

The Efficacy of Orthographic Rime, Grapheme–Phoneme Correspondence, and Implicit Phonics Approaches to Teaching Decoding Skills

Carol A. Christensen and Judith A. Bowey
The University of Queensland

This study compared the efficacy of two decoding skill-based programs, one based on explicit orthographic rime and one on grapheme–phoneme correspondences, to a control group exposed to an implicit phonics program. Children in both explicit decoding programs performed consistently better than the control group in the accuracy with which they read and spelled words covered in the program. Only children in the grapheme–phoneme correspondence program consistently spelled transfer words better than children in the control group. In addition, children in the grapheme–phoneme correspondence group consistently read words more quickly than children in the control group. Children in both explicit decoding programs scored higher than the children in the control group on measures of reading comprehension and oral reading at posttest.

Recent research has clearly shown that ability to use letter-sound correspondences is an important component in programs developing early reading skills (National Reading Panel, 2000). However, the precise nature of what constitutes the most efficacious approach to teaching early reading skills remains contested. Central to this debate are questions about the optimal size of the orthographic units that programs should utilize.

Some researchers argue that larger orthographic units (e.g., orthographic rimes) are optimal units (Goswami, 1986). Orthographic rimes consist of the vowel and final consonant or consonant cluster (e.g., /at/ in cat). Other writers suggest that children begin to read new words on the basis of smaller, grapheme–phoneme

Correspondence should be sent to Carol A. Christensen, School of Education, The University of Queensland, Qld, 4072, Australia. E-mail: c.christensen@uq.edu.au

mappings (*r-a-t*), and only later begin to use larger orthographic rime correspondences (Ehri & Robbins, 1992). The phoneme is the smallest phonological unit, a single speech sound.

Goswami (1986) reported that showing children how to read a clue word such as *beak* increases beginning readers' ability to read unfamiliar words sharing the orthographic rime sequence of the clue word (e.g., *peak*). Significant differences in the relative strength of end (orthographic rime) and beginning (orthographic onset + vowel) analogies were interpreted as suggesting that children use orthographic rimes in word reading from the earliest stages (Goswami, 1986, 1988, 1993; see also Bowey, Vaughan, & Hansen, 1998).

However, the theoretical significance of differences in strength between end and beginning analogies was undermined by findings that the end analogy effect incorporates a phonological priming component (Bowey et al., 1998; Goswami, 1990; Savage, 1997; Savage & Stuart, 1998). More recent work has suggested that the end analogy effect is no greater than the beginning onset + vowel (or even the medial vowel digraph) analogy effect when concurrent controls have been made for phonological priming effects across the range of test words investigated (Bowey et al., 1998; see also Savage, 1997; Savage & Stuart, 1998).

Nevertheless, Goswami's (1986, 1988) work led to suggestions that children learn to read words, from the outset, using analogies based on the orthographic rimes of known words (Goswami & Bryant, 1990). The plausibility of the orthographic rime analogy account in relation to the earliest stages of reading depends on the assumptions made concerning the level of detail characteristic of beginners' orthographic representations of words (Bowey, 1999). It appears that relatively few words are recalled in detail by beginning readers (Seymour & Elder, 1986). Ehri and Robbins (1992) found that only children who already possessed some ability to read could make orthographic rime analogies from words taught as wholes to independently presented transfer items.

Some children do appear to use orthographic rimes in their reading of unfamiliar items fairly early on. Treiman, Goswami, and Bruck (1990) found that nonwords constructed from relatively common orthographic rimes (e.g., *ain*) were read faster and more accurately than those constructed from less common orthographic rimes (*oan*) in both first-grade and third-grade children. Treiman et al. argued that nonwords with common orthographic rimes may be read by analogy to real words using orthographic rime correspondences. Orthographic rime correspondences are less likely to be available for nonwords with uncommon orthographic rimes, which must therefore be read using grapheme-phoneme correspondences.

Given that very young children generally show awareness of rime units before awareness of phonemes (Bryant, Maclean, Bradley, & Crossland, 1990), it has been argued that reading instruction based on orthographic rimes may be an effective means of introducing children to print (Goswami & Bryant, 1990).

There is some empirical support for this suggestion. For example, Bruck and Treiman (1992) found that first-grade readers, taught by whole-language methods, very quickly learned to read new words presented in “word families” (sets of words sharing the orthographic rime). However, children taught using word families retained those words less well than children whose initial training required grapheme–phoneme analysis and they were unable to use the orthographic rimes to read unfamiliar items. These items were most likely to be correctly read by the children who were taught to focus on grapheme–phoneme relations.

Few studies have directly compared extended decoding instruction based on onset-rime and grapheme–phoneme correspondences. Some of these studies failed to show effects based on size of orthographic unit. Haskell, Foorman, and Swank (1992) assigned first-grade children to one of three training conditions: focusing on grapheme–phoneme correspondences, onsets and rimes, or whole words. After 6 weeks of training, the onset-rime and grapheme–phoneme correspondence groups both performed significantly better than the whole-word group. There were no significant differences between the onset-rime and grapheme–phoneme correspondence groups.

Similarly, Levy and Lysynchuk (1997) taught children to read 32 words over 4 weeks. Children were assigned to one of four training conditions: focusing on grapheme–phoneme correspondences, onset plus vowel, orthographic rimes, or whole words. The orthographic rime condition used a “word families” approach that emphasized shared orthographic rimes. Levy and Lysynchuk found that word reading proficiency developed most slowly in the whole-word condition and this group performed at a lower level than the other groups on generalization and retention tests. Skill generalization and retention were equally good for all other conditions.

Other research suggests that programs based on grapheme–phoneme correspondences are more effective with beginning readers. For example, in their meta-analysis, the National Reading Panel (2000) reported that programs including systematic phonics instruction had consistent positive effects on reading and comprehension for young readers. However, the effect size for programs based on phonemes was larger than for those based on larger orthographic units ($d = .45$ compared with $d = .34$).

Thus, although it is clear that explicit decoding programs that have emphasized sublexical units are more effective than whole word approaches in teaching early readers, the relative efficacy of teaching children to decode unfamiliar words using onset-rime compared with grapheme–phoneme correspondences is unclear. Furthermore, some writers and practitioners have argued that letter-sound relationships can be most effectively taught within the context of a whole language approach to reading that takes an implicit phonics approach by embedding development of skills in the process of reading meaningful text (Dahl, Scharer, Lawson, & Grogan, 1999; Kane, 1999). Little is known about the relative efficacy

of teaching decoding skills based on practice in using letter-sound relationships compared with an integrated approach to teaching letter-sound relationships in the context of reading meaningful text.

The study reported here examined the efficacy of three approaches to teaching reading skills. Two of the programs explicitly taught decoding skills. One focused on orthographic rimes (using word families) and one focused on grapheme-phoneme correspondences. The third approach acted as a treatment control. It used an implicit phonics approach by teaching letter-sound correspondences within a whole language approach to reading text.

METHOD

Participants

Participants were 116 children in their 2nd year of schooling from 7 classrooms in two state elementary schools in Brisbane, Australia. The 1st year of schooling in the state of Queensland is termed Grade 1. Thus, these children were in their 2nd year of schooling, Grade 2. The average age of the children at the commencement of the study was 7 years 1.5 months ($SD = 3.17$ months). They were slightly older than children in their 2nd year of schooling in systems that have a kindergarten year (Grade 1 in Queensland). Thus, they could be considered as advanced beginning readers.

Measures

Pretest. Pretest measures assessed phonemic segmentation of words, letter knowledge, decoding, sight word recognition, and spelling. In the letter-sound knowledge test, children were asked to provide the sounds of the 26 letters of the alphabet. Reading ability was tested with a modified version of Clay's (1979) Ready-to-Read Words Test. This test consists of 48 words commonly encountered by beginning readers. Examples of words included in the test are *the*, *are*, *mother*, *said*, *come*, *school*, and *please*. In our version of this test, the items *a* and *I* were omitted, as children can read these on the basis of letter-name knowledge alone (see Bowey, 1994).

Phonemic segmentation was assessed by asking children to identify each of the phonemes in 18 words. The test comprised a series of pictures representing each word. Words ranged from two to four phonemes. Two phoneme words included *shoe* and *knee*. Examples of words with three phonemes were *tap*, *duck*, and *bird*. Words with four phonemes included *bread*, *clock*, *lamp*, and *tent*.

Pretest spelling ability was assessed by asking children to spell 24 words. The spelling list included consonant vowel consonant (CVC) words (e.g. *cap*, *man*),

words containing initial or final consonant clusters (e.g., *glad, sand*), and long vowels (e.g., *gate, boat*).

Interim tests. Interim Test 1 asked children to read and spell CVC words with orthographic rimes covered in all three intervention programs.

The spelling test required children to spell words that had been directly taught (“program” words) as well as words with similar orthographic structures that were not included in the program (“transfer” words). Transfer words used the same orthographic structures (e.g., CVC, initial, or final consonant clusters) but were not included in the program. There were six randomly selected program words from different word families (*rat, sun, top, pet, map, win*) and six transfer words (*cot, fat, log, met, fin, run*). These tests were administered to whole classes.

The reading measure included 32 words covered in the program. They included words from each word family (e.g., *pat, hot, wet, mop, tap, fun, pin*). The children were individually tested, and both accuracy and speed of reading were recorded. The speed measure was the time taken to read the list of words (in seconds). Transfer words were not included at this stage because of the resource demands of individual tests of reading in terms of research assistant time. All word-reading measures provided scores for accuracy (the number of words read correctly) and speed. Children were timed when reading the list of words. Scores were reported in terms of the mean number of seconds per word.

Interim Test 2 consisted of words containing initial and final consonant clusters. Children were asked to read 45 program words (e.g., *drum, frog, sand, bring*) and to spell 10 words covered in the program (*flop, pram, plod, plug, drip, quick, send, bank, dust, sting*) and 10 transfer words (*clap, drag, plop, slim, flip, just, wink, plant, pond, limp*).

Posttest. Posttest measures covered reading and spelling. Decoding was assessed individually by asking children to read 55 program words and 55 transfer words.

Spelling was assessed in whole-class groups. There were 20 words from the program and 20 transfer words. Half the words had silent *e* (e.g., *hope*) and half had vowel digraphs (e.g., *road*).

Oral reading was assessed using the Salford Sentence Reading Test (Bookbinder, 2002). It requires children to read a series of sentences of increasing complexity and difficulty. Scores are provided in the form of a reading age. The first sentence in the sequence is “He got some sweets from the shop” (reading age, 6 years 2 months). The most difficult is “This restaurant has an enviable reputation for delicious dishes” (reading age, 9 years 8 months).

Reading comprehension was assessed by the “Kicking Stones” story from the Basic Academic Skills Samples. This consists of a series of cloze activities where

children have to nominate one of three possible words that best fit in the context of a short piece of text.

Intervention Programs

There were three instructional conditions. Two explicit decoding conditions provided teaching and practice in the analysis and synthesis of words using sublexical units. The Orthographic Rime program (OR program) focused on orthographic rime correspondences and onset-rime blending, and the Grapheme-Phoneme Correspondence program (GPC program) focused on individual grapheme-phoneme correspondences and the analysis and synthesis of individual phonemes. The third program acted as a control. It taught sound-symbol relationships using an implicit approach phonics. This taught decoding skills using symbol-sound relationships as they occurred when reading authentic text.

All classrooms used a whole language approach to reading in their normal lessons. This included whole class reading of “big books” and individual reading of “authentic texts.” There was a focus on reading a variety of genres, so children were given both fiction and informational texts to read and discuss as a class. They were encouraged to write using their own invented spellings. The implicit approach was consistent with the usual reading instruction in the classes.

As far as possible, the three programs corresponded in key instructional features. The programs were organized into modules. Children in the two explicit decoding instruction programs practiced the same number of words in each session and the same words across each module of 10 lessons. Modules consisted of 8 lessons each introducing a set of four new words. In addition there were 2 review lessons.

Children in the skills-based groups worked with one list of words per day. However, the words within sets for each program were presented in different orders and combinations, so that the primary instructional focus was on either orthographic rimes or grapheme-phoneme correspondences. New letters were introduced at the same rate and as close as possible to the same order. All three programs introduced the same limited number of letters in each session. Each list in the OR program contained words with the same orthographic rime or word family. The GPC program differed from the OR program in teaching segmentation and blending skills by focusing on manipulation and representation of phonemes rather than orthographic rimes. Lists in the GPC program did not contain any rhyming words. For example, one OR list consisted of *top*, *mop*, *hop*, *shop*. The corresponding GPC list was *mat*, *hop*, *run*, *shin*.

The programs were presented in a series of six modules, each containing eight sets of four words. Module 1 focused on CVC words, that is, words beginning with a single consonant and ending in two-letter orthographic rimes. Rimes cov-

ered in the module included *at, et, ap, op, un, in, ot, and it*. Examples of words included *mat, pet, cap, top, sun, win, and hit*. Module 2 covered words with initial consonant clusters, including *fl, dr, gl, pr, pl*. Words included *flop, drum, glad, pram, plug*. Modules 3 and 4 introduced rimes with final consonant clusters. Initial consonant clusters introduced in these modules included *bl, cr, br, and st*. Final consonant clusters included *nd, st, nk, and ng*. Words included *brand, must, blank, and sting*. Modules 5 and 6 covered long vowels both digraphs and silent *e*. Digraphs included *ai, ea, oa* (e.g., *snail, float, slope, gate*). Each module contained only words based on the specific orthographic structure.

Each module was divided into lists of four words. Both programs covered the same words in each module. There were review lists that included previously covered words midway through and at the end of each module. Review lists were confined to words in this module and did not cover words that had appeared in previous modules.

In a sense, the GPC program served as a “control” for the OR program. The OR program was constructed first. Sets of 4 new words from a single word family were devised and organised into modules of 32 words (eight sets of 4 words, with each set introducing a single orthographic rime). For instance, Word Set 7 of Module 4 of the OR program contained the words *damp, ramp, stamp, and camp*. The 32 words within each module were then rearranged into eight new 4-word sets for the GPC program.

Because of the need to correspond to the OR program, the words within each four-word set of the GPC program were not necessarily optimal in terms of the grapheme–phoneme correspondences taught. Nevertheless, as far as possible, GPC program word sets contained at least two words that forced fine-grained analyses of somewhat similar orthographic rimes. Thus, GPC program Word Set 7 within Module 5 contained the words *coat, leak, drain, and snail*, with *drain* and *snail* forcing analysis of the two similar orthographic rimes, *ain* and *ail*, and reinforcing the *ai* correspondence. Many word sets contained either two such pairs of words or a group of three such words. Thus, GPC program Word Set 5 in Module 4 contained the words *thump, stamp, kill, and smell*, and GPC program Word Set 2 in Module 5 contained the words *feed, sweet, sheep, and trick*.

The implicit phonics control program covered the same letter-sound correspondences as the other programs. This included all initial consonants, medial vowels and final consonants, and consonant blends. For example, when the final consonant cluster *mp* was introduced in the skills program it was also introduced in the implicit phonics program. However, where the skill programs covered grapheme–phoneme correspondences in the context of reading isolated words, the implicit phonics program introduced letter-sounds in the context of reading books. Thus, children were not given practice in decoding isolated words. Additionally, the constraint of locating texts that contained words with a specific set of letter-sounds meant that the implicit phonics program did not necessarily contain

precisely the same words as the other programs. For example, when the skill-based programs covered the letter-sound correspondence *oa*, the list contained the word *coat*. However, in the corresponding lesson the children in the implicit phonics program encountered the word *boat*. Overall, the implicit phonics program contained the same number or more exemplars of words containing each letter-sound correspondence as the skill-based program. If children made an error when reading one of the target words, they were asked to look at the letter-sound they were learning and to see if they could “work out” the word. If they continued to make an error the teacher modeled the process of working out the word until the student could say the correct word.

Procedure

Pretesting. Initially, all children were tested on phonemic segmentation of words, letter knowledge, reading and spelling words, and the Clay’s (1979) Ready-to-Read-Words Test.

The phonemic segmentation test was administered individually. Children were shown a card with pictures of the words to be segmented. Each card had three pictures. They were asked if they could “say all the sounds in the word.” The first card contained practice examples. The tester pointed to the first picture and said, “This is a cow. Can you tell me all the sounds in the word *cow*?”

If the child answered correctly the child was told that he or she was correct and the tester moved on to the next practice item. If the child made an error, the tester gave the instructions again. If a second incorrect answer was given the tester modeled the correct answer and moved on to the next example. When the tester was sure that the child understood the instructions, she moved onto the test items.

Word reading and the Clay’s Ready-to-Read Words Test were administered individually. Children were given a card on which the words were printed and asked to read each word. Children were given encouragement for all their attempts but not given any feedback on the correctness of their response.

Spelling was administered in whole class groups. The children were given a piece of paper with appropriately spaced lines. They were told that they were going to try to spell some words. If they didn’t know a word they should “have a go and try.” The tester said each word aloud. Then gave a sentence containing the word, and then repeated the word and asked the children to write it on the page.

Assignment to Groups

To control for effects of intact class groups, allocation of children to instructional groups was conducted within each class. Triplets of children were identified matched on pretest phoneme segmentation, reading, and spelling scores. Members

of triplets were randomly assigned to one of the three groups. One group was given the OR program, one group was given the GPC program, and one group was given the implicit phonics control program. Where the number of children in the class could not be divided evenly by three, the additional child or children were assigned to a group. Thus, in each class children were matched on pretest scores and randomly assigned to one of the three programs. There were 39 children in the OR and implicit phonics groups and 38 children in the GPC group.

Interventions

Instruction was conducted within classrooms in small groups of six to eight children. All teaching was conducted by trained research assistants during regularly scheduled literacy lessons. To control for effects of teacher, each research assistant taught each of the three programs to different groups of children, so that each assistant taught approximately an equal number of children in each condition.

The program was implemented for 20 min per day for 14 weeks. Teachers were asked to continue with their normal literacy instruction practices outside the intervention. All participating teachers used a whole language approach to teaching literacy in their regular lessons.

Skills programs. Each lesson in the OR and GPC programs followed the same basic format. Initially, the new letters for the day were introduced to the group as a whole on large cards. The children thought of words that began and ended with the phoneme. For example, the letter *s* was introduced and children were asked to think of a word that began with /s/ and then asked to think of a word that ended with /s/. Children in the OR program were then introduced to the orthographic rime that they were to practice (e.g., *at*, *et*).

The words to be encoded and decoded were introduced one at a time, using letter cards to make the words. Each card contained a single letter. In the OR group the teacher displayed the rime for the day and then added the initial consonant or consonant blend to make the first word (e.g., *at*, *cat*). The children decoded the word with the help of the teacher. There was particular emphasis on using letter-sound correspondences to blend together the phonemes to make each word. When children had worked out the words, they generated a sentence that contained the word. The initial letter (e.g., *c*) was then replaced to make the second and subsequent words (e.g., *pat*).

In the GPC condition, the teacher displayed all the letters to make the first word that was decoded and used in a sentence. She then collected all the letters and displayed the second, third, and fourth words.

After the words were introduced children in both OR and GPC conditions used individual workbooks to read each word a minimum of six times. Words were arranged in random order. They first read the words as a group and then in-

dividually read them to the teacher. This provided extended practice in decoding the words.

To ensure that children analyzed the words fully, they wrote the words from memory as a spelling activity. Corrective feedback was provided, and children who made errors were given additional practice. Finally, children read from workbooks containing one or two sentences that used as many words from their decoding list as possible. Children read the sentences together and alone. Children who needed further instruction were given additional practice; children who were proficient in decoding the words copied the sentence(s) and illustrated the story.

Implicit phonics control. Children in the control program worked with the teacher to read a piece of text from an age-appropriate storybook. This was followed by a discussion of the story. The letter-sound correspondences for the day were introduced on letter cards. The same letter-sound correspondences were introduced to all groups at the same time. For example, when the letter *s* was introduced to children in the skills programs, it was also introduced to the implicit phonics group.

As with the skills programs, children thought of words that began and ended with the sound. The group then went through the story to locate words that contained target letter-sound correspondences. Children then completed workbooks that contained sentences from the story containing words using this letter-sound correspondence. In these workbooks, spaces for letters representing the target letters were left blank. Children completed the activity by inserting the appropriate letter in the spaces.

Fidelity of interventions. Initially all research assistants were given professional development in the steps in presenting the programs. They were also given a teacher's manual that provided a step-by-step guide to each intervention. Finally, they simulated the intervention until they were accurate in following the prescribed sequence of steps in each lesson. If research assistants were unclear of any procedures, techniques were demonstrated and modeled for them.

To ensure uniformity and consistency of implementation, the first author visited each research assistant, teaching each intervention group once every week for the duration of the program. Feedback was given individually on any changes that were required in teaching techniques. All research assistants followed the sequence of lessons accurately. However, some minimal changes were suggested. For example, it was suggested to one research assistant that the pace of lessons be increased.

Interim tests were conducted first at the conclusion of modules covering CVC words and second at the conclusion of Modules 3 and 4 introducing initial and final

consonant clusters. Spelling was conducted in whole class groups and reading was tested individually. Instructions used the same format as pretests.

Posttesting was conducted at the conclusion of the intervention. It included reading and spelling of both “program” and “transfer” words, the Salford Sentence Reading Test (Bookbinder, 2002), and the “Kicking Stones” story of the Basic Academic Skills Samples. Testing was conducted by research assistants who had not worked with the children in instructional groups and were thus “blind” in terms of group assignment.

Oral reading tests were administered individually using the same format as pretests. Spelling test and Basic Academic Skills Samples were given to the whole class.

RESULTS

Pretest

Means and standard deviations for all groups are given in Table 1. A multivariate analysis of variance (MANOVA) revealed no significant differences at pretest among the three instructional groups. To test for interaction effects between pretest scores and treatment, children were coded for rhyme and phonemic awareness (no awareness, developing awareness, and having awareness). Two-way analyses of variance (ANOVAs) (Rhyme and Phonemic Awareness \times Treatment) indicated that there were no interactions between treatment and pretest scores.

Interim Test 1

Means and standard deviations for Interim Test 1 are given in Table 2. The raw reading speed scores were positively skewed, and so a square root transformation

TABLE 1
Means, Standard Deviations, and Results of Analysis of Variance for Each Instructional Condition at Pretest

<i>Measure</i>	<i>Maximum Score^a</i>	<i>GPC</i>		<i>OR</i>		<i>Implicit Phonics</i>		<i>F(2, 113)</i>
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	
Phoneme segmentation	18	10.89	3.45	11.59	3.65	11.55	3.88	< 1
Letter-sound knowledge	26	24.65	1.74	24.69	1.47	23.80	2.87	2.20
Clay Ready-to-Read words	48	42.89	5.88	42.38	6.48	41.42	6.26	< 1
Spelling	24	15.38	4.26	15.38	3.98	14.13	3.40	1.35

^aMaximum score possible.

TABLE 2
Means, Standard Deviations, and Results of Analysis of Variance for Each Instructional Condition on Interim Test 1

<i>Measure</i>	<i>Maximum Score</i>	<i>GPC</i>		<i>OR</i>		<i>Implicit Phonics</i>		<i>F(2, 102)</i>	<i>Tukey's</i>	<i>Eta²</i>
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Reading										
Accuracy	32	31.11	1.06	29.67	2.86	27.25	4.82	2.54*	GPC > IP; OR > IP	.19
Speed (raw) ^a	—	28.65	10.49	49.93	40.43	69.90	52.13	10.39*	GPC > OR > IP	.21
Speed (transform)	—	5.27	0.95	6.61	2.37	7.91	2.74	10.39*	GPC > OR; GPC > IP; OR > IP	.21
Spelling										
Program words	12	5.94	0.23	5.76	0.61	5.28	0.78	8.38*	GPC > IP; OR > IP	.19
Transfer words	12	5.75	0.50	4.94	1.27	4.28	1.26	17.23*	GPC > OR > IP	.25

^aAnalysis of variance conducted on transformed scores (see text).

* $p < .001$.

was performed to reduce skew. Analyses were carried out on transformed scores. MANOVAs indicated that there was a significant effect for group, $F(2, 198) = 5.4$, $p < .001$. Follow-up comparisons using univariate F tests revealed significant differences on all measures (see Table 2).

Post hoc analyses using Tukey's procedure ($\alpha = .05$) revealed that the GPC group was better than the implicit phonics group on all measures. The OR group was significantly better than the implicit phonics group at reading and spelling program words and in spelling transfer words. The GPC group was significantly better than the OR group in reading speed and accuracy of spelling transfer words. No other between-group contrasts were significant.

Interim Test 2

These tests focused on words that contained initial and final consonant clusters. Reading measures included accuracy and speed of reading words directly taught in the program. The spelling test included transfer words as well as words covered in the program. Means and standard deviations are given in Table 3. MANOVAs indicated that there was a significant effect for group, $F(2, 182) = 4.9$, $p < .001$. Follow-up testing found that there were significant differences between groups on all measures (see Table 3).

Post hoc analyses using Tukey's procedure ($\alpha = .05$) revealed that the GPC group performed better than the implicit phonics group on all measures. The OR group was better than the implicit phonics group in accuracy of reading program words and spelling transfer words. The GPC group was better than the OR group in the speed of reading words and at spelling transfer words. No other between-group contrasts were significant.

Posttest. The means and standard deviations for the posttest are given in Table 4. MANOVAs indicated that there was a significant effect for group, $F(2, 182) = 8.71$, $p < .001$. Follow-up comparisons revealed significant differences on all measures (see Table 4).

Tukey's procedure ($\alpha = .05$) revealed that the GPC group performed better than the implicit phonics group on all word-level reading and spelling measures and on both the Basic Academic Skill Samples and the Salford Sentence Reading Test. The OR group performed significantly better than the implicit phonics group on the accuracy with which they read and spelled both program and transfer words, with the one exception of spelling transfer words containing vowel digraphs. The OR group also scored higher than the implicit phonics group on the Basic Academic Skill Samples test, which measured comprehension, and the Salford Sen-

TABLE 3
Means, Standard Deviations, and Results of Analysis of Variance for Each Instructional Condition on Interim Test 2

<i>Measure</i>	<i>Maximum Score</i>	<i>GPC</i>		<i>OR</i>		<i>Implicit Phonics</i>		<i>F</i> (2, 102)	<i>Tukey's</i>	<i>Eta</i> ²
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Reading										
Accuracy	46	43.46	1.63	39.54	6.71	33.43	10.74	17.78*	GPC > IP; OR > IP	.22
Speed (raw) ^a	—	51.54	21.51	117.25	147.24	167.89	165.29	11.29*	GPC > OR; GPC > IP	.16
Speed (transform)	—	7.86	1.40	9.82	4.75	11.86	5.61	11.29*	GPC > OR; GPC > IP	.16
Spelling										
Program words	10	8.47	1.46	7.46	2.42	5.43	2.67	18.03*	GPC > IP; OR > IP	.25
Transfer words	10	8.25	1.34	6.62	2.56	5.85	2.60	10.97*	GPC > OR; GPC > IP	.20

^aAnalysis of variance conducted on transformed scores (see text).

* $p < .001$.

TABLE 4
Means, Standard Deviations, and Results of Analysis of Variance for Each
Instructional Condition at Posttest

<i>Measure</i>	<i>Maximum Score</i>	<i>GPC</i>		<i>OR</i>		<i>Implicit Phonics</i>		<i>F(2, 102)</i>	<i>Tukey's</i>	<i>Eta²</i>
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
<i>Reading</i>										
Program words—accuracy	55	52.86	3.69	49.87	7.99	39.95	12.71	21.84**	GPC > IP; OR > IP	.28
Program words—speed ^{a,b}	—	59.69	28.16	99.36	112.04	164.07	134.09	14.86**	GPC > IP; OR > IP	.20
Program words—speed ^c	—	7.55	1.60	9.13	4.04	11.97	4.62	14.86**	GPC > IP; OR > IP	.20
Transfer words—accuracy	55	46.19	5.12	39.82	10.31	32.75	12.09	16.86**	GPC > OR > IP	.23
Transfer words—speed ^{a,b}	—	77.24	46.60	139.90	132.98	140.44	87.79	6.69*	GPC > OR; GPC > IP	.11
Transfer words—speed ^c	—	8.46	2.32	10.96	4.50	11.29	3.66	6.69*	GPC > OR; GPC > IP	.11
<i>Spelling</i>										
Program words (silent <i>e</i>)	10	6.27	1.59	5.38	2.32	3.29	1.76	23.12**	GPC > IP; OR > IP	.29
Program words (vowel digraph)	10	7.27	2.21	6.05	3.24	3.45	2.67	19.58**	GPC > IP; OR < IP	.26
Transfer words (silent <i>e</i>)	10	6.11	1.59	5.38	2.11	3.40	2.22	19.11**	GPC > IP; OR < IP	.25
Transfer words (vowel digraph)	10	4.59	2.10	3.33	1.94	2.45	2.17	9.90**	GPC > OR; GPC > IP	.15
Sentence reading	9.8	8.41	0.99	7.73	0.93	7.12	0.90	10.86**	GPC > IP; OR > IP	.38
Comprehension	26	23.27	3.28	19.67	5.90	15.95	5.89	19.72**	GPC > OR > IP	.26

^aAnalysis of variance conducted on transformed scores (see text). ^bRaw score. ^cTransformed score.

* $p < .01$. ** $p < .001$.

tence Reading Test. The GPC group was better than the OR group on accuracy and speed of reading transfer words and on the Basic Academic Skill Samples test. No other between-group contrasts were significant.

DISCUSSION

Explicit and Implicit Approaches to Teaching Reading Skills

Many studies comparing instruction in explicit symbol–sound relationships with a whole word instructional approach have found that programs providing explicit instruction in letter-sound correspondences out-perform a whole-word approach to decoding (see Adams, 1990). This study is distinctive in that it compared explicit decoding instruction with an implicit approach that incorporated symbol-sound instruction. Children in the implicit phonics group consistently performed more poorly than the other groups in reading and spelling words. In particular, the GPC group performed at a higher level than the implicit phonics group on all interim and posttest measures. The OR group was more accurate than the implicit phonics group at reading and spelling program words throughout. However, they were more fluent in reading on some measures but not others. In particular, they were faster at reading program words on Interim Test 1 but not Interim Test 2 and were faster at reading program words at posttest but not at reading transfer words. The OR group also obtained higher scores on the Basic Academic Skill Samples, which measured comprehension, and the Salford Sentence Reading Test, which gave a reading age based on oral reading.

It could be argued that, although all groups had the same opportunities to practice each of the letter-sound correspondences, superiority in reading and spelling words by the skill-based groups may be due to the fact that they had more opportunities to practice the words covered in the program. While this may well be true, it does not explain all of the findings. For example, children in the OR and GPC programs had the same level of exposure to all of the program words. However, only the GPC group outperformed the implicit phonics group across the board. The OR group was better than the implicit phonics group on all measures of program word reading and spelling accuracy. However, they were faster in speed of reading program words and had higher scores on accuracy of reading transfer words only at posttest.

The overall superiority of the two explicit decoding instruction groups to the implicit phonics group suggests that the incorporation of systematic decoding instruction with extended practice in decoding words is an important component of any reading instruction program. Explicit decoding instruction and the accompanying practice appears to more rapidly consolidate decoding skills and sym-

bol–sound knowledge to the point where this knowledge can be used to decode unfamiliar words. Both explicit decoding instruction groups read more transfer words at posttest than the implicit phonics group and both did better in the reading of meaningful text, as assessed by the Basic Academic Skill Samples, where children were required to read a variety of words in context and complete a cloze activity. Although the implicit phonics group was exposed to reading a wider range of words in context, this did not compensate for the greater word recognition and decoding skills of the two explicit decoding instruction groups.

In fact, differences between the groups in reading age as measured by the Salford Sentence Reading Test at the conclusion of the study are striking. The mean reading age for children in the implicit phonics group was 7 years 1 month, approximately 3 months below their mean chronological age of 7 years 4 months at posttest. At the end of the program, the children in the OR group had a mean reading age of 7 years 7 months and children in the GPC group had an average reading age of 8 years 4 months. Thus, systematic practice in using symbol–sound correspondences to decode unfamiliar words seems to have accelerated these children’s reading development to a marked degree.

Although reading extended text is an essential component of a comprehensive literacy program, these data strongly suggest that children’s reading is enhanced by systematic instruction and practice in decoding words based on symbol–sound relationships rather than by learning about these symbol–sound relationships only within the context of reading extended text. Within the context of an instructional program that emphasizes reading for meaning, children suffer no loss of text reading abilities when decoding skills are systematically and explicitly taught. Indeed, the study suggests that these abilities are considerably enhanced.

These results are consistent with a series of studies by Torgesen and colleagues. For example, Torgesen, Morgan, and Davis (1992) compared two programs that provided explicit instruction in analytic (segmentation) and synthetic (blending) tasks with a language-experience control group. Only the children who received skill training showed positive effects for word learning or a reading analogue task. Torgesen, Wagner, and Rashotte (1997) found that children with phonological processing difficulties who were given an intervention consisting of training in phonological awareness plus synthetic phonics performed significantly better on a measure of decoding skill than children given embedded phonics or regular classroom instruction.

Similarly, Wise and Olson (1995) found that elementary students given a computer program that provided practice in reading words in isolation as well as words in context performed better than children who received training in reading only words in context.

Orthographic Rimes Compared With Grapheme-Phoneme Correspondences

Significant differences were also detected between the two explicit decoding programs. These differences formed a pattern, consistently favouring the GPC group. Throughout the study, the OR and GPC groups were equivalent in the accuracy with which they read and spelled the program words that had been explicitly taught. However, the interim tests indicated that the GPC group was significantly better at spelling transfer words. They were also faster at reading program words at Interim Test 1 and transfer words posttest. Additionally, the GPC group performed significantly better in reading comprehension, as measured by the Basic Academic Skill Samples.

The ability of children in the GPC program to apply their skills to transfer words is consistent with Bruck and Treiman (1992) who found that first grade readers, taught by whole-language methods, learned to read new words presented in “word families” but, unlike children taught to focus on grapheme–phoneme relations, were unable to use the orthographic rimes to read unfamiliar items.

Goswami (1990) argued that a program based on orthographic rimes is a natural extension of prereading development, where children typically find it easier to make judgments of word similarity based on onsets and rimes than on phonemes. It is known that children who have already acquired some skill in reading can use orthographic rimes to decode unfamiliar words (e.g., Bowey & Hansen, 1994; Bowey & Underwood, 1996; Ehri & Robbins, 1992; Treiman et al., 1990). According to the view that beginning readers use the orthographic rimes of known words as the basis for making analogies when reading similarly–unfamiliar words that share the orthographic rime (Goswami & Bryant, 1990), children in the OR group should have performed particularly well on transfer tasks. The OR group was consistently more accurate than the implicit phonics group in reading and spelling program words and read transfer words more accurately at posttest. However, there was no difference between the OR and the implicit phonics control group in speed of reading program words at Interim Test 2 or at speed of reading transfer words at posttest.

In contrast, not only was the GPC group superior to the implicit phonics group on all five tests of reading and spelling transfer words, but they also read transfer words more fluently than both the implicit phonics and the OR groups at posttest. This indicates that although the OR program enhanced children’s ability to read familiar words to a marked degree, it did not facilitate children’s ability to apply their orthographic knowledge and decoding skill to unfamiliar words to the same extent as the GPC program.

Speed of response is indicative of increasing automaticity in decoding skill. Fast and efficient decoding is essential for reading comprehension (Adams, 1990). The GPC group appears to have developed greater competence in using sym-

bol–sound knowledge both in terms of the accuracy and speed of decoding unfamiliar (transfer) words. The impact of this competence is reflected in their superior comprehension scores on the Basic Academic Skills Sample and in oral reading on the Salford Sentence Reading Test.

Anecdotal evidence from research assistants teaching the programs suggested that during the initial phases of the instructional program, the children in the OR group tended to find both reading and spelling words easier than children in the GPC group, although this did not translate into superior scores in the interim tests of program word reading accuracy. It appeared that reading sets of words with the same orthographic rime required that children focus attention mainly on the orthographic onset (initial consonant or consonant cluster). In contrast, children in the GPC group were required to attend to every grapheme in each word in each word set. Whereas, this appeared a more difficult task initially, in the longer term it seems to have fostered superior development of skills in terms of rapid analysis of unfamiliar words based on symbol–sound relationships. McCandliss, Beck, Sandak, and Perfetti (2003) found that children who had deficient decoding skills after first grade demonstrated a pattern where they were relatively accurate in identifying the first phoneme in a word but showed “relatively worse performance on subsequent vowels and consonants, suggesting that children were not engaging in full alphabetic decoding” (p. 76). It could be suggested that the format of the GPC program encouraged children to develop the habit of attending to every grapheme in the word, thus enhancing their skills to decode unfamiliar words.

Other studies comparing orthographic rime and grapheme–phoneme correspondence approaches have failed to find significant differences between groups (Haskell et al., 1992; Levy & Lysynchuk, 1997). However, the instructional intervention in this study was of relatively long duration, covered a wide range of orthographic structures (CVC words, initial and final consonant clusters, and long vowels using silent *e* and vowel digraphs), and introduced a large number (192) of words. In these circumstances children in the GPC group consistently performed better than children in the OR program.

It is, of course, possible that in other circumstances different results may be obtained. For instance, the children in this study could be characterized as “advanced beginning” readers. Most of the children knew the majority of letter–sound correspondences and could read a number of basic sight words. Different findings may be observed if children were in the earliest stages of reading (Goswami & Bryant, 1990) or perhaps in later stages (Bowey & Hansen, 1994; Bowey & Underwood, 1996).

Bowey and Hansen (1994) argued that the orthographic rime frequency effect suggests that the use of orthographic rimes is based on children’s subjective familiarity with particular orthographic rimes, which must depend critically on the size of their reading vocabularies. The likelihood of any given orthographic rime correspondence being known is likely to vary with the frequency with which it is encountered

in written materials. Subjective orthographic rime frequency approaches veridical orthographic rime frequency as reading proficiency (and the size of the reading vocabulary) increases. If grade level is viewed as a proxy measure of word-reading proficiency, it follows that the orthographic rime frequency effect, and indeed the use of orthographic rimes more generally, should increase with grade level.

Evidence relating to developmental increases in the size of the orthographic rime frequency effect is fairly consistent. Bowey and Hansen (1994) found that, within a large group of children tested at the end of their 1st year of reading instruction, only the better readers showed a significant orthographic rime frequency effect. Bowey and Underwood (1996) reported that the effect did indeed increase from second to fourth grade. The use of orthographic rime correspondences in reading ambiguous nonwords whose orthographic rimes are typically irregular in terms of grapheme–phoneme correspondences also increases with grade level and reading ability (Bowey & Underwood, 1996; Brown & Deavers, 1999; Coltheart & Leahy, 1992). Thus, it could be argued that an orthographic-rime approach may be more efficacious if it were used with older or higher achieving students.

Consistent with application to older students, it is also conceivable that different findings may have been observed if the program focused entirely on digraph vowels and silent *e* words (Goswami, 1993). However, there were no differences at posttest between the GPC and OR groups in spelling program or transfer words containing silent *e* and vowel digraph patterns.

It seems logical that some words would lend themselves to be learned more easily using a GPC approach and others using an OR approach. For example, words that have a direct grapheme to phoneme correspondence (e.g., *top*, *sand*) might be more easily facilitated by a GPC approach, whereas words that do not have a direct grapheme–phoneme correspondence (e.g., *rain*) may be easier to learn using on-set-rime methods. Although this is a reasonable proposition, there is no evidence in this study to support it. Interim Tests 1 and 2 focused on words with one-to-one phoneme–grapheme correspondences. Posttests focused on words with long vowel digraphs and silent *e*. Regardless of the orthographic structure of the words, GPC was superior to OR.

Different types of instructional techniques may favor approaches that emphasize orthographic rimes. These approaches would do well to emphasize the need to fully analyze orthographic rimes of newly taught words. Within this OR program, spelling instruction with corrective feedback and with additional practice when errors were made was included to encourage children to fully analyze orthographic rimes. This instruction was successful to the extent that the OR and GPC groups were equivalent in the accuracy with which they read and spelled words that had been explicitly taught, although the GPC group read these words with greater speed throughout the study. Thus, it appears that the spelling com-

ponent of the intervention was not sufficient to ensure that children fully analyzed all the phonemes in each word.

The fact that significant differences consistently favored the GPC group over the OR group is more impressive given the design of the programs. The words in the GPC program were designed as a control for the OR program, with the result that the four words within each word set were rarely optimal in terms of teaching the target grapheme–phoneme correspondences. An optimally designed GPC program may have produced stronger results.

In summary, this study showed that programs designed to provide explicit practice in the use of letter-sound relationships to decode unfamiliar words can significantly enhance children's performance across a wide range of measures of reading and spelling. Additionally, for relatively early readers, a program that focuses their attention on individual phoneme–grapheme correspondences and encourages them to analyze every grapheme in a word is superior to one that encourages them to focus on larger orthographic units, specifically rimes.

Further research would be useful in detailing more precisely the constituents of decoding skills programs that lead to development of specific competencies. For example, the relative impacts of the reading compared with the spelling components of the programs used in the study are not clear. Thus, a program that focused on reading without spelling may not produce the same results. Further the relationship between the developmental level of children and type of program needs to be explored. Although no interaction effects based on pretest scores were detected in this study, it is possible that there may be interaction effects between initial reading skills and facility of rime-based or phoneme–grapheme correspondence approaches to reading that would enable practitioners to tailor reading programs more closely to individual needs.

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