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Rhyme and analogy in beginning reading: Conceptual and methodological issues

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ABSTRACT
Goswami and Bryant (1990) proposed a theory of reading development based on three causal connections. One of these causal connections was based on the relationship between rhyming skills and reading development found in English. To explain this connection, they suggested that young readers of English used analogies based on rimes as one means of deciphering the alphabetic code. This proposal has recently become the subject of some debate. The most serious critique has been advanced by Seymour and his colleagues (Duncan, Seymour, & Hill, 1997; Seymour & Duncan, 1997; Seymour & Evans, 1994). These authors reported a series of studies with Scottish schoolchildren which, they claim, show that progression in normal reading acquisition is from a small unit (phonemic) approach in the initial stage to a large unit (rime-based) approach at a later stage. Two experiments are presented which replicate those conducted by Seymour and his group with samples of English schoolchildren. Different results are found. It is argued that methodological and instructional factors may be very important for the conceptual interpretation of studies attempting to pit "small" units (phonemes) against "large" units (onsets and rimes) in reading. In particular, it is necessary to consider whether a given phonological awareness task requires the recognition of shared phonological segments ("epilinguistic" processing) or the identification and production of shared phonological segments (metalinguistic processing). It is also important to take into account the nature of the literacy instruction being implemented in participating schools. If the phonological aspects of this tuition focus solely on phonemes (small units), then poor rime-level (large unit) performance may be found in metalinguistic tasks.

Almost two decades ago, a series of studies by Bradley and Bryant (1978, 1983) demonstrated the importance of rhyme awareness for reading development in English. Bradley and Bryant showed that rhyme awareness measured in preschoolers was a significant predictor of later progress in reading and spelling, that backward readers had poorer rhyming skills than younger children reading at the same level, and that teaching children the correspondences between pho-

nological segments like rhymes and the spelling patterns enhanced the acquisition of reading and spelling skills. The early availability of rhyme as a phonological structure and its links with reading have since been confirmed in a number of studies (e.g., Baker, Fernandez-Fein, Scher, & Williams, 1998; Bowey & Francis, 1991; Bryant, Maclean, Bradley, & Crossland, 1990; Chaney, 1992, 1994; Cronin & Carver, 1998; Ellis & Large, 1987; Fernandez-Fein & Baker, 1997; Maclean, Bryant, & Bradley, 1987; Scarborough, 1990; Webster & Plante, 1992, 1995). For example, Maclean et al. (1987) and Chaney (1992) both found that 3-year-olds showed some success in rhyming tasks and reported relationships between this early rhyme awareness and later phonological skills predictive of literacy. Chaney found that her rhyme measure (rhyme production) was the best correlate of the other metalinguistic skills and argued that 3-year-olds were already developing a mental framework for analyzing language structure separately from language meaning. Maclean et al. found a significant connection between rhyming skills at 3 years and single word reading at 4½ years. Following up Maclean et al.'s sample two years later, Bryant et al. (1990) reported a significant relationship between nursery rhyme knowledge at age 3 and success in reading and spelling at ages 5 and 6, even after factors such as social background and IQ were controlled. Baker et al. (1998) showed that kindergarten nursery rhyme knowledge was the strongest predictor of word attack and word identification skills measured in second grade, accounting for 36% and 48% of the variance, respectively. The second strongest predictor was letter knowledge, which accounted for an additional 11% and 18% of the variance, respectively. Nursery rhyme knowledge has also been shown to be related to subsequent sensitivity to both rhymes and phonemes. In Bryant et al.'s (1990) study, a path analysis showed a route from nursery rhymes to rhyme awareness to reading and an independent route from nursery rhymes to phoneme awareness to reading.

This early awareness of rhyme does not appear to be matched by comparable levels of early awareness of phonemes. In fact, a number of studies have suggested a developmental progression from phonological awareness of "large" units (syllables, onsets, and rhymes) to phonological awareness of "small" units (phonemes) (e.g., Christensen, 1997; Kirtley, Bryant, Maclean, & Bradley, 1989; Liberman, Shankweiler, Fischer, & Carter, 1974; Treiman & Zukowski, 1991, 1996; see Goswami & Bryant, 1990, for a review). For example, Treiman and Zukowski (1991) used a same/different judgment task to demonstrate that awareness of syllables, onsets, and rhymes was superior to awareness of phonemes in 4- and 5-year-old children. Comparable performance at the phoneme level was only found at age 6 and appeared to emerge as a consequence of instruction in literacy. Christensen (1997) reported a study of the development of phonological skills at the onset, rhyme, and phoneme level in 630 children during the first year in school. At the beginning of the school year, all children were preliterate, and most either scored at floor on her tests (40%) or succeeded in the rhyme task only (rhyme generation, 29%). By the middle of the school year, she found that the majority of the children had become aware of onsets, rhymes, and phonemes (60%). The developmental progression in phonological awareness from large units to small units has also been shown to be robust

when stringent controls for the size of the shared unit are employed (Treiman & Zukowski, 1996). Although some phonemic sensitivity can be demonstrated in prereaders (e.g., Chaney, 1992, 1994; Thomas & Senechal, 1998), the acquisition of reliable phonemic skills appears to depend largely on the receipt of instruction in reading and spelling (e.g., Liberman et al., 1974) or on the receipt of training at the phonemic level (e.g., Byrne & Fielding-Barnsley, 1995; Content, Kolinsky, Morais, & Bertelson, 1986).

To explain how this developmental progression in phonological awareness might be related to reading development, Goswami and Bryant (1990) proposed a model of reading development based on three causal connections. The three connections suggested were (1) a connection between preschool awareness of rhyme and alliteration and later progress in reading and spelling, (2) a connection between tuition at the level of the phoneme and the development of phonemic awareness (which was suggested to be rapid following such tuition), and (3) a connection between progress in spelling and progress in reading (and vice versa). It was claimed that the first two connections were in play as soon as children began to read and spell, but it was hypothesized that preschool awareness of rhyme and alliteration and the phonemic awareness that emerged as a consequence of direct tuition at the level of the phoneme might make separate contributions to reading development. However, it was noted that the first two connections must be linked, as rhyming ability was a predictor of children's ability to detect phonemes (e.g., Bryant et al., 1990). Most subsequent debate has focused on Goswami and Bryant's first causal connection between rhyming and reading. The second and third connections have received less attention, although debate is currently growing over the best teaching methods for facilitating the second connection (e.g., Chew, 1997; Macmillan, 1997; McGuinness, 1998).

Goswami and Bryant argued that the first connection between rhyme and reading operated largely on the basis of analogies. Analogies in reading refer to the use of the spelling–sound pattern of one word, such as *light*, as a basis for decoding a new word, such as *fight*. It was argued that the ability to use analogies was present from the beginning of reading and initially took the form of associations between onsets and rimes and strings of letters. As children's early analogical inferences were infrequent and often unsuccessful, it was suggested that a great deal of development took the form of getting better at using strategies that were available from the start. The ability to use analogy per se was not thought to develop. Rather, the main factor governing the developing use of analogies was claimed to be the number of words in the child's mental lexicon from which analogies could be made (Goswami, 1986, 1988). The power of analogy as a self-teaching mechanism was also stressed. Given the subsequent debate concerning large versus small units in reading, it is important to emphasize that it was never claimed that analogy was the only strategy used by beginning readers. In Goswami and Bryant's (1990) model, the second causal connection between phonemes (small units) and reading was thought to operate in parallel with the first causal connection (large units), although it was argued to be more dependent on direct tuition. The fact that children use rime analogies in reading was also not taken to mean that they should be taught all of the rime

correspondences found in the English language. Rather, it was taken to imply that all children would benefit from being taught to use analogy as a metacognitive decoding strategy, as they could then apply analogies strategically as a basis for acquiring new words (Goswami, 1994, 1995, 1996).

Experimental evidence that is consistent with this first causal connection has been reported by a number of authors. For example, it has been shown that beginning readers do have analogy strategies available (e.g., Ehri & Robbins, 1992; Moustafa, 1995; Muter, Snowling, & Taylor, 1994; Walton, 1995), and that more analogies are used as children's reading vocabularies expand (e.g., Bowey & Hansen, 1994; Bowey & Underwood, 1996; Leslie & Calhoon, 1995; Treiman, Goswami, & Bruck, 1990). It has also been demonstrated that onset–rime skills and phonemic skills play somewhat independent roles in early reading. For example, Stahl and Murray (1994) reported a strong connection between early reading and the ability to separate an onset from a rime in a sample of 113 kindergarten and first grade children and a much weaker relationship between separating rimes into phonemes and reading. Hansen and Bowey (1994) measured both onset–rime knowledge and phonemic knowledge in 77 second grade children and used multiple regression procedures to show that onset–rime awareness predicted significant independent variance in word attack skills, even after controlling for phonemic awareness, but not vice versa. McClure, Ferreira, and Bisanz (1996) found that blending onsets and rimes into CCVC words was easier than blending phonemes for kindergarten children. Finally, a recent connectionist simulation model of reading development has shown that giving the model onset–rime segmentation skills leads to important benefits in reading acquisition (Zorzi, Houghton, & Butterworth, 1998). Even when the model was trained with a very small reading vocabulary (86 regular and exception words), lexical analogy effects were observed, and successful generalization to new words occurred. Zorzi et al. argued that this demonstrated the benefits of "self-teaching" mechanisms for reading acquisition (see also Share, 1995).

Other authors, however, have reported experimental evidence that appears inconsistent with Goswami and Bryant's first causal connection. For example, it has been claimed that rhyme skills do not always predict reading development in English (e.g., Muter, Hulme, Snowling, & Taylor, 1997; Nation & Hulme, 1997; but see Bryant, 1998; Goswami, 1999b), and that orthographic analogies may reflect "phonological priming" (e.g., Bowey, Vaughan, & Hansen, 1998; Savage & Stuart, 1998; but see Goswami, 1999a, 1999b). It has also been claimed that "progression in normal reading acquisition is from a small unit (phonemic) approach in the initial stage towards a large unit (rime-based) approach at a later stage" (Seymour & Duncan, 1997, p. 130; see also Duncan et al., 1997; Duncan, Seymour, & Hill, submitted; Seymour & Evans, 1994). This claim is most frequently cited as evidence against Goswami and Bryant's causal connections model (e.g., Macmillan, 1997; McGuinness, 1998), as it appears to contradict their proposal concerning the first causal connection between rhyme and reading mediated by analogy.

The experimental evidence for the claim that progression in normal reading acquisition is from a small unit (phoneme-based) to a large unit (rime-based) approach is the focus of the current investigation. However, it is important to

establish at the outset that Goswami and Bryant did not propose a large-unit-to-small-unit theory of reading development, as is sometimes assumed by Seymour and his colleagues. Rather, small units were hypothesized to be in play from the beginning of learning to read (the second causal connection), but their contribution was thought to be dependent on teaching and more visible in spelling. Goswami and Bryant instead proposed a large-unit-to-small-unit theory of phonological development, as have a number of other theorists (e.g., Treiman, 1988). Goswami (1993) subsequently proposed a large-unit-to-small-unit path for the use of analogies in reading (cf. Goswami and Bryant's first causal connection). Goswami and Bryant in fact took care to emphasize that their three connections did not represent separate stages of reading development that were causally sequential.

The evidence for the claim advanced by Seymour and his colleagues concerning the small-unit-to-large-unit progression in normal reading acquisition comes from two research studies. The first was by Seymour and Evans (1994). They studied the blending (synthesis) and segmentation skills of groups of 4-, 5-, and 6-year-old Scottish children who were receiving a program of reading instruction based on intensive and systematic tuition in phonics (i.e., a phoneme-based approach to decoding). For the segmentation task, the children were asked to segment monosyllables into two, three, or many parts by "speaking like a robot." Guidance concerning which two, three, or many parts (referred to as "dimensions" in the article: i.e., 2D, 3D, nD) were expected as responses was not given. Seymour and Evans reported that the 4- and 5-year-old children were unable to perform the segmentation task at either level. The 6-year-olds were more successful in segmenting the words into many parts (scored as correct when the many parts corresponded to phonemes or nD – 60% correct) than into two parts (scored as correct when the two parts corresponded to onset–rime units or 2D – 33% correct). The finding of superior levels of segmentation at the phonemic level compared to the onset–rime level is at variance with results reported by other researchers (e.g., Stahl & Murray, 1994, for 4- to 5-year-olds; Nation & Hulme, 1997, for 6-year-olds). In the synthesis task, the 5- and 6-year-olds showed more success with onset–rime units than with phonemes. This agrees with the findings of other researchers (e.g., McClure et al., 1996). In a follow-up study conducted six months later, the same 5-year-olds did have some success in the segmentation tasks, scoring 28% correct with onset–rime segmentation and 41% correct with phonemes. Seymour and Evans (1994) used their segmentation results to assess theories of phonological and literacy development. They concluded that their findings were at variance with the proposals of Goswami and Bryant (1990). They argued that "the hypothesis that phonological awareness normally develops . . . from larger to smaller units predicts that segmentation ability should emerge in the sequence 2D $\rightarrow$ 3D $\rightarrow$ nD. In practice, the reverse of this order was found" (p. 221).

To examine Goswami and Bryant's (1990) theory further, Duncan et al. (1997) devised some new reading-related tasks for a different group of Scottish 5-year-olds. Of these new measures, two common unit tasks (one orthographic and one phonological) were argued to provide a particularly critical test of Goswami and Bryant's account.[1] In each task, responses corresponding to the onset,

rime, peak (vowel), body (onset–vowel), and coda (final phoneme[s]) were measured. The phonological common unit task required the verbal identification of a phonological unit shared between two words spoken by the experimenter. For example, if the experimenter said "home–gnome," the child was meant to respond "ome," whereas if the experimenter said "home–sum," the child was meant to respond "/m/." As in Seymour and Evans (1994), the children were not explicitly told the kind of responses that were required. Instead, they were told that the shared sound was at either the beginning or the end of the words, and two examples were given. (Note that these instructions were ambiguous; for a rime pair like *home–gnome*, a response like /m/ would comply with the instructions.) The orthographic common unit task required the identification of an orthographic unit that corresponded to a sound spoken by the experimenter. For example, if the child was given the written word *home* and the experimenter said "ome," the child was meant to circle the letters OME, whereas if the experimenter said "/m/," the child was meant to circle the letters ME. In both of these common unit tasks, the identification of units corresponding to rimes was found to be most difficult. This was seen as a direct contradiction to Goswami and Bryant's (1990) proposals: "the common unit task provides a 'window' through which the language segments involved in reading can be observed . . . reading development involves a progression towards the use of larger orthographic units" (Seymour & Duncan, 1997, p. 132; my italics).

To assess the significance of Seymour and colleagues' findings for theories of reading development, however, we need to be sure that they are representative of all children and not just of children in Scotland who receive systematic, phoneme-based phonics teaching from the beginning of literacy instruction. One possibility raised by Duncan et al. (1997) but not pursued further is that "what may appear to be a linguistic effect may be an instructional effect" (p. 199). If their findings are in fact not universal, then tasks such as the common unit task would not provide a window upon the "natural" progression of reading development but would be influenced by instructional practice. We therefore set out to examine whether the findings reported by Seymour and Evans (1994) and by Duncan et al. (1997) would be robust in a different subject population. In particular, we wanted to find out whether the "natural" progression from small to large units reflected in the data reported by Seymour and Evans and by Duncan et al. would be characteristic of 5-year-old children receiving the more typical mixture of "whole language" and phonics instruction characteristic of reading instruction in primary schools in England.[2]

EXPERIMENT 1

Our first experiment examined the performance of a group of 5-year-olds in the segmentation and synthesis tasks used by Seymour and Evans (1994). Recall that Seymour and Evans reported that phoneme segmentation (many parts) was superior to onset–rime segmentation (two parts) for 5-year-olds, both in the November assessment (18% vs. 8%) and six months later (41% vs. 28%). We also included Bradley and Bryant's (1983) oddity task in this study, using both an onset–rime and a phoneme version of the task. As much of the early evidence

for the large-unit-to-small-unit progression in phonological awareness depended on the oddity task, we were interested to see whether rimes might be more accessible in the oddity task and phonemes more accessible in the segmentation task for 5-year-olds. The same pool of CCVC words was used as a basis for all of the tasks.

METHOD

Participants

A group of 29 children took part in the study. The mean age of the group was 5;0 (range = 4;6 to 5;4). The children were unselected, comprising all those enrolled in the two participating schools who were available for testing at the time of the study. Testing was conducted just before and after Christmas. Both schools used a "mixed" method of teaching reading with a whole language bias. The children were not receiving any rime-based instruction. Although race and social class data were not systematically collected, the majority of participants were of Caucasian descent and were from a lower middle class neighborhood. Neither school permitted the use of standardized reading tests.

Procedure

Over the experiment as a whole, each child received four versions of the oddity task (onset oddity, rime oddity, initial phoneme oddity, final phoneme oddity), two segmentation tasks (onset–rime, phoneme), and two synthesis tasks (onset–rime, phoneme). Each child participated in four testing sessions. In each session, one oddity task and one segmentation or synthesis task was administered. Two task orders were used so that half of the children received all the onset–rime tasks prior to the phoneme tasks while the other half received all the phoneme tasks prior to the onset–rime tasks.

Oddity task. This task was based on triples of words. Each triple was spoken by the experimenter; the child was asked to select the odd word out. Children were told whether the odd word would sound different at the end or at the beginning. Four versions of the task were used: onset oddity (e.g., *glum, **stick**, glad*); rime oddity (e.g., *swam, tram, **cliff***); initial phoneme oddity (e.g., *glum, grab, **stick***); and final phoneme oddity (e.g., ***cliff**, drum, swam*). All stimuli were words with a CCVC phonological structure in order to equate the number of phonemes in the onset and the rime. There were 10 trials in each version of the task. No feedback was given on the experimental trials, but two practice trials were given prior to each task.

Segmentation task. This task was based on some of the same words used in the oddity task. Either onset–rime or phonemic segmentation was required. The children were asked to listen to a word spoken by the experimenter and then to say it slowly so that each of the two (onset–rime) or four (phonemes) sounds in the word could be heard. Two practice trials were given in each task, followed by 10 experimental trials.

Table 1. *Performance in the phonological awareness tasks used in Experiment 1*

Order	Onset oddity	Rime oddity	Initial phoneme oddity	Final phoneme oddity
1	7.33	6.33	5.07	3.73
	(1.18)	(1.35)	(1.28)	(0.96)
2	6.79	5.79	4.43	3.64
	(1.25)	(1.63)	(0.94)	(1.55)
Order	Onset–rime synthesis	Onset–rime segmentation	Phoneme synthesis	Phoneme segmentation
1	8.07	3.53	6.46	0
	(2.09)	(3.74)	(2.39)	(0)
2	7.43	3.00	4.29	0
	(1.50)	(2.66)	(2.27)	(0)

Note: Maximum score = 10. Standard deviations in parentheses. Order 1 = onset–rime tasks given first; order 2 = phoneme tasks given first.

Synthesis task. Again, this task was based on some of the same words used in the oddity task. Either onset–rime or phonemic synthesis was required. The children were asked to listen to either two (onset–rime) or four (phonemes) sounds spoken by the experimenter and to say the word made by the sounds. Two practice trials were given, followed by 10 experimental trials.

RESULTS

The mean number of correct responses in each task at each phonological level is shown in Table 1, separated by whether onset–rime or phoneme-level analysis was required first. Inspection of the table reveals that performance at the onset–rime level was superior to performance at the phonemic level in all tasks. No order effects were apparent. The segmentation task could not be carried out by any of the participants at the phonemic level.

To investigate this pattern of results, a $2 \times 2 \times 4$ (Order [onset–rime first vs. phoneme first] $\times$ Phonological Level [onset–rime, phoneme] $\times$ Task [beginning oddity, end oddity, segmentation, synthesis]) analysis of variance was carried out, taking the number of correct responses out of 10 as the dependent variable.[3] The ANOVA showed a main effect of phonological level, $F(1, 27) = 88.3$, $p < .001$, $\eta^2 = 0.77$, and a main effect of task, $F(3, 81) = 104.1$, $p < .001$, $\eta^2 = 0.79$. No other effects or interactions were statistically significant. The main effect of phonological level reflected the fact that performance at the onset–rime level was superior in all tasks to performance at the phonemic level (see Figure 1). Post-hoc tests (Tukey's) on the main effect of task revealed that the synthesis and beginning oddity tasks were statistically significantly easier than the end

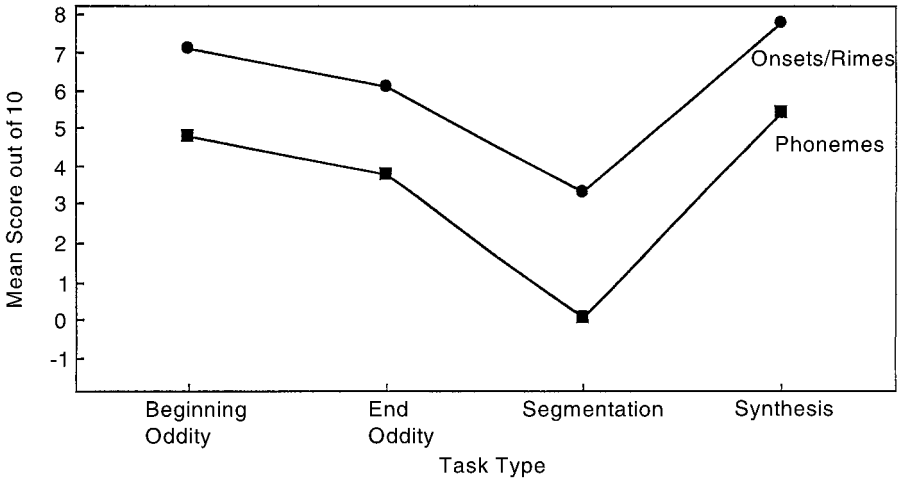

Figure 1. Performance in the tasks used in Experiment 1 at the onset–rime and phoneme levels, adding across order.

oddity task, which was easier than the segmentation task ($ps < .05$). Because of the low levels of performance in the segmentation task, we inspected the children's errors in this task. The most common error was stimulus repetition, accounting for 59% of responses at the phoneme level and 49% of responses at the onset–rime level. This response pattern suggests that segmentation tasks at both phonological levels are difficult for most children of this age group.

DISCUSSION

The aim of this study was to find out whether the apparently "natural" progression from small to large units reflected in the data reported by Seymour and Evans (1994) would be characteristic of 5-year-old children receiving the mixture of whole language and phonics instruction characteristic of early reading instruction in England. Accordingly, 5-year-old children's awareness of onset–rime and phonemic structure in segmentation, synthesis, and oddity tasks based on the same words was examined. In line with previous findings reported by Bryant and others (e.g., Bryant et al., 1990; Kirtley et al., 1989), we expected that onset–rime awareness would be superior to phoneme awareness in the oddity task. Given the conflicting results reported by Seymour and Evans (1994) and other researchers (e.g., Stahl & Murray, 1994), we were interested to see whether phoneme awareness might be superior to onset–rime awareness in the segmentation task.

Our data showed clearly that performance in all tasks was superior at the onset–rime level. This contradicts the findings reported by Seymour and Evans (1994), although it is important to recall that superior performance with small units was only found in one of their two tasks (segmentation but not synthesis).

Our data replicate the findings reported by Stahl and Murray (1994), who found that onset–rime segmentation was easier than phonemic segmentation for kindergarten children, and by McClure et al. (1996), who found that blending onsets and rimes was easier than blending phonemes for kindergarten children. Interestingly, the overall level of onset–rime segmentation that we found (33%) was very similar to the overall level reported by Seymour and Evans (28%).

These results suggest that the claim that the "natural" progression in reading is from small units to large units is misguided. Instead, an early facility with small units in segmentation tasks appears to depend on whether children are receiving explicit literacy instruction at the level of the phoneme (as were the children studied by Seymour & Evans, 1994). We would argue that the early availability of rhyme as a phonological structure explains the ability of children experiencing either instructional regime to segment words into onset–rime or large units. Comparable differences in performance in phoneme manipulation tasks between 5- and 6-year-old children receiving whole language instruction versus phoneme-based phonics instruction have been reported by Alegria, Pignot, and Morais (1982), using a phoneme reversal task. (In their study, the whole language children scored 15% correct, whereas the phonics children scored 58% correct; see also Leybaert & Content, 1995, for related work.) It seems likely that the children studied by Seymour and Evans were using the letter–sound knowledge that they had been taught in reading to perform the phonemic segmentation task. Consistent with this suggestion, Seymour and Evans (1994) noted that many of their children adopted an "alphabetic" strategy in the phoneme segmentation task, using letter–sound knowledge or "reading from an orthographic image" to solve the task (p. 242). The observation that children (and adults) use orthographic knowledge to solve phonemic segmentation and manipulation tasks is not a new one (e.g., Ehri & Wilce, 1980; Scholes, 1998). In fact, Scholes reported that, whereas 86% of literate adults could delete the fourth sound from "stable" (to leave "stale"), only 6% of the same adults could delete the fourth sound from "faxed" (to leave "fact"). Only the former has a letter representing the sound to be deleted (the sounds are /b/ and /s/, respectively). Note, however, that segmentation was the most difficult of the phonological awareness tasks, at both the onset–rime and the phoneme level (see also Yopp, 1988). Reasons why young children might experience difficulties in onset–rime segmentation tasks were pursued further in Experiment 2.

EXPERIMENT 2

Our second experiment focused on Duncan et al.'s (1997) common unit tasks. Our aim was to investigate the extent to which patterns of performance in the common unit tasks might also be dependent on instructional practice – in this case, the absence of direct instruction at the level of the rime. We studied a new group of 5-year-olds, whom we matched as closely as possible in terms of age and length of time in school to those studied by Duncan et al. (1997). In order to compare sample characteristics, we gave our children the measures of letter–sound knowledge, onset–rime segmentation/synthesis, and simple nonsense word reading used by Duncan et al. (1997) as well as the British Ability Scales

single word identification reading subtest (Elliot, 1996) and the British Picture Vocabulary Scales (Dunn, Dunn, Whetton, & Pintilie, 1982). The children in our sample were following a mixed program of reading instruction that included the establishment of a sight-word vocabulary (using reading schemes based on a whole language approach) and some systematic tuition in letter–sound relationships. They were not receiving any rime-based instruction.

There were two critical testing sessions. In the first, we administered Duncan et al.'s (1997) common unit tasks along with some other reading-related tasks in the first term of the school year. To replicate Duncan et al.'s procedures as closely as possible, we used their stimuli and presentation conditions. However, while administering the tasks, we gained the impression that the children were very unsure about how to respond and so were relying heavily on activities that were familiar from their formal reading instruction (such as producing the first sound in the words for both the onset and body conditions). We therefore decided to examine whether a brief period of literacy instruction focusing on the onset–rime distinction would affect performance in the common unit tasks. Accordingly, we gave the children some extra literacy tuition based on rhyme and analogy methods for a total period of 5 hours spread across eight weeks. In the second testing session, we then readministered the common unit and other tasks (during the second term of the school year; the same male experimenter provided the intervention and carried out the pretests and posttests). We were particularly interested in (a) whether in session 1 the children would show similar patterns of performance in the common unit tasks to those observed by Duncan et al. (1997), and (b) whether these patterns of performance would change in favor of rime-level units following a small amount of extra literacy tuition that included a focus at the onset–rime level. The other reading-related tasks included in this study were the oddity task devised by Bradley and Bryant (1983) and the same/different judgment task devised by Treiman and Zukowski (1991). Inclusion of the same/different judgment task enabled us to use the same stimuli as in Duncan et al.'s phonological common unit task and to test the same levels of phonological structure (onset, rime, peak, coda, body) using a task that made fewer demands on the child (recognition rather than production).

METHOD

Participants

A group of 32 children took part in the study. The mean age of the group was 5;6 ($SD = 3.1$ months; range = 5;1 to 5;11). The children were all those of the right age range enrolled in the participating school who were available for testing at the time of the study and who did not have documented educational or hearing difficulties. Sample characteristics are shown in Table 2, along with comparative results for the Duncan et al. (1997) sample whenever the same tests were administered. Although race and social class data were not systematically collected, the majority of participants were of Caucasian descent and were from a lower middle class neighborhood.

Table 2. *Sample characteristics of the children in Experiment 2*

Measure	Our sample	Duncan et al.'s sample
Chronological age	5;6 (3 months)	5;5 (3 months)
Reading age	5;8 (8 months)	n/a
Letter–sound knowledge (%)	64.1 (33)	46.7 (28)
Letter–name knowledge	74 (24)	n/a
Simple nonword naming (%)	20.9 (27)	8.83 (22)
Blending (%)	93.4 (12)	77.8 (22)
Segmentation (%)	31.3 (38)	36.1 (34)

Note: Standard deviations in parentheses.

Procedure

Each child was seen to administer the common unit tasks and the other experimental measures as well as the tasks used to compare sample characteristics with Duncan et al.'s (1997) participants. Each child then participated in 19 short literacy sessions of approximately 15 to 20 minutes in length, based on rhyme and analogy methods, for a total of 5¼ hours of extra tuition per child over a period of eight weeks.[4] Following this rime-based tuition, the common unit and other tasks were readministered. The tasks were as follows (reported in the order in which the child received them in session 1): British Ability Scales (BAS) Reading subtest, British Picture Vocabulary Scales (BPVS), letter–sound and letter–name tests, blending and segmentation tasks, nonsense word reading task, oddity task, and common unit tasks. The session 2 tasks, which were given in a slightly different order due to scheduling constraints and a half-term holiday, were as follows: phonological common unit task, BAS, segmentation task, nonsense word reading task, orthographic common unit task, oddity task, same/different judgment task.

British Ability Scales Reading subtest. This is a standardized, single word decoding test consisting of a list of words that increase in difficulty.

British Picture Vocabulary Scales. This is a receptive vocabulary test requiring the identification of pictures that correspond to words spoken by the experimenter (similar in design to the Peabody Picture Vocabulary Test).

Tests of letter sound and letter name knowledge. For these tests, the children were shown in a random order all the alphabet letters written on individual cards and were asked for their names and sounds.

Onset–rime blending and segmentation tasks. This task used a puppet, following Duncan et al. (1997). The children were asked either to make the puppet say the word made by the two sounds (onset and rime) spoken by the experimenter or to make the puppet repeat the word spoken by the experimenter so that its two component sounds (onset and rime) could be heard. Each task consisted of 10 experimental trials, five based on "simple" stimuli (CVC), following Duncan et al. (1997), and five based on "complex" stimuli (CCVCC). The experimental trials were preceded by one example trial and two practice trials with feedback. No feedback was given during the experimental trials.

Simple nonsense word reading task. This task was taken directly from Duncan et al. (1997), although we changed three of their stimuli because they sounded like real words or real names (*ceb* was replaced with *ret*, *hon* with *dop*, and *wud* with *wub*). Each word was presented on a single card to be read aloud. Two practice items were first given with feedback.

Oddity task. We used Bradley and Bryant's (1983) oddity task in which the child listened to a sequence of four words and was asked to select the word that has a different sound from the others at the beginning, middle, or end. A total of 10 sequences of each type were given in a counterbalanced order, preceded in each case by two practice trials with feedback.

Orthographic common unit task. This was taken directly from Duncan et al. (1997). In this task, the child was given a list of words printed in lower case and was asked to underline the letters that correspond with a sound spoken by the experimenter. These sounds varied at random over onset (e.g., /l/ for *lad*), body (e.g., /læ/ for *lad*), rime (e.g., /æd/ for *lad*), peak (e.g., /æ/ for *lad*), coda (e.g., /d/ for *lad*). Five lists of 10 words were given in all. We used the same lists based on the same words in the same order as Duncan et al. (1997), although we changed three of their stimuli because they seemed ambiguous. *Yes* and *Ben* were changed because their rime is a letter name, which may lead children to circle the coda in the rime condition, and *Dad* was changed as the experimenter saying /d/ could refer to either the onset or the coda. The items *big*, *cut*, and *dog* were substituted. Two practice items with feedback preceded each list.

Phonological common unit task. This was also taken directly from Duncan et al. (1997). In this task, the child listened as the experimenter said a pair of words and was asked to report the shared sound. Eight pairs were given for each phonological unit in the order onset (e.g., *can–couch*), body (e.g., *can–cat*), rime (e.g., *can–man*), peak (e.g., *can–hat*), coda (e.g., *can–bin*). We used the same words as Duncan et al., but we told the children that the shared sound was either at the beginning (onset, body), middle (peak), or end (rime, coda) of the words. Two example items with feedback preceded each block of trials. As

we noted order effects in children's responses at session 1, with carry-over from the onset condition to the body condition, we varied task order at session 2. Half of the children received the session 2 tasks in the order rime, peak, body, coda, onset; the other half received the same order as in session 1.

Same/different judgment task. Our experiences with the phonological common unit task at session 1 revealed that the instructions were ambiguous, as children who provided an onset for the body condition or a coda for the rime condition were still following task instructions. We therefore added a second phonological task at session 2 in order to measure knowledge of the same phonological units in the same words with a recognition rather than a production task. We used the same/different judgment task devised by Treiman and Zukowski (1991). In this task, children were asked to judge whether a pair of words spoken by the experimenter shared a sound. Eight pairs of words in which a sound was shared were given at each phonological level (onset, body, rime, peak, coda); these word pairs were the same as those used in the phonological common unit task (the phonological common unit task and this task were given at least five weeks apart during session 2). Eight pairs of words in which no sound was shared were also used for this task at each phonological level, making 16 trials at each level in all. Two practice trials with feedback preceded each block of trials.

The stimulus lists for the simple nonsense word reading task, the onset–rime segmentation task, and the orthographic and phonological common unit tasks are given in the Appendix.

Rime-based literacy tuition

The children were taught in small groups of three or four. The instruction was based on a selection of 12 short rhyming stories published by Oxford Reading Tree (see Goswami, 1996). These stories are written around sets of rhyming words; they have accompanying listening games and reading and writing activities that are designed to increase children's awareness of onsets and rimes and to teach them to use analogies in reading and spelling. Each story covers four rhyme "families" graded for frequency in the language and phonological complexity; thus, story 1 covers the rimes -et, -ip, -an, and -ub, whereas story 12 covers the rimes -ass, -ung, -iss, and -iff. Children always received the same games and activities during training so that the same skills were taught in all sessions. However, the stories that acted as the basis for these activities varied according to the reading level of each small group. A full description of the games and activities used during the intervention is provided in the Appendix.

RESULTS

The main aim of Experiment 2 was to examine the children's performance in the common unit tasks. These findings are reported first. Performance in the other reading-related tasks and correlations between the different reading-related measures that were administered are then presented.

Table 3. *Performance in the phonological common unit task*

		Our sample	
Unit	Duncan et al.	Session 1	Session 2
Onset	72.71	78.13	88.67
	(27.9)	(24.0)	(10.2)
Peak	43.61	29.30	38.28
	(39.6)	(34.9)	(37.0)
Coda	50.97	41.02	60.16
	(35.4)	(36.8)	(34.4)
Body	24.03	35.16	50.00
	(30.0)	(40.8)	(40.3)
Rime	14.17	16.80	52.34
	(31.4)	(31.4)	(44.2)

Note: Raw scores are converted to percentages to permit comparison with Duncan et al.'s data. Standard deviations in parentheses.

Phonological common unit task

The mean percentage of correct responses at each phonological level (onset, peak, coda, body, rime) in sessions 1 and 2 is shown in Table 3, along with Duncan et al.'s (1997) results for comparative purposes. The data show that we broadly replicated Duncan et al.'s finding of a selective deficit in rime judgments at session 1. The biggest improvement at session 2 (following rime-based literacy instruction) appears to occur for the rime judgments. Our session 1 data also indicate that our children were less able to make judgments based on small units (peaks and codas) than those tested by Duncan et al.

To investigate changes in performance between session 1 and session 2, a $2 \times 2 \times 5$ (Order [Duncan et al.'s order vs. our new order] $\times$ Test [session 1 vs. session 2] $\times$ Phonological Unit [onset, peak, coda, body, rime]) analysis of variance was carried out with repeated measures on phonological unit, taking the number of correct responses out of 8 as the dependent variable. The ANOVA showed a main effect of test, $F(1, 30) = 28.4$, $p < .01$, $\eta^2 = 0.49$, a main effect of phonological unit, $F(4, 120) = 29.7$, $p < .001$, $\eta^2 = 0.50$, an interaction between test and phonological unit, $F(4, 120) = 3.7$, $p < .01$, $\eta^2 = 0.11$, and an interaction between order, test, and phonological unit, $F(4, 120) = 3.0$, $p < .05$, $\eta^2 = 0.09$. Post-hoc inspection of the latter interaction (Newman–Keuls) showed that, for the order group receiving Duncan et al.'s order, the only statistically significant improvements occurred for the body and rime units (ps $< .01$). For the order group receiving our new task order, which was designed to eliminate carry-over effects from the onset to the body, the only statistically significant improvement occurred for rime units ($p < .01$). The most probable explanation for this selective improvement is the extra literacy tuition that we provided based on rhyme and analogy, which appears to have had a selective large unit

Table 4. *Performance in the orthographic common unit task*

		Our sample	
Unit	Duncan et al.	Session 1	Session 2
Onset	92.08	88.44	96.25
	(11.0)	(15.3)	(6.6)
Peak	94.79	85.00	93.44
	(9.3)	(17.6)	(7.9)
Coda	89.79	78.24	82.81
	(13.1)	(14.2)	(6.9)
Body	69.11	70.63	86.56
	(35.0)	(25.3)	(11.8)
Rime	59.79	58.75	76.56
	(33.8)	(31.3)	(21.6)

Note: Raw scores are converted to percentages to permit comparison with Duncan et al.'s data. Standard deviations in parentheses.

effect on performance in the common unit task, irrespective of testing order.[5] Although improvement at the large unit level cannot unambiguously be attributed to our intervention as we were using Duncan et al.'s sample as our control group, it is notable that, when Duncan et al. followed up their sample of 5-year-olds two years later, as 7-year-olds, performance in the phonological common unit task was approximately 44% correct, compared to 52% correct for our 5-year-olds (Duncan et al., submitted). This comparison suggests that improvement over time at the rime level in the phonological common unit task is more gradual than that found here.

Orthographic common unit task

The mean percentage of correct responses at each phonological level (onset, peak, coda, body, rime) in sessions 1 and 2 is shown in Table 4, along with Duncan et al.'s results for comparative purposes. The data presented is based on 7 of the 10 items. The other items (*home*, *loop*, and *help*) showed unusually high and selective error rates at the rime, peak and coda levels and so were omitted from the analysis.[6] As with the phonological unit task, the data show that we broadly replicated Duncan et al.'s finding of a selective deficit in rime judgments in session 1. Again, the biggest improvement in session 2 following rime-based literacy instruction appears to occur for the rime judgments. Our session 1 data again indicate that our children were less able to make judgments based on small units (peaks and codas) than those tested by Duncan et al.

To investigate changes in performance between session 1 and session 2, a 2 $\times$ 5 (Test [session 1 vs. session 2] $\times$ Orthographic Unit [onset, peak, coda, body, rime]) analysis of variance was carried out with repeated measures on ortho-

Table 5. *Performance in the oddity and same/different judgment tasks*

Task	Unit	Session 1	Session 2
Oddity	Shared initial sound	37.50 (23.6)	58.75 (24.7)
	Shared medial sound	42.50 (26.2)	60.00 (23.4)
	Shared final sound	42.81 (25.0)	61.88 (25.6)
Task	Unit	Session 2 (Same/Different)	Session 2 (Common Unit)
Same/Different Judgment	Onset	88.09 (34.0)	88.67 (10.2)
	Peak	73.63 (33.9)	38.28 (37.0)
	Coda	78.71 (42.7)	60.16 (34.4)
	Body	90.82 (27.5)	50.00 (40.3)
	Rime	89.84 (36.9)	52.34 (44.2)

Note: Raw scores are converted to percentages to permit cross-task comparisons. Standard deviations in parentheses.

graphic unit, taking the number of correct responses out of 7 as the dependent variable. The ANOVA showed a main effect of test, $F(1, 31) = 18.4$, $p < .001$, $\eta^2 = 0.37$, a main effect of orthographic unit, $F(4, 120) = 13.5$, $p < .001$, $\eta^2 = 0.30$, and an interaction between test and orthographic unit, $F(4, 124) = 3.4$, $p < .01$, $\eta^2 = 0.10$. Post-hoc inspection of the latter interaction (Newman–Keuls) showed that the only statistically significant improvements following training occurred for body and rime units ($ps < .01$). As in the phonological common unit task, a selective large unit effect on performance was found. However, as Duncan et al. (submitted) did not repeat the orthographic common unit task with their sample at age 7, progress in this task in the absence of rime-based literacy tuition is not known.

The oddity and same/different judgment tasks

The Bradley and Bryant oddity task measures awareness of onsets and rimes by varying the beginning sound in words with a CVC phonological structure, the middle sound, or the final sound. Session 1 performance in these three measures, along with performance following our rhyme and analogy intervention, is shown in Table 5. Treiman and Zukowski's (1991) same/different judgment task was used to measure phonological awareness at all of the linguistic levels tapped by the common unit tasks. The mean percentage of correct responses at each phonological level (onset, peak, coda, body, rime) in this task (which was only given at session 2), along with the same children's performance in the phonological common unit task at session 2, is also shown in Table 5.

The data for the same/different judgment task show that children's linguistic awareness of rimes and bodies in this recognition task appears markedly different from their awareness of the same units in the same words when measured by the phonological common unit task (a production task). In the same/different

judgment task, awareness of rimes appears superior to awareness of peaks and codas, whereas in the common unit task, awareness of peaks and codas is either superior to (at session 1) or approximately equivalent to (at session 2) awareness of rimes. To investigate whether these differences were statistically significant, a one-way analysis of variance with repeated measures on phonological unit (onset, peak, coda, body, rime) was carried out, taking the number of correct responses out of 16 as the dependent variable. A statistically significant effect of phonological unit was found, $F(4, 31) = 16.88$, $p < .001$, $\eta^2 = 0.35$. Post-hoc inspection (Newman–Keuls) confirmed that performance with onsets, bodies, and rimes was superior to performance with peaks and codas. This pattern is the opposite of that found in the common unit task.

The data for the oddity task show that children's performance increased by about 20% from session 1 to session 2 for each type of sound judgment. To see whether these changes were statistically significant, a 2×3 (Test [session 1 vs. session 2] $\times$ Position [beginning sound different, middle sound different, final sound different]) analysis of variance was carried out with repeated measures on position, taking the number of correct responses out of 10 as the dependent variable. The ANOVA showed only a main effect of test, $F(1, 31) = 38.1$, $p < .001$, $\eta^2 = 0.55$, confirming that improvement was statistically significant across all the versions of the oddity task. For comparison, similar levels of improvement over time in the absence of rime-based instruction would be expected to take around eight months (Maclean et al., 1987). Performance in Duncan et al.'s (1997) simple nonword reading task, assumed by Duncan et al. to be a measure of small unit decoding, also increased by about 20% following the rhyme and analogy intervention: from 21% at session 1 ($SD = 27\%$) to 39% at session 2 ($SD = 36\%$). Thus, the effects of rime-based literacy instruction may not be limited to so-called large unit variables. It is interesting to note that, when Duncan et al. (submitted) followed up their sample two years later as 7-year-olds, they found that the children in their group who had had superior rhyming skills at 5 years showed superior nonsense word reading for items based on small units (nonsense words with unfamiliar rimes).

Correlational analysis

Given the inclusion of a number of reading-related measures in this study, we investigated the correlations between these different measures and reading age in our sample. The correlations obtained are shown in Table 6.[7] As would be expected, most of the tasks were significantly correlated with reading ability. Of particular interest is the finding that onset–rime segmentation was not correlated with reading either before or after training. This result was unexpected, but it mirrors a finding reported by Nation and Hulme (1997) with a slightly older sample (6-year-olds). Recall also that onset–rime segmentation was a comparatively difficult task for the 5-year-olds studied in Experiment 1.

Performance in the onset–rime segmentation task was 31.3% ($SD = 38\%$) at session 1 and 59.1% ($SD = 27\%$) following the rime-based literacy intervention. Performance in the onset–rime blending task was 93.4% ($SD = 12\%$, session 1

Table 6. *Correlations between the phonological tasks and reading in Experiment 2*

	Correlation with reading age	
Measure	Session 1	Session 2
Letter–name knowledge	0.57**	—
Letter–sound knowledge	0.76**	—
Nonsense word reading	0.85**	0.86**
Oddity (beginning sound)	0.39*	0.67**
Oddity (middle sound)	0.54**	0.35
Oddity (final sound)	0.40*	0.44**
Segmentation (onset–rime)	–0.11	–0.02
Synthesis (onset–rime)	0.51**	—
Phonological unit (onset)	0.30	0.15
Phonological unit (peak)	0.69**	0.77**
Phonological unit (coda)	0.51**	0.52**
Phonological unit (body)	0.28	0.43*
Phonological unit (rime)	0.54**	0.80**
Orthographic unit (onset)	0.40*	0.31
Orthographic unit (peak)	0.38*	0.16
Orthographic unit (coda)	0.19	0.19
Orthographic unit (body)	0.41*	0.35
Orthographic unit (rime)	0.56**	0.52**

*$p < .05$; **$p < .01$.

only). Inspection of the raw data for the onset–rime segmentation task revealed that, prior to training, half of the children were completely unable to perform the onset–rime segmentation task, scoring 0 (16 of the 32 children). Following training, all of the children were able to perform the task. The average gain following training was 2.78, with the smallest increase being from 0 to 1 and the largest increase from 0 to 10. Gain scores were uncorrelated with reading ability. Note that the rapid acquisition of onset–rime segmentation skills cannot be attributed unambiguously to the rime-based literacy intervention in the absence of a control group. However, Nation and Hulme's (1997) cross-sectional study found that onset–rime segmentation skills were static across age in their sample of children (who were receiving literacy instruction that did not emphasize rimes: performance was 55% correct at age 6, 58% correct at age 8, and 60% correct at age 9). In our study, the absence of a relationship between onset–rime segmentation and reading was found at both session 1 and session 2. One possibility is that this measure is not a particularly sensitive measure of individual differences. On the other hand, onset–rime blending skills were strongly correlated with reading ability. Another explanation may be that all children can acquire onset–rime segmentation skills, irrespective of their reading ability.

DISCUSSION

The first aim of this study was to find out whether poor rime-level performance in the common unit tasks devised by Duncan et al. (1997) would be characteristic of 5-year-old children who were receiving a mixture of whole language and phonics instruction. Somewhat to our surprise, we found that it was. The performance profile of our children was remarkably similar to that of Duncan et al.'s sample with respect to large units (rimes and bodies), although our children were poorer with small units (peaks and codas) than the children that they studied. The second aim was to find out whether this pattern of performance was to any extent dependent on instructional practice. A common feature of the instructional practices of the schools taking part in our study and that of Duncan et al. was the absence of rime-based literacy instruction. Accordingly, we provided our children with a relatively brief period of literacy tuition at the large unit (onset–rime) level. This led to improvements in the common unit tasks which were specific to the large unit measures. Although we did not utilize a control group design, our brief training resulted in greater gains in Duncan et al.'s phonological common unit task than was found to occur naturally in the Scottish sample during two years of reading tuition at the phonemic level.

Seymour and Duncan (1997) argued that the common unit task provided a window through which the language segments involved in reading could be observed (p. 132). Our data suggests that the view through this window is dramatically affected by the kinds of literacy instruction that the child is receiving. As little as 5 hours of literacy tuition with large units can change the patterns of performance found in the common unit task. Furthermore, the phonological common unit task and a directly comparable task using the same words and phonological segments but requiring same/different judgments yielded different patterns of results concerning the relative ease of small units and large units. In the recognition task, children showed greater facility with large units (see also Treiman & Zukowski, 1996). On the basis of these results, we would argue that it is too early to conclude that "progression in normal reading acquisition is from a small unit (phonemic) approach in the initial stage towards a large unit (rime-based) approach at a later stage" (Seymour & Duncan, 1997, p. 130). The question of why different phonological awareness tasks yield different patterns of results concerning small versus large units is an important one and is discussed further later.

OVERALL DISCUSSION

The literature on the relationship between phonological awareness and reading development increasingly demonstrates a connection between children's representation of phonology, their performance in phonological awareness tasks, and their progress in learning to read and spell (e.g., Fowler, 1991; Gathercole & Baddeley, 1989; Goswami, in press-b; Hansen & Bowey, 1994; Katz, 1986; Metsala, 1997b; Metsalla & Walley, 1998; Snowling, Goulandris, Bowlby, & Howell, 1986; Swan & Goswami, 1997a, 1997b). The representation of phonology appears to become increasingly segmental with development. Recent theo-

ries in child phonology have argued that the phoneme is the last segment to be represented, even though infants are known to make simple discriminations between phonemes (e.g., Eimas, Siqueland, Jusczyk, & Vigorito, 1971). Some child phoneticians have argued that, when vocabulary size is small, there is no need to represent words in a systematic or detailed manner, and so early word representations are holistic and relatively undifferentiated, representing fairly global phonological characteristics (e.g., Ferguson, 1986; Jusczyk, 1986, 1993). As vocabulary grows, the continued use of relatively undifferentiated representations becomes impractical, thus these global representations are gradually restructured so that smaller segments such as syllables, onsets, rimes, and ultimately phonemes are represented (Fowler, 1991; Goswami, in press-b; Logan, 1992; Walley, 1993). The main impetus for this "lexical restructuring" is thought to be the "vocabulary burst" that begins between 18 and 24 months, requiring the child to specify the phonological characteristics of each word more precisely (Metsala & Walley, 1998). Lexical restructuring occurs on a word-by-word basis, and so at any given time some words will be represented in more segmental detail than others (Metsala, 1997a).

According to this "emergent" view, the phoneme is not an integral aspect of speech representation and processing from infancy onward (cf. Eimas et al., 1971) but rather emerges as a representational unit via spoken language experience and also, presumably, via reading experience (see Goswami & Bryant, 1990). The degree to which segmental representation has taken place is in turn thought to determine how easily the child will become phonologically aware and will learn to read and write (e.g., Metsala & Walley, 1998). According to this view, children's use of small (phonemic) and large (onset–rime) units in reading will depend on whether onset–rime and phonemic segments are represented in the particular words that constitute an individual child's mental lexicon. By around age 5, most children would be expected to have represented segments corresponding to onsets and rimes for most words. However, segments corresponding to phonemes are unlikely to be represented for many words unless they have been directly taught.

This developmental view suggests that much of the current debate concerning the respective roles of large units and small units in early reading is based on the false premise that both levels of phonology are available to the beginning reader at the same level of specification and the beginning reader simply chooses between them. Instead, we would argue that most beginning readers have large units available at an implicit level of specification but need to be taught about small units in order to use them in reading and in reading-related tasks. Large units can be used from the beginning of reading via analogy, but the use of large units will be limited by the size of the child's reading vocabulary. Small unit tuition can commence from the beginning of reading, as shown by the findings of Seymour and his colleagues and as argued by a number of educators (e.g., Chew, 1997; McGuinness, 1998), and the acquisition of phonemic skills can be expected to be fairly rapid for most children (cf. Goswami & Bryant, 1990). However, children who are relatively advanced in segmental representation (as indexed, for example, by good rhyme awareness) would be expected to find it easier to benefit from phoneme-level instruction than children

who are less advanced in segmental representation (as indexed, for example, by poor rhyme awareness). Similarly, as the presence of onset–rime representation will involve some phoneme-level representation (as many onsets and some rimes are single phonemes), there should be a connection between an individual child's facility with rimes and that child's facility with phonemes (cf. Bryant et al., 1990).

However, there is another aspect of representation that is also important for reading development. This concerns whether children have explicit access to their represented knowledge. Research in many areas of cognition has shown that much of what we "know" is known implicitly (e.g., Berry & Dienes, 1993; Karmiloff-Smith, 1992). We can use implicit knowledge to solve many cognitive tasks, but for many other cognitive tasks we need our knowledge to be explicit in order to use it consciously (see the developmental work on metacognition; e.g., Forrest-Pressley, MacKinnon, & Waller, 1985). Karmiloff-Smith (1992, 1994) referred to this process of making implicit knowledge explicit as "re-representation." She argued that children first take in salient information from a particular domain (we will use the example of phonology) until they achieve consistently successful performance (e.g., they can comprehend and produce particular spoken words). As knowledge grows (e.g., vocabulary size increases), the currently available internal representations become organized (e.g., lexical restructuring occurs). Finally, and usually in response to some external pressure (e.g., being taught to read), children gain conscious access to their own knowledge. Children can only state their knowledge verbally at this final level of explicit representation (e.g., they can identify and produce the rime in a given word, as required by the common unit task, rather than simply recognize whether two words share the same rime, as required by the same/different judgment task). It is important to note that early levels of representational description remain in the mind (see Karmiloff-Smith, 1992). Thus, the child eventually has multiple representations of similar knowledge at different levels of detail and explicitness.

To account for children's use of large versus small units in reading and in different phonological awareness tasks, therefore, two aspects of representational competence need to be considered. The first is whether the child has developed segmented representations as part of the development of speech processing (at either the large unit or small unit level). Useful accounts of this developmental process can be found in the work of Metsala and Walley (1998) and Stackhouse and Wells (1997). The second is whether the child has conscious access to these representations. A useful account of this developmental process can be found in the work of Gombert (1992). Gombert distinguished between "epilinguistic" (or implicit) phonological knowledge and "metalinguistic" (or explicit) phonological knowledge. Either or both representational processes might entail the development of an abstract store of information about phonological segments (e.g., Butterworth, 1992), which might form the basis of responding in phonological awareness and other phonological tasks based on nonsense stimuli.

Note that it could only be argued that the "natural" progression in reading was from small units to large units if the process of making phonological knowl-

edge explicit was much easier for phonemes than for rimes. In fact, however, the reverse appears to be the case. Furthermore, it is also known that the phonological correspondences established early in development are less vulnerable to neurological accident than those established later. For example, onset–rime correspondences are still available to adult acquired dyslexics and alexics even when phonemic correspondences are not (e.g., Patterson & Marcel, 1992; Shallice, Warrington, & McCarthy, 1983), and syllabic correspondences may still be available to adult phonological dyslexics even when onset, rime, and phoneme correspondences are not (Lesch & Martin, 1998).

The adoption of a developmental perspective on representation thus suggests that the juxtaposition of small unit and large unit approaches to early reading is misguided. In fact, children should benefit from direct literacy tuition at both levels of phonology. It is premature to argue that teachers should no longer be encouraged to develop rhyming skills as part of the early reading curriculum (cf. Muter et al., 1997). Direct tuition at the level of the rime helps make the phonological structure already represented in the mental lexicon explicit, facilitates the use of analogies in reading, and reflects an important level of consistency in the spelling system of English (see Treiman et al., 1995). Nevertheless, it is important to be clear that the role of large units in reading would of course be expected to increase at a later stage in reading, mirroring growth in the child's orthographic lexicon (see Goswami, 1986, 1999a). This was demonstrated by Marsh and his colleagues, who showed that children used more rime analogies in reading as they got older (e.g., Marsh, Desberg, & Cooper, 1977; Marsh, Friedman, Welch, & Desberg, 1981; see also Bowey & Hansen, 1994; Bowey & Underwood, 1996; Coltheart & Leahy, 1992; Leslie & Calhoon, 1995; Treiman et al., 1990). Goswami and Bryant (1990) argued that the ability to use rime analogies was present from the beginning of reading. They did not argue that the use of rime analogies provided a complete explanation of early decoding behavior. "Beginning readers are ready to make analogies even though they know so few written words and therefore have such a small basis for making any analogies at all" (Goswami & Bryant, 1990, p. 77).

To conclude, we would argue that the most plausible developmental models of reading are ones that give both rhymes and phonemes a role to play from the beginning of learning to read, as originally proposed by Goswami and Bryant (1990). Rhyme makes a contribution to early reading because it is usually the smallest level of segmental structure represented in the beginning readers' mental lexicon, which is reflected in the orthography (first causal connection), and phonemes make a contribution to early reading because children need to learn letter–sound correspondences in order to acquire the alphabetic principle (second causal connection). However, research such as that of Duncan et al. (1997) has demonstrated that the role played by rhyme is limited by the absence of direct literacy instruction at the level of the rime. Similarly, although grapheme–phoneme correspondences may be acquired rapidly by most children, children for whom the segmental representation of onsets, rimes, and phonemes has been delayed will experience difficulties in acquiring these phoneme-level correspondences (see Swan & Goswami, 1997a, 1997b).

These proposals await further research. However, a focus on the representa-

tion of linguistic knowledge may not only offer a way forward in distinguishing between claims about the relative importance of large units and small units in reading development, but also be useful in linking the process of reading development more closely to the development of speech processing skills (cf. Stackhouse & Wells, 1997). There is growing evidence that the development of well-specified phonological representations of words is critical for adequate reading development, as degraded or poor-quality phonological representations seem to underlie the phonological processing difficulties characteristic of dyslexia (e.g., Elbro, 1996; Fowler, 1991; Katz, 1986; Metsala, 1997b; Metsala & Walley, 1998; Snowling et al., 1986; Swan & Goswami, 1997a, 1997b). An emphasis on representation would also mean that a new causal connection needs to be added to Goswami and Bryant's (1990) framework. This new connection concerns the quality of a child's phonological representations of speech, and it would be causally primary in terms of the other proposed causal connections (see Goswami, in press-a).

APPENDIX

Stimuli for Experiment 2

Simple nonsense word reading task: tas, kax, ret, lem, vip, jir, yog, dop, wub, zuf
Onset–rime segmentation task: hot, rock, stand, fan, crisp, plant, bed, scarf, jug, twist
Orthographic common unit task: lad, home, loop, help, can, not, stop, big, cut, dog
Phonological common unit task:
Onset: look–lamb, help–horse, can–couch, yes–yacht, dad–door, not–neck, Ben–bath, stop–star
Peak: loop–food, met–hen, can–hat, yes–leg, dance–path, not–sock, ben–red, stop–frog
Coda: look–week, help–gulp, can–bin, yes–kiss, dad–mud, not–rat, Ben–fun, stop–clap
Body: loot–loop, met–men, can–cat, yes–yell, dad–dam, not–nod, Ben–bell, stop–stock
Rime: look–book, help–yelp, can–man, yes–mess, dad–sad, not–cot, Ben–ten, stop–drop
(Note that three peak word pairs and six body word pairs had to be altered to take account of differences in Scottish and southern English pronunciation. In these cases, at least one word from Duncan et al. was retained: e.g., lad–laugh was changed to lad–lap.)

Rime-based intervention

Each group of children received intervention based on two books from the *Oxford Reading Tree Rhyme and Analogy* scheme. The poorest readers used books 1 and 2 in the series: *Supersonic engine juice* (rimes -et, -ip, -an, and -ub) and *Scat, cat!* (rimes -at, -in, -ed, and -og). Most children (23) were in this group. The intermediate readers ($N = 3$) used books 4, *Bad day, good day* (rimes -ad, -it, -eg, and -un), and 6, *The spell shell* (rimes -ab, -im, -ot, and -ell). The best readers ($N = 6$) used books 9, *The king's socks* (rimes -ock, -ing, -ug, and -ash), and 10, *Gran, gran* (rimes -ack, -ong, -ush, and -ess). In each case, sessions 1 through 12 were based on the first book, and sessions 13 through 19 were based on the second book.

The 19 sessions, in the order given, were as follows:

1. Read through a book, placing emphasis on rhymes. Show children the book and the rhyming words while reading (5–10 mins).

2. Read through book once as revision; read through again, but children supply the rhyming words (10 mins).
3. *Onset work 1.* Experimenter says each of the key words associated with the story. Children take turns generating a word beginning with each onset; hints are given to help them do this when necessary (e.g., "What fastens up our anorak?" for *zip*). Finally, a list of words beginning with each onset is read to the children (15 mins).
4. *Rhyme competition.* Children take turns saying which word rhymes with another in the story. "Can anybody think of another word which rhymes?" (10 mins).
5. *Story comprehension and rhyme competition.* Children are asked questions about story to check comprehension and then are asked to think of words that rhyme with keywords; they are given clues when necessary (e.g., "What do you catch fish with?" for *jet–net*). Children are given a keyword and then another word. They are asked to say whether it rhymes. Experimenter reads a list of rhyming words based on keywords in the story (15 mins).
6. *Onset work 2.* Children listen to a list of "What granny bought in the shops"; all items begin with the same sound. Each child has to remember an item beginning with the same sound or think of their own item beginning with that sound (15 mins).
7. *Rhyme rollers as a class activity.* Each child writes rimes on a cardboard roll and onsets on a second roll that fits around the first. Onsets and rimes can then be matched to form words. Children practice generating the words. Later, children get into pairs and swap their rolls with each other (so that each child now has a different type of roll). One child draws a picture depicting a word on the roll, while the other has to generate the word using the roll (30 mins). (Note that seven children missed this session.)
8. *Eye-spy rhyme game.* Each child is given a word to give as a clue for the others to guess the object in the room which rhymes with it (e.g., "I spy, something rhyming with ten" for *pen*) (30 mins).
9. *Rhyming snap.* Four picture cards each are used of the following rimes: -in, -at, -ing, -an, -ip, -ig, -ock. Snap is then played between the children (15 mins).
10. *Rhyming card game.* Rimes include -in, -at, -ing, -an, -ip. Children turn over two cards; they have to say what the pictures are and whether they rhyme. If they rhyme, the child keeps the two cards (15 mins).

11/12. *Spelling and reading analogies* (two sessions). This involves a game form of the clue word technique, based on a metallic board and magnetic letters. Activities run as follows. A child tries to spell (copy) a clue word with the help of a clue card (picture and word). Each child thinks of another word which rhymes and tries to spell it. Children have to read one or two other words generated by experimenter. Onset–rime are kept spatially separate. Children have to respond to questions: "Which bit of these words looks the same?" "Which part of net sounds like part of pet?" Children are required to point to these parts of the words and say what the part sounds like. Children are reminded throughout that "We can think of a word we do know to help us spell/read a word we don't know" (e.g., while generating a word and referring to a key word). Finally, each child copies out the list from the metallic board in pencil, keeping the separation between onset and rime and arranging the rimes in a column (20 mins for each session).

13. Read through a book slowly, exaggerating the rhyming words. Refer to the pictures in the book, especially those which rhyme. Ask questions about the pictures: "What is happening here?" "What can you see in the picture that rhymes with 'sock'?" Ask children what word in the story rhymes with another word (15 mins).
14. *Story comprehension and filling in missing words.* As the story is read, the children

are asked to fill in the missing rhyming words. Children take turns doing this. They are asked questions to test comprehension of the story: "Was the mouse happy?" "Why not?" (10 mins).

15. *Rhyming picture pelmanism.* Same task as in session 10, but using the rimes -en, -ap, -og, -ill, -un (15 mins).

16/17. *Rhyming and picture pelmanism* (two sessions). This task is based on 24 cards; 4 words and 4 pictures are used for each of the following rime groups: -ar, -all, -at (first session); -ock, -ug, -ill (second session). Each child has a word card with a word representing one of the three rhyme groups. The other 21 cards are face-down on the table; each child takes a turn at turning over a card and collecting the other 7 cards (3 words, 4 pictures) from their rhyme group (15 mins for each session).

18/19. *Spelling and reading analogies* (two sessions). Same task as in sessions 11/12, but using rimes from the second book (20 mins for each session).

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NOTES

1. A second measure given critical emphasis by Duncan et al. (1997) was a nonsense word reading task. In this task, nonsense words were created that used either the onset + rime, the body + rime, the body + coda, or the onset + peak + coda units from words in the children's reading vocabularies. Duncan et al. reported that, although success rates on all nonsense word categories were similar (respectively, 29%, 27%, 33%, and 32%), the body + coda nonsense words were read significantly better than the body + rime nonsense words (33% vs. 27%). They interpreted this finding as inconsistent with large unit theories. However, this task was not diagnostic of children's reading strategies, as no attempt was made to match the different nonsense words for phonological complexity or for the depth of learning of the different real words on which they were based. Moustafa (1995), who controlled for the latter factor, reported opposite results.
2. This is no longer characteristic; since 1998, all English schoolchildren have begun to receive systematic phonics tuition as part of the National Literacy Strategy.
3. As the phoneme segmentation scores were at floor, a reviewer noted that it would have been desirable to carry out this analysis omitting these scores. Unfortunately, this has not been possible due to loss of the raw data during a move. Given the power of the effect sizes, however, it seems unlikely that omitting one of the eight categories of data would greatly affect the reported results.
4. Some of the children did not receive a nineteenth training session; their teacher did not wish to devote a class session to making "word wheels" (in which different onsets are written on an outer wheel and are aligned with different rimes written on an inner wheel). A total of seven children missed this session.

5. As we were concerned that performance with onsets was close to ceiling, we ran the same ANOVA without the onset data. Exactly the same effects were found.
6. For *home*, there were 20 rime errors and 32 coda errors; for *loop*, there were 15 rime errors and 13 peak errors; and for *help*, there were 13 rime errors and 21 coda errors. Interestingly, the coda errors for *home* arose because the children were reluctant to underline the letters ME to represent the coda. Most underlined the M, which is of course correct, as the E in *home* is part of the peak. However, as we were following Duncan et al.'s procedure, we scored these as errors. In order to check that these items were indeed affecting the analyses, we compared the children's performance at session 1 across the different orthographic units when all 10 items were scored and when only the 7 items that did not show selective error patterns were scored. A 2×5 (Item Number [7 vs. 10] $\times$ Orthographic Unit [onset, peak, coda, body, rime]) analysis of variance showed statistically significant effects of item number, $F(1, 31) = 350.3$, $p < .001$, $\eta^2 = 0.92$, and orthographic unit, $F(4, 31) = 14.3$, $p < .001$, $\eta^2 = 0.65$, and a statistically significant interaction between these two factors, $F(4, 124) = 30.94$, $p < .001$, $\eta^2 = 0.50$. Post-hoc inspection of this interaction showed that, when the stimuli *home*, *loop*, and *help* were included ($N = 10$), performance with rimes was statistically significantly poorer than performance with bodies, which in turn was statistically significantly poorer than performance with onsets, peaks, and codas. Without them ($N = 7$), performance with rimes and bodies was equivalent and statistically significantly poorer than performance with onsets, peaks, and codas.
7. The nonsignificant correlations between some of the onset tasks and reading are explained by near ceiling performance in these tasks.

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