofsson, A., & Lundberg, I. (1983). Can phonemic awareness be trained in kindergarten? *Scandinavian Journal of Psychology*, 24, 35-44.
- Rack, J. P., Snowling, M. J., & Olson, R. K. (1992). The nonword reading deficit in developmental dyslexia: A review. *Reading Research Quarterly*, 27, 29-53.
- Share, D. L. (1995). Phonological recoding and self-teaching: *Sine qua non* of reading acquisition. *Cognition*, 55, 151-218.
- Siegel, S. (1956). *Nonparametric statistics for the behavioral sciences*. New York: McGraw-Hill.
- Skjelfjord, V. J. (1987). Phonemic segmentation: An important subskill in learning to read: 1. *Scandinavian Journal of Educational Research*, 31, 41-57.
- Slocum, T. A., O'Connor, R. E., & Jenkins, J. R. (1993). Transfer among phonological manipulation skills. *Journal of Educational Psychology*, 85, 618-630.
- Smith, S. S., Christensen, L., Goodale, D., Ingebrand, S., & Steele, K. (1993, December). *Effects of phonemic awareness training on impoverished first and second graders*. Paper presented at the annual meeting of the National Reading Conference, Charleston, SC.
- Stahl, S. A., & Murray, B. A. (1994). Defining phonological awareness and its relationship to early reading. *Journal of Educational Psychology*, 86, 221-234.
- Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. *Reading Research Quarterly*, 21, 360-406.
- Stanovich, K. E., Cunningham, A. E., & Cramer, B. B. (1984). Assessing phonological awareness in kindergarten children: Issues of task comparability. *Journal of Experimental Child Psychology*, 38, 175-190.
- Stanovich, K. E., & Siegel, L. S. (1994). Phenotypic performance profile of children with reading disabilities: A regression-based test of the phonological-core variable-difference model. *Journal of Educational Psychology*, 86, 24-53.
- Torgesen, J. K., & Bryant, B. R. (1994). *Test of Phonological Awareness*. Austin, TX: Pro-Ed.
- Torgesen, J. K., Morgan, S. T., & Davis, C. (1992). Effects of two types of phonological awareness training on word learning in kindergarten children. *Journal of Educational Psychology*, 84, 364-370.
- Torneus, M. (1984). Phonological awareness and reading: A chicken and egg problem? *Journal of Educational Psychology*, 76, 1346-1358.
- Treiman, R. (1985). Onsets and rimes as units of spoken syllables: Evidence from children. *Journal of Experimental Child Psychology*, 39, 161-181.
- Wagner, R. K., & Torgesen, J. K. (1987). The nature of phonological processing and its causal role in the acquisition of reading skills. *Psychological Bulletin*, 101, 192-212.
- Wallach, M. A., & Wallach, L. (1979). Helping disadvantaged children learn to read by teaching them phoneme identification

- skills. In L. B. Resnick & P. A. Weaver (Eds.), *Theory and practice of early reading* (Vol. 3, pp. 197–215). Hillsdale, NJ: Erlbaum.
- Williams, J. P. (1980). Teaching decoding with an emphasis on phoneme analysis and phoneme blending. *Journal of Educational Psychology*, 72, 1–15.
- Wright, G., & Beach, S. A. (1994, April). *Developing phonemic awareness in kindergarten children*. Paper presented at the annual meeting of the American Educational Research Association, New Orleans, LA.
- Yopp, H. K. (1988). The validity and reliability of phonemic awareness tests. *Reading Research Quarterly*, 23, 159–177.

Appendix

Detailed Description of Treatments

Identity Group Activities

Lessons for the phoneme identity group were focused on developing knowledge of phoneme identities for a restricted set of eight phonemes: /f/, /l/, /m/, /n/, /s/, /t/, /i/ (long e), and /ei/ (long a). These phonemes were selected because (a) all but one were continuants, permitting children to stretch their pronunciations and examine their articulation; (b) the vowels were the relatively familiar letter names; and (c) many example words could be constructed using these phonemes.

During the first eight lessons, a single phoneme was introduced to children in the phoneme identity group each day. Participants studied the identity of each phoneme in a systematic instructional program. Each lesson cycled through seven brief activities:

1. Introduction to the phoneme with a semantic representation and demonstration of its production.
2. Learning an alliterative tongue twister featuring the phoneme (e.g., for /n/, "Nobody was nice to Nancy's neighbor Nick, but he was never nasty").
3. Using a puppet to isolate the initial phoneme in the alliterative words of the tongue twister.
4. Stretching the phoneme to explore its articulation using a stretchable action figure as a visual demonstration.
5. Isolating the phoneme in the final (for vowels, the medial) position of other example words.
6. Practicing sound-to-word matching for the target phoneme, first as a yes-no game (e.g., "Do you hear /n/ in *next*?") and then as a forced choice with a single foil (e.g., "Do you hear /n/ in *old* or *new*?").
7. Blending the target phoneme to partial words in the initial or final position.

After the first day, each lesson began with a brief review of phonemes previously studied. Lessons 9–14 provided practice with blending, segmentation, and word-to-word matching, with examples restricted to words composed of the limited eight-phoneme set. The blending and segmentation activities for the phoneme identity group were different from those of the phonological manipulation group in that they focused on locating particular phonemes in word contexts. Lessons were scripted allowing for variable student input. A sequence of activities was planned for each day's lessons, but children's spontaneous comments, questions, insights, and miscues were addressed.

Manipulation Group Activities

Lessons for the phonological manipulation group were aimed at developing skills in segmenting words into a relatively unrestricted number of phonemes. Their instructional program was devised to parallel the work of the phoneme identity group while eliminating

activities specifically aimed at learning phoneme identities. Each lesson for manipulations cycled through seven brief activities:

1. Introduction to the alphabetic principle using interlocking blocks as a visual demonstration of segmentation.
2. Learning a brief rhyming verse (e.g., "Rain, rain, go away, come again another day; little Tommy wants to play").
3. Using a puppet to isolate the initial phoneme in the principal words of the rhyming verse.
4. Stretching words using a stretchable figure as a visual demonstration.
5. Isolating phonemes in the final (for vowels, the medial) position of other example words.
6. Practicing segmentation with onset-rime feedback.
7. Blending onsets and rimes to approximate the pronunciations of words.

Lessons 9–14 provided practice with blending, segmentation, and word-to-word matching using example words not restricted to particular phonemes. The phoneme manipulations for the phonological manipulation group were different from those of the identity group in that they used a variety of phonemes to work on the skills of blending and segmentation rather than on locating particular phonemes in spoken words. Lessons for the manipulation group were also improvised around scripts. A sequence of activities was planned for each day's lessons, but allowance was made for responding to children's spontaneous comments, questions, insights, and miscues.

Language Experience Group Activities

The language experience group participated in a program of holistic language instruction equivalent in duration to the instruction of the identity and segmentation groups. Children engaged in two principal activities: listening and responding to oral readings of illustrated storybooks and orally composing stories in response to the oral readings. Oral readings were introduced with questions designed to activate background knowledge and interest. In the oral composition, the teacher wrote down the children's words, moderated conflicting views when children disagreed on the direction the story should take, modified ungrammatical constructions, and occasionally made suggestions when the composition process came to a halt. Stories written by the children in the shared writing activities were transcribed to make printed copies in 18-point Times New Roman font for children to practice rereading the next day.

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