Kindergarten teachers develop phoneme awareness in low-income, inner-city classrooms

Does it make a difference?

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ABSTRACT: Recent evidence suggests that training in phoneme awareness has a positive impact on beginning reading and spelling. The objective of this study was to investigate the effectiveness of instruction in phonological awareness provided in low-income, inner-city kindergarten classrooms by kindergarten teachers and their teaching assistants. Prior to the intervention, the 84 treatment children and 75 control children, who attended inner-city schools in an urban district in upstate New York, did not differ on age, sex, race, SES, PPVT-R score, phoneme segmentation, letter name knowledge, letter sound knowledge, or reading. After the 11 week intervention, the treatment children significantly outperformed the control children on measures of phoneme segmentation, letter name and letter sound knowledge, two of three reading measures, and a measure of invented spelling. Implications for improving beginning reading instruction are discussed.

KEY WORDS: Beginning reading, Kindergarten, Literacy, Phoneme awareness, Phoneme segmentation, Phonological awareness

INTRODUCTION

By discovering the importance of phonological processes in literacy, we have made enormous strides in our understanding of literacy acquisition (Adams 1990; Brady & Shankweiler 1991; Rieben & Perfetti 1991; Shankweiler & Liberman 1989; Wagner & Torgesen 1987). One area of phonological processing that has received considerable attention, and about which we have the greatest consensus, is phonological awareness (an awareness of, and ability to manipulate, the phonological segments in words) (Blachman 1989, 1994; Goswami & Bryant 1990; Liberman, Shankweiler, Fischer & Carter 1974; Stanovich 1987). For many poor readers, difficulties in decoding seem to stem from a lack of awareness that speech can be segmented into the phonemic units that are more or less represented in an alphabetic script (Iversen & Tunmer 1993; Juel 1988; Liberman et al. 1980; Stanovich 1986; Williams 1987; Vellutino 1991). As literate adults, we have been conditioned by our long-standing familiarity with an alphabetic writing system to appreciate that graphic symbols more or less represent the sounds of speech. However, it cannot be taken for granted that the young child, who has not yet learned to read, recognizes that speech can be segmented into phonemes

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or understands that it is these sublexical units that are captured by an alphabet.

Understanding the complex relationship among the phonemes in the speech stream may help us appreciate what the would-be reader confronts. As A. Liberman and his colleagues at Haskins Laboratories originally discovered (1967), the sound units (or phonemes) in a word, such as *bag*, are coarticulated or 'merged' in speech production (the consonants are folded into the vowel). The result is that we hear only a single acoustic unit — the syllable. Thus, when speech is made visible on a spectrograph, the 'picture reveals no natural segments that might correspond to single letters' (Frith 1978: 279). As noted by Ball and Blachman, 'although we may teach children to "hear" three sounds in *cat*, the three sounds are not characterized in the acoustic stimulus. . . . Therefore, gaining access to these coarticulated or "encoded" phonemes is more a matter of abstraction than discrimination' (1991: 5—6). And yet, despite the complexity of the spoken message the child must analyze, one of the fundamental tasks facing the beginning reader is understanding that speech can be segmented and that these segmented units can be represented by printed forms (Liberman 1971, 1973). Indeed, there is now overwhelming evidence that children who are proficient at this level of linguistic analysis (segmenting spoken language into phonemes) are more likely to become good readers and, conversely, that children who lack phoneme awareness are more likely to become poor readers (Blachman 1984; Blachman & James 1986; Bradley & Bryant 1983; Byrne & Fielding-Barnsley 1993; Iversen & Tunmer 1993; Juel 1988; Juel, Griffith & Gough 1986; Lundberg, Olofsson & Wall 1980; Mann 1984; Mann & Liberman 1984; Share, Jorm, Maclean & Matthews 1984; Stanovich, Cunningham & Cramer 1984; Torneus 1984; Vellutino & Scanlon 1987).

The good news about phonological awareness is that it appears to lend itself to instruction. That is, the results of training studies (see, for example, Olofsson & Lundberg 1983, and Byrne & Fielding-Barnsley 1993) indicate that young children can be made more phonologically aware, prior to the formal reading instruction typically offered in the first grade classroom. For example, they can be taught to segment words into phonemes or to engage in a variety of other tasks, such as categorizing words on the basis of common initial, middle, or final sounds, which indicate a heightened level of phonological awareness. In addition, the evidence suggests that training in phonological awareness has a positive effect on reading and spelling (Ball & Blachman 1991; Bradley & Bryant 1983; Cunningham 1990; Fox & Routh 1984; Lundberg, Frost & Peterson 1988; Treiman & Baron 1983; Williams 1980). In a review of these data, Adams concludes: 'The evidence is compelling: Toward the goal of efficient and effective reading instruction, explicit training of phonemic awareness is invaluable' (1990: 331).

As might be expected, the training studies, conducted here and abroad, vary in the activities used, the duration and intensity of the training, and the method of delivery of the instruction (e.g., whole class, small group, one-to-

one). They also differ in whether or not the phoneme awareness intervention includes explicit instruction in the connections between the segmented sound units and the letters of the alphabet. For example, in a large-scale study in Denmark (Lundberg et al. 1988), 235 nonreading kindergarten children participated for 8 months in a variety of metalinguistic games (e.g., rhyme production, isolation of initial phonemes in words), but they did not have training in letter sounds. After the treatment, the performance of the experimental group was superior to the control group on tasks requiring word, syllable, and phoneme segmentation and synthesis; however, the groups did not differ on posttests of beginning reading. The children were tested again at the end of grades one and two, and the experimental children significantly outperformed controls in spelling in grade one, and outperformed controls in both reading and spelling in grade two.

In a more recent study in the United States, Cunningham (1990) provided kindergarten and first grade children with 10 weeks of training in phoneme awareness but, like the Lundberg training, did not provide explicit instruction in sound-symbol correspondences. The training did involve the use of concrete visual aids. For example, wooden markers were used to represent the sounds in words (from *The ABD's of Reading* developed by Williams 1979), and worksheets depicted a series of boxes that corresponded to the number of phonemes in the word to be analyzed (e.g., three boxes for *cot*). Children were taught to mark an 'x' in either the first, middle, or last box, to represent the appropriate placement of individual phonemes in spoken words. After the intervention, the experimental children significantly outperformed the control children on measures of phoneme awareness and on a measure of general reading ability.

Although these studies clearly demonstrate the value of training in phoneme awareness, there is also evidence that instruction in phoneme awareness may be enhanced when the connections between the sound segments in words and the corresponding printed symbols are made explicit during training (for a review, see Blachman 1989). For example, in a combined longitudinal and experimental training study in England, Bradley and Bryant (1983, 1985) found a significant relationship between the phoneme awareness (measured by a test of sound categorization) of 368 four- and five-year-olds and the reading and spelling achievement of the same children three years later. During the second year of the study, 65 of the children who had low scores on the sound categorization task were divided into four groups. Children in the first group learned to categorize pictures of objects on the basis of common sounds (e.g., rhyme or alliteration). The second group received the same instruction, but in addition were taught to represent the shared sounds with letters of the alphabet. The third group learned to categorize the same pictures on the basis of semantic categories, while a fourth group received no special intervention. The training for children in the first three groups involved 40 individual lessons spread over a two-year period. Although the children who received sound cate-

gorization training scored somewhat higher on posttests of reading and spelling than those who did not receive this training, children who were taught to make the connections between sound categories and letter strings were the most successful. They significantly outperformed both control groups in reading and spelling and had significantly higher spelling scores than children who had received only the sound categorization training. In a follow-up study conducted four years after the original study ended, the children who had been taught to make the connections between sound categories and letter strings were still the most successful in reading and spelling (Bradley 1988).

The Bradley and Bryant study demonstrates that the benefits of phoneme awareness training are increased by connecting the sound segments in words to their corresponding printed symbols (see also Blachman 1989, and Hohn & Ehri 1983). However, because the Bradley & Bryant study did not include a letter-training-only group, it was not possible to determine whether it was actually the combination of sound categorization and letter training or the letter training itself that made the difference. To answer this question, Ball & Blachman (1991) conducted a study in which ninety nonreading kindergarten children were randomly assigned to a treatment group for instruction in phoneme awareness plus letter names and letter sounds, or to one of two control groups. In the first control group, children received instruction in a variety of language activities (e.g., listening to stories) plus letter name and letter sound instruction that was identical to the treatment group. Children in the second control group received no special treatment. Children in the treatment and first control group received instruction in groups of five for 20 minutes, four times a week, for seven weeks. Prior to the intervention, the children did not differ on age, sex, race, SES level, Peabody Picture Vocabulary Test scores, phoneme segmentation, letter name knowledge, letter sound knowledge, or reading ability. After the intervention, the children in the treatment group, who had received instruction in phoneme awareness (e.g., moving tiles to represent each sound in a spoken word) plus instruction in letter names and letter sounds, significantly outperformed both control groups in phoneme awareness and in beginning reading and spelling. It should also be noted that after the intervention, children in the language activities control group (the group that received instruction in letter-sound knowledge that was identical to the treatment group) were equal to the treatment group in letter-sound knowledge. Despite this increase in letter-sound knowledge, and despite now having significantly more letter-sound knowledge than untrained controls, the children in the language activities control group did not differ from untrained controls in phoneme awareness, reading, or spelling. Thus, it appears that phoneme awareness training, especially when it includes instruction in sound-symbol connections, can play an important role in early reading and spelling acquisition.

Despite evidence that training in phonological awareness offers 'one of the most promising areas for improving early reading instruction' (Juel 1986:

242), activities to increase phoneme awareness have not routinely been incorporated into kindergarten classrooms. This may be due, at least in part, to the fact that in almost all of the previous training studies (Ball & Blachman 1991; Bradley & Bryant 1983, 1985; Byrne & Fielding-Barnsley 1991; Cunningham 1990; Torgesen, Morgan & Davis 1992), the treatment was conducted *outside* the regular classroom by specially trained teachers or clinicians brought to the school by the researchers. (Although Lundberg et al. 1988, did train kindergarten teachers to provide the instruction, the study was conducted in Denmark, where children are a year older when they begin kindergarten than children in the United States.)

The missing link in this research is an intervention study conducted in kindergarten classrooms in the United States, with kindergarten teachers providing the instruction. If educators are going to heed the advice of numerous researchers (see, for example, Adams 1990; Blachman 1989, 1991; Juel 1988) to provide instruction in phoneme awareness in regular classrooms before children have experienced failure, we need more direct evidence that this model of instruction is effective.

In an attempt to provide such evidence, we embarked on a classroom intervention study in four, low-income, inner-city schools in upstate New York. The goal of this study was to train kinderdergarten teachers and their teaching assistants to provide phoneme awareness activities to small groups of children in the regular classroom (during the regular school day) and to compare the phoneme awareness, letter-sound knowledge, and the reading and spelling skills of these children to the skills of children who did not have this instruction.

METHOD

Subjects. Children were selected from four, demographically comparable low-income, inner-city schools, in a large, urban district in upstate New York. To avoid possible exposure of the control children to the treatment activities, a decision was made to select the treatment and control children from different schools. The 84 treatment children and 75 control children were selected after an initial screening of all 393 kindergarten children attending these four schools. Children with scores on the Peabody Picture Vocabulary Test-Revised that were more than 1.5 standard deviations below the mean ($M = 100$; $SD = 15$) were not included in the study. Children were also eliminated if they did not reach criterion (three consecutive items correct) on a sound counting control task. In this task, children are asked to move a disk to represent each sound made by the examiner (i.e., one, two, or three knocks under the table). This skill is considered a prerequisite to the phoneme segmentation pretest. (See *Measures* for a discussion of this issue.) Twenty-two children who could not yet demonstrate the one-to-one correspondence required on this sound counting control task were not included in

the study. In addition, two children who were identified as readers by their teachers and two children who obtained raw scores greater than 3 on the Word Identification Subtest of the Woodcock Reading Mastery Tests-Revised (WRMT-R) were also eliminated, as were four children with severe articulation problems. After screening, 192 children remained eligible for the study. All 78 eligible children at the two control schools were used as a control group. These children were drawn from all eight of the kindergarten classrooms in these two schools. Of the 114 eligible children at the two treatment schools, 27 were randomly deleted, leaving a treatment sample of 87 who were drawn from all 10 of the kindergarten classrooms at these two schools. Between the kindergarten screening in January and the posttesting in May, six of the 165 children moved (three treatment and three control children), leaving a total sample of 159. The 84 treatment children included 47 boys and 37 girls with a mean age of 5.62; the 75 control children included 38 boys and 37 girls with a mean age of 5.64.

Procedure. At the beginning of the kindergarten year, the PPVT-R was administered to all 393 kindergarten children as part of the school district's kindergarten screening. In January of the kindergarten year, additional screening and pretest measures were administered for this study by specially trained examiners. These measures included a test of phoneme segmentation (preceded by a sound counting control task), a test of letter name and letter sound knowledge, and the Word Identification Subtest of the Woodcock Reading Mastery Tests-Revised (WRMT-R). Prior to the intervention, there were no significant differences between the 84 children in the treatment group and the 75 children in the control group on age, $t(157) = 0.46$, $p = 0.64$; sex, $\chi^2(1, N = 159) = 0.44$, $p = 0.50$; race, $\chi^2(2, N = 159) = 0.56$, $p = 0.76$; SES (measured by number of children in each group receiving free lunch), $\chi^2(1, N = 159) = 0.28$, $p = 0.60$; developmental level (based on a screening instrument designed by the school district and administered to all of its kindergarten children), $t(157) = 1.50$, $p = 0.13$; sound counting, $t(157) = 0.56$, $p = 0.58$; or any of the other pretest variables (see Table 1).

From March until May of the kindergarten year, the treatment children participated in a phoneme awareness training program. The children met in their respective classrooms (in the two treatment schools) during the regular school day in groups of four or five, 15 to 20 minutes a day, four times each week. All children completed 41 lessons (using prepared lesson plans) over a period of 11 weeks, and all lessons were conducted by one of the ten kindergarten teachers or one of the ten kindergarten classroom teaching assistants. All kindergarten classrooms in both treatment and control schools were all-day kindergartens. It is standard practice in this district for each all-day kindergarten classroom to be staffed by two adults (a certified teacher and a paraprofessional — or teaching assistant, as they are called in this school district). Thus, all persons conducting the treatment were employees of the school district (either the classroom teacher or their teaching assistant). None

Table 1. Pretest and posttest means for treatment and control groups*

Variable	Phoneme awareness (Treatment) Mean	SD	No intervention (Control) Mean	SD	*p*
Pretests					
PPVT-R	91.4	11.3	90.7	9.6	0.655
Segmentation	11.9	4.2	11.8	4.6	0.897
Letter names	11.2	6.9	10.7	7.4	0.653
Letter sounds	2.4	3.9	2.8	4.0	0.493
Woodcock	0.1	0.4	0.1	0.4	0.432
Posttests					
Segmentation	23.6	6.9	13.2	4.4	0.0001
Letter names	19.0	6.2	17.1	7.1	0.0201
Letter sounds	13.3	5.8	9.4	6.8	0.0001
Woodcock	0.6	1.6	1.0	3.0	0.0807
Phonetically regular real words	4.2	5.3	0.4	1.7	0.0001
Phonetically regular nonwords	2.3	3.2	0.2	0.8	0.0001
Developmental spelling	11.6	6.8	6.0	5.0	0.0001

* N = 84 for phoneme awareness training group and N = 75 for control group for all variables except developmental spelling. For developmental spelling N = 77 for phoneme awareness training group and N = 72 for control group. There were no significant differences in pretest scores when differences were recalculated based on only those children available for the developmental spelling test.

were affiliated with this university research project prior to the conduct of this research.

Teachers and their teaching assistants from the 10 kindergarten classrooms in the two treatment schools participated in a series of seven, two-hour inservice workshops to learn to conduct the phoneme awareness training program. During these workshops, teachers were also given a theoretical framework to support the teaching of phonological awareness, and they were given opportunities to practice activities and to ask questions about the implementation of the program.

The 11 week phoneme awareness training program conducted by the teachers and their assistants was adapted and expanded from an earlier 7 week version of this program (see Ball & Blachman 1988, for a more detailed description of activities). Each 15 to 20 minute lesson consisted of three parts: (a) say-it-and-move-it phoneme segmentation activities, (b) segmentation-related activities; and (c) letter name and letter sound training.

The segmentation activities incorporated suggestions found in the phoneme awareness literature (Bradley & Bryant 1985; Elkonin 1973; Lewkowicz 1980; Liberman et al. 1980). The *say-it-and-move-it* activities were designed to teach children to segment words into phonemes. Children were taught to move disks from the top half of an 8½ by 11 inch card to the bottom half to represent the phonemes in one-, two-, and three-phoneme items. First, children learned to represent single sounds (e.g., 'i'), then double sounds (e.g., 'i-i'), then two phoneme items (e.g., 'it'), and finally three phoneme items (e.g., 'lip', 'sun'). Initially, continuous sound letters were used in the initial position to reduce the distortion of the sounds in the segmentation activity. During the fourth week of instruction, one or two letters (beginning with the letter *a*) were put on the tiles of only those children who had mastered both the name and sound of the letter. The letters were selected from among the eight letters introduced during the intervention (*a, m, t, i, s, r, f, b*). The children who were ready for the letter tiles could use a combination of letter tiles and blank tiles or they could continue to use all blank tiles to segment a word. During the eighth week of instruction, children who had mastered several letter names and sounds were given enough letter tiles to produce a consonant-vowel-consonant real word (e.g., bit) during the segmentation activities. Thus, during the last three weeks of instruction (i.e., during the last 12, 15 to 20 minute lessons), selected children were exposed to a small pool of real words. The children in each group who had not mastered letter names and sounds continued to use blank tiles throughout the intervention.

The *segmentation-related activities* included activities involving various degrees of segmentation. For example, a sound categorization task that was similar to the task used by Bradley & Bryant (1983, 1985) (e.g., children were asked to group words on the basis of rhyme or alliteration) was included in this part of the lesson. In another segmentation-related activity, modeled after Elkonin (1973), children were given booklets containing pictures of objects representing simple consonant-vowel-consonant words (e.g., fan, sit, lip). Underneath each picture was a series of boxes representing the number of phonemes in the word. Children learned to say the word slowly and simultaneously move a disk to the appropriate box to represent each phoneme in the word.

A third part of each lesson involved direct instruction in *letter names and letter sounds*. The results of previous phoneme awareness training studies suggest that phoneme awareness instruction may have a greater influence on early reading and spelling when connections are made between the sound segments of the word and letters representing those segments (Blachman 1989; Bradley & Bryant 1983). Eight letters were included in our intervention (*a, m, t, i, s, r, f, b*). These letters were selected because combinations of these letters generate a significant number of real words, using the consonant-vowel-consonant pattern. Illustrated alphabet cards were used to reinforce initial sounds. For example, the *r* card had a picture of a *r*ed *r*ooster in *r*ed *r*unning shoes and the *t* card showed *t*wo *t*eenagers *t*alking on *t*elephones.

Children also played a variety of games (e.g., Bingo) to reinforce sound-symbol associations. The children in the control group followed a traditional kindergarten curriculum that included whole class instruction in letter names and sounds.

In May of the kindergarten year, a battery of posttests was administered to the 159 treatment and control children. Specially trained examiners administered all posttests. Children were retested on phoneme segmentation, letter name knowledge, letter sound knowledge, and the Word Identification Subtest of the WRMT-R. In addition, children were asked to read a list of phonetically regular real words and a list of phonetically regular nonwords and to spell a list of 5 words.

Measures. The phoneme segmentation test (Ball & Blachman 1988), which measures the child's ability to segment single syllable words into phonemes, was used as both a pretest and posttest. Originally adapted from a segmentation test designed by Liberman et al. (1974), the measure used in this study consists of 34 randomly arranged one-, two-, and three-phoneme items. The test was introduced by the examiner with four training sequences, during which modeling and corrective feedback were provided in segmenting one-, two-, and three-phoneme items. During the administration of the test, the child was asked to indicate the number of segments in each test item by moving disks on a card. Using the Spearman-Brown split-half analysis, the internal reliability of the phoneme segmentation test was reported to measure 0.91 (Ball & Blachman 1988). The phoneme segmentation pretest was preceded by a sound counting control task. During this task, children were asked to count sounds (i.e., knocks under the table) made by the examiner. This task was used to ensure that poor performance on the phoneme segmentation test was not due to an inability to count sounds.

Other tests administered both before and after the intervention included informal measures to asses letter name and letter sound knowledge and the Word Identification subtest of the Woodcock Reading Mastery Tests-Revised. To assess letter name and letter sound knowledge, each of the 26 lower-case letters was written on an individual card and presented in the same random order to each child. The child was asked to give the name of each letter and the sound of each letter. On the Word Identification subtest of the Woodcock Reading Mastery Tests-Revised, children were asked to read single words on a graded word list.

Three posttest-only measures were also used to assess early reading and spelling skills. First, each child was asked to read a list of 16 phonetically regular, two- and three-phoneme real words selected for this study. These words were made up of the eight letters taught during training (*a, m, t, i, s, r, f, b*). Second, each child was asked to read a list of 10 phonetically regular nonwords also selected for this study. A list of nonwords was included to ensure that none of the children had been exposed to these words during the intervention. Half of the nonwords were made up of the eight letters intro-

duced during the intervention (e.g., sim), and half of the nonwords included one letter not introduced during the intervention (e.g., *n*ab). Finally, each child was asked to spell five words (lap, sick, pretty, train, elephant). These words (originally selected by Ball & Blachman 1991) were chosen, not because we thought that kindergarten children should be able to spell them correctly, but because they provided an opportunity to evaluate the developmental sophistication of the 'invented' spellings (Read 1971) of the treatment and control children. We created a developmental scoring procedure (Tangel & Blachman 1992) to evaluate the extent to which an unconventional (incorrect) spelling captured the phonetic structure of the word. More specifically, the scale was designed to measure spelling proficiency by taking into consideration the number of phonemes represented and the level of orthographic representation (use of phonetically related or conventional letters) (adapted from Liberman, Rubin, Duques & Carlisle 1985). Each response to each dictated word was given a score ranging from 0 to 6, with a score of 6 indicating that the word had been spelled correctly. Using the word *train* as an example, the following points were awarded:

Response	*Criteria*	*Points*
FMTXBR	Random string	0
J	Phonetically related letter	1
T	Correct first letter	2
JRA, TAN	More than one phoneme, but not all, with phonetically related or conventional letters	3
HRAN, TREN	All phonemes with mix of phonetically related and conventional letters	4
TRANE	All phonemes with conventional letters; attempt to mark long vowel	5
TRAIN	Correct spelling	6

The preceding example represents a simplified version of the scoring criteria (see Tangel & Blachman, 1992, for the unabbreviated version of the scoring criteria for each word). The interrater reliability of the unabbreviated version of the scoring procedure, based on 48% ($n = 71$) of the total sample, was $r = 0.98, p < 0.0001$.

RESULTS

As indicated previously, there were no significant pretreatment differences between the treatment group and the control group on any pretest measure (see Table 1). Analysis of covariance (with the appropriate pretest as covariate) and independent *t*-tests (for posttest-only measures) were used to assess treatment effects. Table 1 gives an overview of the results.

Phoneme segmentation. The first question explored in this study addressed whether the group that received phoneme segmentation training would be

better able than the control group to segment words into their constituent phonemes. Posttest results were evaluated with analysis of covariance using pretest segmentation scores as the covariate. Results indicate that the phoneme awareness treatment group performed significantly better than the control group on the phoneme segmentation posttest, $F(1, 156) = 126.50$, $p < 0.0001$.

Letter names and sounds. After the intervention, differences between the two groups in letter name and letter sound knowledge were also evaluated using analyses of covariance with the appropriate pretest as covariate. Results indicate that the phoneme segmentation group performed significantly better than the control group on the test of letter name knowledge, $F(1, 156) = 5.51$, $p = 0.0201$, and on the test of letter sound knowledge, $F(1, 156) = 23.43$, $p < 0.0001$.

Reading. The effects of the training on reading were evaluated using posttest scores on the Woodcock Reading Mastery Tests — Word Identification subtest and posttest-only scores on two phonetically regular word lists (real words and nonsense words). The means and standard deviations for these posttests are in Table 1. To evaluate group differences on the Woodcock posttest, analysis of covariance with the pretest score as covariate was used. The posttest difference between the groups on this measure was not significant, $F(1, 156) = 3.09$, $p = 0.0807$.

Independent t-tests were used to evaluate differences between the treatment and control group on both the posttest-only phonetically regular real word list and the phonetically regular nonsense word list. Results indicate that the children trained in phoneme awareness read significantly more phonetically regular real words than the control group $t(157) = 6.1$, $p < 0.0001$, and the phoneme awareness group read significantly more phonetically regular nonsense words than the control group $t(157) = 5.9$, $p < 0.0001$.

Spelling. The Developmental Spelling Test (DST), administered as a posttest-only measure, was used to evaluate the influence of phoneme awareness training on spelling. It should be noted that although the DST was administered as a posttest-only measure, there were no pretest differences on the variables that are thought to have the most influence on beginning spelling ability — specifically, phoneme segmentation and letter name and sound knowledge (Ehri & Wilce 1987; Juel, Griffith & Gough 1986; Liberman et al 1985). Thus, it seems appropriate to consider posttest differences on the DST as an indicator of the influence of the phoneme awareness intervention. Scores on the DST were analysed using independent t-tests. Results indicate that the total number of points earned on the DST was significantly higher for the treatment group than the control group $t(147) = 5.8$, $p < 0.0001$ (see Table 1).

In order to determine the relative representation of treatment and control children among our bottom, middle, and top invented spellers, the treatment and control groups were merged and all children were rank ordered by their total score on the DST. Within the limitations imposed by tied scores, the children in our study were divided into three roughly equal groups. The range in total points scored for each group was as follows: bottom group (0—4 points), middle group (5—11 points), and top group (12—24 points). The top group of invented spellers included 51% of the treatment children and only 17% of the control children. On the other hand the bottom group of invented spellers included 44% of the control children and only 21% of the treatment children. Differences in the representation of treatment and control children in the three groups of invented spellers were significant, $\chi^2 (2, N = 149) = 20.2, p = 0.0005$ (see Table 2). (See Tangel & Blachman, 1992, for more detail on the influence of the phoneme awareness training on invented spelling.)

Table 2. Representation of treatment and control children in the bottom, middle, and top groups of invented spellers[a]

	Treatment group		Control group		Total
	f	%	f	%	
Bottom group (0—4 points)	16	20.8	32	44.4	48
Middle groups (5—11 points)	22	28.6	28	38.9	50
Top group (12—24 points)[b]	39	50.6	12	16.7	51
Totals	77	100.0	72	100.0	149

[a] Group membership was determined by rank ordering all children by total points earned on the developmental spelling test. Three roughly equal groups were formed.
[b] The developmental spelling test has a total possible score of 30; however, the top score received by any child was 24.

DISCUSSION

The results of this study confirm and extend the results of previous research which found that training kindergarten children in phoneme awareness has a positive influence on early reading skills and developmental spelling. Perhaps most important is the fact that in this study these activities were provided to groups of children in the regular classroom and introduced effectively by kindergarten teachers and their teaching assistants using manipulatives

and language games that are appropriate for the kindergarten child. After completing the training program, our treatment children significantly outperformed controls on tests of phoneme segmentation, letter name knowledge, and letter sound knowledge. In addition, the treatment children read significantly more phonetically regular words and nonwords, and demonstrated a more sophisticated level of developmental spelling than the control children.

It should be remembered that prior to the intervention, our treatment and control children, who were from comparable low-income, inner-city schools (86% of the treatment children and 83% of the control children received free or supported lunch), did not differ on any of our pretest variables. The scores of both groups tended to cluster in the lower end of the average range on the Peabody Picture Vocabulary Test-Revised. In addition, both groups had extremely limited knowledge of the alphabet (i.e., each group demonstrated knowledge, on average, of only two letter sounds prior to the intervention). Yet, after a relatively short period of instruction (10 to 13 hours of classroom group instruction spread over 11 weeks), the treatment children demonstrated a greater awareness of the internal structure of words. That is, the treatment children were better able than the control children to segment words into the segments of sound (phonemes) that are represented by the letters in an alphabetic script. The treatment children were also able to demonstrate their knowledge of the system of correspondences in an alphabetic orthography by identifying more letter sounds than the control children, by reading more phonetically regular real words and nonwords, and by creating invented spellings that more closely captured the phonetic structure of the dictated words. For example, although none of the treatment or control children were able to spell the word *sick* correctly, 31% of the treatment children represented all of the phonemes with conventional letters (e.g., *sic, sik*). None of the control children demonstrated this level of representation. When asked to spell *lap*, 42% of the treatment children spelled *lap* correctly, compared to 4% of the control children. This was in spite of the fact that *lap* contains two letters — the *l* and *p* — which were not included among the eight letters (*m, s, t, f, r, b, a, i*) introduced in the training. It should also be noted that the treatment children did not do any writing of words or single letters during the intervention. Thus, although both the treatment and control children knew only two letter sounds prior to the intervention in January, after the intervention the treatment children appeared to know much more about the system of correspondences in an alphabetic orthography and were able to begin to use the system to demonstrate superior beginning reading and spelling skills.

Although this study focused on the benefits of providing phoneme awareness instruction in regular kindergarten classrooms, it is important to remember that our ultimate goal in exploring such instructional alternatives is to reduce the incidence of reading failure. Although the effectiveness of providing a phoneme analysis program to older learning disabled children

(ages 7 to 12) has been demonstrated (Williams 1979, 1980), Williams, like many others (Adams 1990; Blachman 1989, 1994; Juel 1988; Liberman et al. 1980), argues that these phonemic awareness skills should be emphasized in beginning reading instruction, before reading failure has occurred. We now know that difficulties with the phonological aspects of language (e.g., segmentation) are common characteristics of children whose learning disabilities are manifested in problems learning to read, write, and spell (Chall 1983; Liberman & Shankweiler 1985). In addition, we have considerable evidence that limited phonological awareness contributes to problems in the acquisition of decoding skills (Juel 1988; Stanovich 1986, 1988; Vellutino 1991), and we know that the lack of development of fluent decoding skills is a source of difficulty for many poor readers (Chall 1983; Gough & Tunmer 1986). This argument is made more powerful by the findings from a longitudinal study of 54 children from first to fourth grade (Juel 1988). Juel found that 'children who became poor readers entered first grade with little phonemic awareness. . . . poor entering phonemic awareness appeared to contribute to a very slow start in learning spelling-sound correspondences. . . . By the end of fourth grade the poor decoders had still not achieved the level of decoding that the average to good readers had achieved by the beginning of second grade' (1988: 444). The overall results of the Juel study indicated that there was a probability of 0.88 that a child who was a poor reader at the end of first grade would still be a poor reader three years later. Juel concludes that 'instructors should not wait to build phonemic awareness until after the child has already experienced failure learning to read' (1988: 446).

There are limitations to applied research conducted in naturalistic setting, such as the study described here. Specifically, it is not possible to control as many of the potentially confounding variables as can be controlled using a more artificial or laboratory paradigm, as Lundberg et al. explain, field experiments must operate within 'the constraints imposed by reality' (1988: 267). We were not able, for example, to utilize strict random assignment of children to treatment and control groups, and although there was a no intervention control group, we did not have a third group which received a comparable amount of 'special instruction' (e.g., listening to stories) to control for the special attention (i.e., Hawthorne effects) given to the treatment group. It should be noted, however, that earlier phoneme awareness training studies (in which the training was conducted outside regular classrooms using specially trained teachers or clinicians brought to the schools by the researchers) did include groups to control for the special instruction provided to the treatment children (see, for example, Ball & Blachman 1991; Bradley & Bryant 1983, 1985; Cunningham 1990). In all of these studies, the results indicated that it was the phoneme awareness instruction and not 'special attention' that was responsible for the superior phoneme awareness and superior beginning reading and/or spelling skills of the treatment children.

The current study was designed to provide a missing link in the phoneme awareness literature by evaluating the effectiveness of phoneme awareness instruction provided by kindergarten teachers and their teaching assistants in kindergarten classrooms in the United States. We now have evidence that phoneme awareness instruction provided in our regular classrooms can make a difference in beginning reading skills and in developmental spelling. Taken together, the findings of the phoneme awareness training studies appear robust enough to survive the varying levels of compliance one is likely to find among the teachers in a field experiment, as well as other teacher and school factors. Kindergarten teachers can successfully incorporate these activities into the regular school day. Furthermore, when they do, it makes a difference.

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