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AUTHOR O'Connor, Rollanda E.
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ABSTRACT

A study explored the construct of phonological awareness by examining the effects of different instructional treatments on the development of generalized phonological skills, reading, and spelling. The effect of phonological instruction with kindergarten children who might be expected to have more than average difficulty learning to read in first grade was also tested. Subjects, 88 kindergarten children, were randomly assigned to one of four conditions. One treatment taught only auditory blending and segmenting with limited letter-sound correspondences, and the other a more global array of phonological tasks, also with limited letter-sound correspondences. Treatment effects were compared with two control conditions: letter-sound only, or no treatment. Results suggest that both types of metaphonological instruction improved phonological abilities and transferred to reading and spelling analog tasks; and that children whose phonological skills were initially low achieved a level of phonological awareness comparable to that of naturally proficient children, but were still less efficient in learning to read. Regression analyses suggested that blending and segmenting contribute more to variance on reading and spelling analog scores than a measure of generalized phonological awareness. (Contains 52 references; includes 5 tables of data.) (RS)

Unpacking Phonological Awareness:

Comparing Treatment Outcomes for Low-skilled Kindergarten Children

Rollanda E. O'Connor

University of Pittsburgh
Special Education
4F29 Forbes Quadrangle
Pittsburgh, PA 15260

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ABSTRACT

In this study we sought to (1) explore the construct of phonological awareness -- children's ability to blend, segment, rhyme, and in other ways manipulate the sounds in spoken words -- by examining the effects of different instructional treatments on the development of generalized phonological skills, reading, and spelling; and (2) test the effect of phonological instruction with Kindergarten children who might be expected to have more than average difficulty learning to read in first grade (children with disabilities and others at risk for reading disabilities). Eighty-eight Kindergarten children were randomly assigned to one of four conditions. One treatment taught only auditory blending and segmenting with limited letter-sound correspondences, and the other a more global array of phonological tasks, also with limited letter-sound correspondences. Treatment effects were compared with two control conditions: letter-sound only, or no treatment.

Results suggest that both types of metaphonological instruction improved phonological abilities, and transferred to reading and spelling analog tasks; and that children whose phonological skills were initially low achieved a level of phonological awareness comparable to that of naturally proficient children, but were still less efficient in learning to read. Regression analyses suggest that blending and segmenting contribute more to variance on reading and spelling analog scores than a measure of generalized phonological awareness.

Researchers who study phonological awareness and its role in reading and spelling acquisition consistently recommend teaching phonological skills to children at risk of failing to acquire them independently (Adams, 1990; Brady, 1991; Ehri, 1992; Goswami & Bryant, 1990; Lewkowicz, 1980; Stanovich, 1986). The ability to blend, segment, rhyme, and in other ways manipulate the sounds in spoken words probably influences a child's grasp of the alphabetic principle, which in turn makes learning to read a reasonable and motivating activity.

Evidence from experimental training studies links increases in phonological skills to higher levels of reading in Kindergarten and first grade (Ball & Blachman, 1991; Bradley & Bryant, 1985; Cunningham, 1990); nevertheless, few studies investigate the effect of increasing the phonological skills of children who enter Kindergarten with lower skill levels than their peers. The exclusionary criteria of intervention studies in phonological awareness often reject children with IQ or receptive language scores more than one standard deviation below the mean (Ball & Blachman, 1991; Vellutino & Scanlon, 1987), those with behavior difficulties, those eligible for special education services, or whose phonological skills are very low (e.g., pretest scores on phonological tasks in the bottom 15%; Torgesen, Morgan & Davis, 1992). We wanted to test the effect of phonological training with the children usually excluded from other experimental studies--children with very low entering phonological skill levels and other risk factors (e.g., low receptive language or special education classifications)--those who might be expected to have more than average difficulty learning to read in first grade. For phonological intervention to improve the reading and spelling acquisition of young children, the treatment may have to induce levels of phonological awareness that approximate the level associated with children naturally skilled in phonological tasks, a level rarely obtained in intervention research with low-skilled children. Closer delineation of the collection of skills that require training is clearly needed.

The Content of Instruction

Studies with normally achieving Kindergarten children have found that segmenting training (e.g., teaching children to say the first sound in spoken words, or to separate all of the sounds in

short words) and *combinations* of blending and segmenting produce improvements in reading (Ball & Blachman, 1991; Cunningham, 1990; Torgesen, et al., 1992), and/or spelling (Davidson & Jenkins, 1992; Lundberg, Frost & Petersen, 1988); however, blending training alone (e.g., /c/ -- /a/ -- /t/ = cat) does not produce improvement unless children were already able to segment prior to treatment (Fox & Routh, 1976; 1984). Torgesen, et al. (1992) speculate that teaching *both* blending and segmenting produces a more complete, decontextualized understanding of the phonemic structure of words than training in blending or segmenting.

The correlation and prediction studies which fueled the intense interest in phonological awareness training (Bradley & Bryant, 1985; Calfee, Lindamood, & Lindamood, 1973; Juel, 1988; Liberman & Shankweiler, 1985; Rosner & Simon 1971; Rozin & Gleitman, 1977; Share, Jorm, Maclean & Matthews, 1984; Tunmer, Herriman & Nesdale, 1988; Yopp, 1992; Zifcak, 1981) reported high correlations among a broad array of phonological tasks and reading and spelling achievement, suggesting that phonological awareness might represent a broader construct than is captured by blending and segmenting. Tunmer, et al. (1988) argued that all specific phonological skills are facets of a single metalinguistic metacognitive sound manipulation ability. Stanovich, Cunningham, and Cramer (1984) agree, citing high correlations among 9 of their 10 measured phonemic skills (rhyming was the exception). The implication of these high intercorrelations is that each task measures some aspect of a unitary construct; however, it is still unclear whether a few individual skills (e.g., merely blending and segmenting) or an understanding of the broad generalization are needed to facilitate the acquisition of reading and spelling.

Instructional studies provide a different view of relationships among skills. Marsh and Mineo (1977), after teaching preschool children to blend, concluded that blending may consist of separate generalizations for each specific sound. Treiman and Baron (1983), too, reported that instruction in segmenting and blending resulted in phoneme-specific effects. Thus the children were able to take advantage of specifically taught auditory skills in learning the same syllables taught alongside print; however, they did not generalize the trained sounds to novel syllables. The

circumscribed effects noted by Treiman and Baron may have been due to the brevity of instruction (four days), and the degree to which children learned the target skills. In another training study with prereaders, Slocum, O'Connor, and Jenkins (1993) found a similar effect for blending (i.e., limited generalization from taught to novel words), but noted broader generalization to novel sounds and words for children taught to segment. If phonological awareness is not a unitary construct--and worse, if phoneme-specific effects operate within individual skills--then designing phonological intervention for low-skilled children becomes dauntingly complex.

A combination of segmenting and blending provides a basis for transfer to learning to read words (Davidson & Jenkins, 1992; Fox & Routh, 1976; 1984; Torgesen, et al. 1992; Wagner & Torgesen, 1987). Also, an advantage is usually reported for phonological treatments which include a phoneme/grapheme correspondence component (see Ball & Blachman, 1991, for discussion of this issue), suggesting that the *minimal content* of instruction would include blending and segmenting, along with at least a limited number of phoneme/grapheme correspondences. Children who read and spell successfully in first grade, however, typically perform a much larger array of phonological tasks than this minimal set.

If, however, phonological awareness encompasses a wide range of sound play which includes rhyming, isolating the first or last sound in words, and deleting or substituting syllables and sounds, as well as blending and segmenting, then an approach designed to induce generalization across the breadth of the concept should be more effective in promoting reading and spelling achievement than a treatment which teaches only a pair of skills. This approach would teach a broad set of examples, varied to represent the range of appropriate applications of the concept (Carnine, Silbert & Kameenui, 1990; Tiemann & Markle, 1985). For the current study, we designed two treatments to reflect different views of the construct "phonological awareness": one treatment which taught blending and segmenting, and a second treatment which included a global array of phonological tasks. We expected that the initially low-skilled children would learn primarily what we taught them, so that the first treatment (blend/segment) would be unlikely to

induce generalization to other phonological skills which might be part of the underlying construct, while the global treatment would be more likely to do so.

This study was designed to examine the outcomes affected by different instructional contents. We selected Kindergarten children functioning below the level of their peers on phonological tasks and assessed the effects of four conditions--two phonological treatments (both with a limited letter-sound training component), and two control conditions (letter-sound training alone, and no treatment)--on the development of specific phonological skills, a transfer measure of phonological awareness, a reading analog task, and spelling.

Method

Subjects

The subject pool included the children enrolled in Kindergarten in four elementary schools in a mid-sized city in the United States ($N = 268$). Thirty to 40 percent of students in each school qualified for free or reduced lunch; the majority of children were Caucasian; and approximately 10% of the children spoke English as a second language (ESL). We excluded non-English-speaking children from the subject pool (receptive vocabulary scores more than 2.5 standard deviations below the mean on the Peabody Picture Vocabulary Test-Revised [PPVT-R]).

The low-skilled children. We selected children for the low-skilled experimental groups based on pretest scores of 0-30% on two phonological subtests: blending and segmenting single-syllable words from and into onset-rime (c--at). All of these children were nonreaders. We included children who had already been identified as qualifying for special education services or who were in the referral process (14 children). From the 98 children selected in November, 10 of the low-skilled children moved out of the district, leaving 88 children available in April with complete sets of pretest to posttest scores .

The high-skilled children. Children who scored above 50% on the combined phonological measures were categorized as "high-skilled" children. From this group of 54, we eliminated 14 children who could read one or more of the target words from the reading analog test, and

randomly selected 25 of the nonreaders across all four schools to serve as a highly skilled comparison group. Two of these children moved prior to posttesting. Children in the middle range, who fell between the extremes on the phonological pretests, were not considered further. Table 1 shows descriptive statistics for the low and high-skilled children.

Measures

Assessing phonological skill.

The pretest and posttest tasks were based on those commonly used in studies of phonological awareness and Kindergarten prediction of reading skill in first grade (Ball & Blachman, 1991; Cunningham, 1990; Fox & Routh, 1984; O'Connor, Jenkins, Slocum & Leicester, 1993; Perfetti, Beck, Bell & Hughes, 1987; Rosner & Simon, 1971; Yopp, 1988). Each task included three unscored practice items with feedback, and an opportunity for the child to repeat the correct response. Following each testing item, the examiner wrote the child's response and then provided correction. We wanted to select children genuinely low-skilled in phonological manipulations, and we expected some children to have difficulty with phonological tasks due to inexperience with the directions and format. By providing feedback on all items, we were able to eliminate children who quickly learned the new tasks. None of the actual testing items (except items on the mastery tests) was used in training.

Blending. Blending ability in Kindergarten is a good predictor of later reading ability (Lundberg, Olofsson & Wall, 1980; Perfetti, et al., 1987; Shankweiler & Liberman, 1989; Uhry, 1992; Yopp, 1992). The first 10 items were 3-phoneme words presented in onset-rime format. The examiner said, "M (pause) -ake. What word is that?" The posttest also included five words presented as three separate phonemes (t-o-p).

Segmenting. Children segmented the first 10 words in onset-rime format (e.g., The examiner said, "Make. Tell me two sounds in make."), and 5 additional words (at posttest only) into three phonemes. Children received 1 point for each correctly segmented portion of the word (1-3 points per item). To avoid penalizing children with advanced skills, we also awarded maximum points for complete segmentation during either phase of the task.

Rhyme production. Rhyme was included because it may be a precursor to later developing phonological skills (Maclean, Bryant & Bradley, 1988; Stanovich, et al., 1984). Following an explanation and examples, the examiner gave the instruction for the first of five items: "Say a word that rhymes with *make*." Correct responses included real or nonsense words. For incorrect responses, the examiner modeled correct alternatives.

Assessing factors associated with beginning reading acquisition

Rapid letter naming. Letter naming correlates highly with beginning reading (e.g., Juel, 1988; Share, et al., 1984), and timed letter naming is an even stronger predictor of reading performance (Levy & Stewart, 1991; Wolf, 1991). Examiners showed children a card with 60 randomly ordered letters in large, upper-case type. The children named as many letters as they could in 1 minute. We report the number of correctly named letters.

Word identification. Children who can read without assistance in December of Kindergarten are probably different from their peers in other abilities as well. Because of the reciprocal nature of reading and phonological skills, reading ability prior to treatment could affect the outcomes in substantial ways: thus, we excluded children who, at the beginning of this study, could read any of the words which comprised our end of treatment reading test.

Assessing receptive vocabulary

The Peabody Picture Vocabulary Test-Revised (PPVT-R; Dunn & Dunn, 1981) is an individually administered measure of receptive vocabulary. The child selects from among four pictures, one which best represents a word read by the examiner. We report standard quotient scores here, with a mean of 100 and standard deviation of 15.

Posttests

First sound. Identifying the first sound may be the first stage in segmentation. In this 10-item task, the examiner said, "Tell me the first sound in *pill*." Items were scored correct if the child provided *only* the first sound (/p/ or /puh/ were correct; /pi/ was not).

Sound repetition. During treatment some children had difficulty remembering the sounds of phonemes presented singly. Other studies have implicated short-term memory and memory for

phonemes in reading difficulties (Brady, 1991; Levy & Stewart, 1991; Snowling, 1987; Wolf, 1991). The first 3 items in this 12-item test were single phonemes; the next 4 items presented two phonemes separated by a 1-second pause. The child waited 1 second before repeating the two sounds. The next 4 items had three phonemes, and the last item four phonemes, each separated by 1-second pauses and a 1-second response delay.

Pretest to posttest measures. Children repeated the blending, segmenting, rhyme production, and rapid letter naming in the posttest battery.

Transfer tasks

For phonological intervention to be effective, children need to transfer their learning to new words and to new tasks (ultimately reading and spelling). The Lindamood Auditory Conceptualization Test (Lindamood & Lindamood, 1979) was selected to estimate transfer of learned phonological skills to a broader phonological context, and the reading and spelling analogs provided estimates of transfer to decoding and spelling new words.

The Lindamood Auditory Conceptualization Test (LAC). We selected the LAC to assess the transfer of learned phonological skills to more generalized phonological ability. The LAC does not closely mirror tasks used during instruction, and was designed to measure students' ability to process and arrange phonetic sequences (Calfee, Lindamood & Lindamood, 1973). During test administration, children discriminate one speech sound from another, and compare the number and order of sounds within spoken patterns. In the first part of the test, the examiner says a pattern of sounds (/s/ /s/ /m/), and the child uses colored blocks to mimic the pattern spoken by the examiner. During the second part, the examiner shows a block pattern to a child and says what the pattern represents, then asks the child to change the pattern to fit a new nonsense word. The tasks, stimuli, and responses of the LAC were not taught in either experimental treatment.

Reading analog task. To help gauge the degree of transfer that treated children might demonstrate when initially learning to decode words, we conducted a reading analog test following training in phonemic manipulation. A glaring difference distinguishing children who exhibit reading disabilities from their normally reading peers is their difficulty using sound-symbol

relationships to decipher unfamiliar words (Gough, Juel, & Griffeth, 1992; Perfetti, 1992). Regardless of the method of reading instruction in first grade, the ability to use systematic correspondences must be acquired in order to achieve independence in reading. A critical issue is how readily a child makes use of these correspondences between sounds and letters following explicit instruction in the process of segmenting and blending (Yopp, 1988).

An examiner taught four letter-sound correspondences (A, M, S, T), and counted how many exposures the child needed to learn to read five real words containing only those four letters (AM, AT, MAT, SAT, SAM), using a say-the-sound/blend-the-sounds approach. The examiner told the child, "We'll take turns reading these words. You'll read them, I'll read them, then you'll read them. Do you know this word?" The word cards were shuffled after each trial, and each error was recorded. During the examiner's turn, she blended the sounds, then said the whole word (e.g., "This is *Aaaaat.* At"). Turns continued for 25 trials (125 words), or until the child read all five words correctly (after which the remaining words were scored as correct). The score was the number of words read correctly out of 125 opportunities.

Spelling test. Following the reading analog, four letters (A, M, S, and T) were spread on a table. The examiner said, "I can use these letters to spell words. Watch me spell *mas.*" The examiner said the letter sounds as she assembled the letter cards to spell *mas.* Then children were asked, "How would you spell *am*?" The examiner recorded the letters selected by the child, then demonstrated the correct ordering. The words from the reading analog were presented in random order, each word once. Each letter was scored as follows: 2 points for a letter used correctly; 1 point if the letter appeared anywhere in the word; 1 point subtracted for each letter used by the child which occupied no place in the word. For example, if the examiner said *AM*, and the child spelled *MA*: 1 point awarded for M, 1 point for A, no points deducted. The two-letter words were awarded a maximum of 4 points; the three-letter words a maximum of 6 points, for a total of 26.

Procedures

Pretests.

Examiners administered pretests and the PPVT-R individually during the first two weeks of December, then divided children into low-, middle-, and high-skilled groups based on their pretests of phonological blending and segmenting. Within each teacher's class, we randomly assigned low-skilled subjects to one of the four experimental conditions to reduce potential teacher bias in the results. We randomly selected children from the high-skilled nonreaders for an end-of-intervention comparison group, and did not consider children in middle group further.

The Kindergarten curricula.

Twelve classes participated in this study, and the amount of attention their teachers devoted to tasks promoting literacy varied. In most cases, teachers scheduled either story reading or calendar activities during the phonological training. All of the teachers engaged in story book reading, and each week, starting in January, a new letter was introduced. Children were encouraged to say the names of letters, trace them in the air or on paper, and pair each letter with a picture. By the posttests, all teachers had introduced the four letters in the reading analog. Ten of the classes practiced identifying the first sound in words; rhyming was treated as an exposure objective. We observed no formal reading instruction in any of the classrooms.

Teacher training and fidelity of treatment.

Two certified teachers conducted the training in the two phonological conditions, each teaching three groups of each treatment type. The teachers learned routine formats for the two conditions during two 2-hour sessions in late December and early January. We scheduled additional training sessions every Tuesday morning during the treatment phase to practice new formats for the week, and to discuss teaching and management issues. Weekly, the first author observed at least one blend/segment and one global session taught by each teacher, noting the points in the lessons where children responded well or poorly; management issues; and content accuracy. Accuracy of lessons presented as scripted was 90-100%, except for two sessions cut

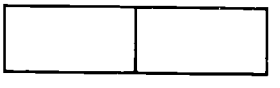
short due to class parties. At the close of the teaching days, the first author met with the teachers to discuss the responses of the groups to training and the progress of individual children.

Sessions.

We conducted sessions for the two experimental treatments in groups of three-to-five children for 15 minutes, twice weekly, for 10 weeks (6 groups in each treatment drawn from 12 classrooms). In both training conditions, we used picture boards (large displays to illustrate the meaning of words to be blended during the lesson), puppets (B-ob B-ear and L-ucy L-ion, who only understand words delivered in segments), and frequent responding, and these seemed sufficient to keep most of the children interested in the activities. Instruction for both treatments used the same core of 13 phonemes and 71 two- and three-phoneme words. During the last 5 weeks of training, we added 3 minutes of instruction in letter-sound correspondences, introduced at the rate of one new letter per session (A, S, T and M from the reading analog, plus P, O, K, L).

The experimental treatments.

Blend/segment Treatment. Blending and segmenting instruction began with stretched blending *(SSSaaammm)* and onset-rime forms (weeks 1-3), then proceeded to totally separated phonemes. During the early weeks of training, blending activities included picture cues, which were used as error corrections in later weeks. A large poster board displayed pictures representing five to seven words (e.g., *sail, cat*); children named the pictures, and then pointed to the picture that represented *sssaaailll*. We prompted segmenting activities with two-square and three-square laminated forms which children touched while saying the phonemes (see Elkonin, 1973):



To segment into onset-rime, the child touched the first square and said /s/, then the second square /ail/.

Global Treatment. This treatment combined many types and examples of phonological tasks. If phonological awareness is a single broad generalization (including blending, segmenting and many other related abilities), then presenting a wide range of examples should help to bring

that generalization about. Each global lesson included a focus "word of the day" (e.g., *sat*), and the teacher guided children through several distinct manipulations with the target word:

1) Today's secret word is /s/ - /a/ - /t/. What word is that? [sat]

2) Let's rhyme with sat. Cat, Rat, Mat. Who can rhyme with sat? [children respond]

3) Sat, pill, cat. Which word doesn't rhyme? [pill]

4) Sat. What's the first sound [last sound] in sat? [s]

5) Sat. Say all the sounds in sat. [s - a - t]

6) Let's clap [count] the sounds in sat. [clap once for each phoneme]

7) Sat. Say it without the /s/. [at]

Picture card games provided extra practice and motivation on specific manipulations. For example, in the *Say the Sounds Game* (Lesson 15), the teacher said: "Today we're going to play *Say the Sounds*. I'll show you how: You'll take a card, and say what's in the picture. Then you'll say all the sounds. If you can say some of the sounds, you get the card. If you can't say all the sounds, I'll show you how. Let's try it." The children took turns and played for about 10 minutes. We played the blending and segmenting games with both groups; however, three additional games targeted skills taught only in the global treatment.

Letter/sound Control. Children were taught the 8 phoneme/grapheme correspondences used in the treatments. This condition controlled for the influence of practice in letter-sound correspondences by providing the same amount of letter-sound practice as in the two phonological treatments. Children began instruction in the fifth week of the treatment phase (timed to coincide with the letter-sound instruction in the treatments) and continued for six sessions.

Untreated Control. Children received no training beyond their regular Kindergarten curricula. This condition assessed the phonological development of low-skilled children who received no specific phonological instruction.

Posttests.

We administered posttests individually in three 15-to-20 minute sessions to the children in the four experimental conditions, and to the children selected as initially high in phonological skills. The first session included tests of blending and segmenting, rhyme production, rapid letter naming, identifying the first sound, and sound repetition. The LAC was administered next, then the reading analog and spelling tests.

Results

Pretests

After randomly assigning the children who were low in phonological manipulation skills to one of four conditions, we analyzed pretests for differences among the groups. Neither Chi Square analyses on classification variables, nor analyses of variance revealed differences among the low-skilled groups on any of the pretest measures.

Univariate tests (following a multivariate contrast) between low-skilled and high-skilled children found differences beyond the phonological skill levels which determined group membership: age [$F(1, 119) = 26.98$, $MS_e = 0.09$, $p < .01$], PPVT-R [$F(1, 119) = 19.67$, $MS_e = 195.07$, $p < .01$], rapid letter naming [$F(1, 119) = 21.22$, $MS_e = 85.60$, $p < .01$], rhyme [$F(1, 119) = 28.55$, $MS_e = 3.41$, $p < .01$], blending [$F(1, 119) = 213.93$, $MS_e = 2.82$, $p < .01$], and segmenting [$F(1, 119) = 776.58$, $MS_e = 4.47$, $p < .01$]. Means and standard deviations for all pretests are displayed in Table 1.

Posttests

Following the 10-week intervention, children from the four low-skilled groups and those from the high-skilled group were tested again. Posttest means and standard deviations are shown in Table 1. We conducted an orthogonal set of four weighted group contrasts using data from the five groups. The first three tests compared posttest outcomes among the low-skilled children: (1) the two treatments versus the two controls; (2) the treatments versus the letter-sound control; and (3) the two phonological treatments. The fourth test compared outcomes between the combined phonological treatments and the high-skilled group. Each test began with a multivariate analysis of variance, followed by univariate tests.

The two phonological treatments versus the two controls.

This comparison analyzed the effect of phonological intervention for low-skilled children without regard to the specific content of instruction. The multivariate statistic was significant (Wilks' lambda = 0.33; $F(9, 98) = 21.93$, $p < .01$), and univariate tests revealed significant differences on all posttest measures except rapid letter naming. Training clearly improved phonological abilities, and resulted in transfer to performance on measures of generalized phonological awareness (the LAC test), reading, and spelling.

The two experimental treatments versus the letter-sound training control.

It is possible that the superiority of the treatment groups resulted from their training in letter-sound correspondences. By contrasting performance of the letter-sound control with the treatments, all receiving comparable letter-sound instruction, we can estimate the unique contribution of phonological training to phonological awareness, reading, and spelling. The overall multivariate test was significant [Wilks' lambda = 0.43; $F(9, 98) = 14.23$, $p < .01$)], and all but three of the univariate tests -- rapid letter naming, sound repetition, and first sound -- revealed an advantage for phonological training over training in letter/sound correspondences alone. Children in the phonological treatments scored significantly higher than children in the letter-sound group on phonological measures and transfer tasks, suggesting that the higher performance of the treated children over untreated children in generalized phonological skills, reading, and spelling cannot be attributed to the letter-sound training component.

The two experimental treatments: Blend/segment versus Global.

This contrast examined the relative effects of each training condition on the acquisition of phonological skills, and on reading analog and spelling tasks. We expected the treatments to be comparable on blending and segmenting, which both groups were taught. However, because of the broad range of phonological tasks comprising the global treatment, we expected those children to outperform the blend/segment group on other phonological tasks (e.g., identifying the first sound; rhyming), and on the generalized measure of phonological awareness (i.e., the LAC). Moreover, if generalized phonological awareness facilitates performance more than simple

blending and segmenting on reading, the global treatment should surpass the blend/segment group on the reading analog. Neither the overall multivariate statistic, nor specific univariate tests revealed *any* differences between the two treatments on posttest measures.

The two experimental treatments versus the highly skilled children.

Several studies have suggested that training can improve phonological manipulation skills, but these studies usually show a considerable gap between low-skilled children and their higher skilled peers on phonological tasks, even after training. Table 1 shows the disparity between pretest scores of children initially low or high in phonological abilities. This contrast compares children initially low in phonological skills who received 10 weeks of training with untrained children who began the study with well-developed phonological abilities.

The multivariate contrast was significant [Wilks' lambda = 0.79; $F(9, 98) = 2.79$, $p < .01$], with tests of rapid letter naming and reading favoring the highly skilled children. No other significant differences were found. For the low-skilled children, intervention in phonological manipulation appeared necessary to advance their ability on blending and segmenting tasks, however, the children initially high in these abilities continued to grow in skill without specific instruction. Although the treatments improved the initially low-skilled children's blending, segmenting, and generalized phonological awareness (the LAC), their ability to learn new words was still inferior to children who began Kindergarten high in phonological awareness.

Contributions to variance on the transfer measures

Children in both training conditions improved their scores on phonological measures, and children performed similarly on the transfer phonological task (the LAC) whether their training was relatively narrow (only blending and segmenting) or more broadly-based (blending, segmenting, rhyming, and phoneme isolation). Moreover, children who began Kindergarten with high skills continued to improve across all of the measured areas without explicit training. To discover which abilities contributed most directly to performance on reading, we performed a series of stepwise regression analyses. The first explored the contributions of specific phonological skills to the

measure of generalized phonological awareness (the LAC); the next two examined the contribution of generalized awareness and specific phonological skills to the reading and spelling analogs.

To minimize intercorrelations among predictors where measures were repeated, we used the posttest scores in the regressions (pretest scores among low-skilled groups did not differ). Blending and segmenting activities formed the core of both treatments, therefore, we aggregated the posttests of blending and segmenting into a single index. Other predictors of theoretical interest included potential precursors of blending and segmenting: sound repetition, designed to tap short term memory for phonemes; first sound, which may be an early step in the development of segmentation ability; and rhyme, one of the earliest developing phonological abilities. The PPVT-R, the LAC and rapid letter naming were included in regression of the reading and spelling analogs. Table 2 shows the matrix of Pearson correlations among the phonological variables, student characteristics and transfer measures.

Regression of the Lindamood Auditory Conceptualization Test.

The LAC was significantly correlated (using Bonferroni probabilities) with all of the variables in Table 2 except the PPVT-R. The intent of this stepwise regression was to explore the relative contributions of phonological measures to LAC performance. Table 3 shows correlations, squared correlations, and the change in variance accounted for by variables on each step. As expected, the combined blending and segmenting measure accounted for most of the variance in LAC scores, nevertheless, rhyme still accounted for significant additional variance, suggesting that the construct tapped by the LAC represents a broader ability than merely blending and segmenting.

Regression of the reading analog task.

Results of stepwise regression of the reading analog on variables accounting for significant amounts of variance are shown in Table 4. Blending and segmenting again accounted for the largest portion, and the LAC did *not* add significant additional variance to reading scores. For this task, being able to blend and segment were more important than more generalized phonological ability. The additional variance added by rapid letter naming, on the second step, may explain why the high-skilled children performed better on the reading task than the trained children in this study.

Regression of the spelling task.

Table 5 shows the results of the regression of the spelling scores, along with the increase in variance attributed to each variable. Again, LAC scores added no significant variance, even though phonological abilities beyond blending and segmenting (saying the first sound in words and rhyme production) influenced spelling scores.

Discussion

The questions which drove this study extend the work of others (Ball & Blachman, 1991; Bradley & Bryant, 1985; Cunningham, 1990; Torgesen, et al., 1992) to include children at risk for developing reading disabilities: Can we help very low-skilled, prereading children acquire phonological awareness? If we succeed, will it improve their reading acquisition? Which aspects of phonological awareness should we include in a program for low-skilled children? For example, which aspects most assist children in the *beginning* stages of learning to decode words? The analyses of contrasts suggests that for low-skilled children, training in phonological skills increases phonological abilities, and transfers to reading and spelling analog tasks.

The effect of instructional content on phonological awareness

Despite the differences in instructional content (e.g., The global treatment included identifying the first and last sounds in words, sound-to-word matching, deleting the first sound, phoneme counting, alliteration, and rhyming activities, as well as blending and segmenting), children in the two treatments performed comparably on phonological measures and transfer of learned skills to the Lindamood (LAC) test, and to analog tasks for reading and spelling. Just as surprising, children in the global treatment who spent a relatively short time each session on blending and segmenting were able to perform these tasks as well as children who spent their entire sessions blending and segmenting.

If children in the global treatment learned fewer tasks than the treatment attempted to instruct, the comparable results between treatments could be attributed to a lack of differences in student learning (e.g., children may have learned only to blend and segment). The daily training log detracts from this hypothesis. Most children in the global treatment were able to perform the

instructed tasks on the set of training words, and over half approached ceiling (80% or higher) on the two measures of tasks taught only in the global treatment (rhyme production and first sound).

Alternatively, the construct "phonological awareness" may hinge upon blending and segmenting--taught in both treatments--so that learning additional skills does not improve a child's understanding of phonemes in words. Regression on the LAC, however, suggests that rhyme contributes to successful performance beyond variance accounted for by blending and segmenting.

A third possibility is that learning to blend and segment is sufficient to produce transfer to a broader array of phonological skills. It is reasonable to suppose that if children learn segmentation (c--a--t), they might transfer that knowledge to identifying the first sound in words, because the latter task is incorporated in the former. Nevertheless, other studies found that young children did not transfer learning from one phonological skill to another (Fox & Routh, 1984; O'Connor, et al., 1993; Slocum, et al., 1993), although in those studies only one skill was taught (e.g., blending or segmenting). A comparison of posttest means on the LAC suggests that children taught only to blend and segment applied their knowledge to new phonological tasks. This evidence suggests that the *combination* of blending and segmenting increases the probability of transfer.

Generalized phonological awareness, reading, and spelling

It was not generalized phonological awareness (LAC scores), however, which influenced performance on the reading analog task. After blending and segmenting were selected in the regression, LAC scores accounted for no unique variance. In spelling, also, specific skills (blending, segmenting, rhyme, first sound) made larger contributions than generalized phonological awareness (the LAC). This evidence suggests that when the intent of phonological instruction is to improve reading and spelling, concentrating the phonological teaching efforts on blending and segmenting may be sufficient.

Reading effects in this study, like nearly all of the other research examining phonological awareness which uses isolated word reading as the dependent variable, are at best suggestive. We considered only a narrow slice of reading behavior--learning to decode a few, regularly spelled words--because decoding becomes the major stumbling block for children who develop reading

disabilities (Gough, et al., 1992; Perfetti, 1992; Stanovich, 1986). We trained children in the bottom quartile of their Kindergarten classes, and we expected that measures of *real* reading (e.g., sight words, reading fluency, and comprehension) would be insensitive due to probable floor effects. The degree to which the reading analog task is a proxy for learning to read has not been assessed. Later measures of real reading in the first grade and beyond must be the final arbiter of efficacy for phonological intervention.

The high-skilled children.

The high-skilled children made gains in phonological skills without intervention, ending at comparable levels to the treated groups. Their higher skill attainment earlier in the school year, in receptive language and letter knowledge as well as in phonological skills, may have allowed them to take better advantage of classroom experiences. Studies have suggested that letter naming may be a proxy for the kind of automatic lower-level processing necessary for decoding, and eventually for reading comprehension (Stanovich, 1986; Wolf, 1991). Along with phonological skills, significant variance in our reading analog scores was accounted for by rapid letter naming, which began (at pretest) significantly higher for higher-skilled children, and ended with an even larger gap between group classifications. Despite comparable ending levels of phonological skills, treated children performed less well on the reading analog task than children who were classified as high-skilled early in the Kindergarten year.

Instructional implications

The application of phonological learning to novel items (e.g., segmenting new words) and new tasks (i.e., reading and spelling) may be especially troublesome for young children at risk for reading failure (some in this study had already qualified for special education services). We expected our subjects to have difficulty learning phonological tasks.

Our primary question concerned the breadth of instruction necessary to bring low-skilled children to the level of their higher skilled peers in phonological awareness. Although the global treatment was designed to encourage a broader, more encompassing ability to do many different kinds of phonological manipulations, the blend/segment treatment produced transfer as strong as

the varied, global treatment on the measures used here, and both treatments produced phonological skill levels commensurate with those of the high-skilled children. Moreover, both treatments were effective prior to the onset of formal reading instruction. This distinction is important because for intervention in phonological manipulation to be optimally useful, it should be delivered to children prior to formal reading instruction as a preventive measure, and it should evoke levels of phonological skill comparable to the threshold levels documented for children with high phonological abilities (levels beyond which no increase in reading achievement occurs).

Without specific intervention, young poor readers are unlikely to show much improvement in manipulating phonemes. They appear less able to take advantage of the reciprocal interplay of increasing reading and phonological abilities that assists good readers to grow dynamically in real and nonword reading throughout the first and second grades. In the current study, children in the untreated control group did not improve very much on phonological tasks, despite the 5 months between pre- and posttesting phases.

Despite low-skilled children achieving high levels of phonological ability through treatments, children *initially* high in phonological awareness learned to read the words on the analog task more quickly than the treated children. Studies have suggested that a combination of phonological skills and letter knowledge are needed to learn to decode and spell new words (Byrne & Fielding-Barnsley, 1989; Fox & Routh, 1984; Perfetti, et al., 1987; Torgesen, et al. 1992). Although improved phonological skills gave the treated children an advantage over untreated children who remained low in phonological awareness, improvement in phonological skills without commensurate improvement in letter knowledge left them less prepared than the high-skilled children to learn to decode. Stanovich (1991) called developments in our understanding of the contribution of phonemic awareness to reading one of the scientific success stories of the last decade. This research begins to explore that contribution with the children most desperately in need of scientific breakthroughs: the children who may have real and sustained difficulty learning to read.

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Table 1

Means and Standard Deviations for Pretest and Posttest Measures

	Low-skilled children					High-skilled children	
	Pretests	Posttests, by treatment				Pretests	Posttests
	(combined low-skilled groups)	Blend/Seg + Letter/sounds	Global + Letter/sounds	Letter/sounds	Untreated		
	n = 88	n = 21	n = 23	n = 22	n = 22	n = 23	
Measures	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Age	5.8 (0.3)					6.1 (0.4)	
PPVT-R	90.2 (13.4)					102.4 (14.2)	
Rapid letter naming	7.0 (8.3)	22.2 (17.3)	21.8 (15.5)	23.0 (14.6)	20.0 (14.5)	15.5 (10.8)	35.1 (14.6)
Rhyme Production (5)	1.4 (1.9)	2.8 (2.3)	3.4 (2.2)	2.0 (2.2)	1.9 (2.1)	3.4 (1.6)	4.0 (1.4)
Segment (35)	0.8 (1.4)	25.8 (10.8)	22.9 (8.8)	6.1 (8.0)	4.9 (6.6)	12.6 (3.2)	22.4 (11.3)
Blend (15)	1.2 (1.4)	10.7 (4.0)	10.4 (3.7)	3.0 (3.1)	2.2 (2.1)	6.1 (2.2)	9.4 (3.6)
First sound (10)		7.4 (3.0)	7.4 (2.9)	5.9 (3.6)	3.5 (2.9)		7.0 (2.4)
Sound repetition (12)		10.0 (1.9)	9.8 (2.4)	9.0 (2.0)	8.8 (1.6)		10.3 (1.4)
Lindamood (LAC)		29.4 (11.5)	31.3 (10.5)	12.0 (9.6)	15.8 (10.4)		29.5 (14.3)
Reading analog (125)		97.4 (28.7)	85.6 (37.3)	65.1 (40.6)	40.4 (33.6)		109.5 (15.2)
Spelling (26)		16.0 (6.5)	17.7 (5.5)	12.4 (7.7)	10.6 (5.9)		18.5 (6.2)

Note: Numbers in parentheses following the test names indicate maximum possible scores at posttest.

Table 2

Correlations among the Posttest Measures (N = 111)

	Sound Repetition	1st Sound	Rhyme	Letter Names	Blend/Seg[a]	LAC[b]	Reading	Spelling
PPVT-R[c]	.197	.133	.432	.557	.192	.252	.360	.357
Sound Repetition	1.00	.558	.427	.343	.563	.513	.575	.462
1st Sound		1.00	.226	.244	.618	.369	.563	.548
Rhyme			1.00	.290	.391	.517	.416	.442
Letter Names				1.00	.308	.307	.490	.493
Blend/Seg					1.00	.700	.660	.602
LAC						1.00	.521	.553
Reading							1.00	.723
Spelling								1.00

[a] Combined blending and segmenting posttest scores

[b] Lindamood Auditory Conceptualization Test

[c] Peabody Picture Vocabulary Test - Revised, administered during the pretest phase

Table 3

Portioning the Variance on the Lindamood Auditory Conceptualization Test for Children in Low- and High-Skilled Groups (N = 111)

Enter	Variables	R	Change in R^2	Total R^2
Step 1	Combined blending and segmenting	.70	.49	.49
Step 2	Rhyme production	.75	.07	.56

Table 4

Portioning the Variance on the Reading Analog Test for Children in Low- and High-Skilled Groups (N = 111)

Enter	Variables	R	Change in R^2	Total R^2
Step 1	Combined blending and segmenting	.66	.44	.44
Step 2	Rapid letter naming	.73	.09	.53
Step 3	Sound repetition	.75	.03	.56

Table 5

Portioning the Variance on the Spelling Test for Children in Low- and High-Skilled Groups

(N = 111)

Enter	Variables	R	Change in R^2	Total R^2
Step 1	Combined blending and segmenting	.60	.36	.36
Step 2	Rapid letter naming	.68	.11	.47
Step 3	First sound	.71	.04	.51
Step 4	Rhyme production	.73	.03	.54