Components of phonological awareness

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ABSTRACT: The factorial structure underlying different types of tasks within the domain of phonological awareness was examined in two studies. Large sample sizes allowed for sensitive differentiation of constructs. In the first study, 128 preschool children without any experience of formal reading instruction were tested with a battery of tasks intended to tap various aspects of phonological awareness: rhyme recognition, syllable counting, initial-phoneme matching, initial-phoneme deletion, phoneme blending, and phoneme counting. Three basic components were extracted in a principal component analysis: a phoneme factor, a syllable factor and a rhyme factor. Cross-tabulations indicated considerable dissociation between performance on phoneme, syllable, and rhyme tasks. The structural relationships were replicated on a much larger sample (n = 1509) in the second study. Subjects in this study were one year older and were attending grade 1 thus providing an opportunity to test their reading achievement. Multiple regression analyses demonstrated that the phonemic factor was by far the most potent predictor. However, the rhyming factor made an independent (although small) contribution to explaining the reading variance. Among the phonemic tasks, phoneme identification proved to be the most powerful predictor.

KEY WORDS: Factorial structure, Phonological awareness, Reading acquisition

INTRODUCTION

Language analysis abilities are some of the most reliable indicators of success in early reading acquisition. For example, a growing body of research has indicated that a variety of sound analysis tasks – often referred to as phonological awareness or phonological sensitivity measures – are strongly related to early reading acquisition (Adams 1990; Bradley & Bryant 1983; Brady & Shankweiler 1991; Bruck & Treiman 1990; Bryant et al. 1990; Goswami & Bryant 1990; Juel 1988; Lundberg, Frost & Petersen 1988, Stanovich, Cunningham & Cramer 1984; Vellutino & Scanlon 1987; Wagner 1988; Wagner & Torgesen 1987; Wagner et al. 1993; Yopp 1988). In fact, phonological abilities are stronger predictors than such important correlates as intelligence, vocabulary, and listening comprehension, and remain significant predictors of reading achievement even after such factors as intelligence and verbal ability are partialled out (Stanovich 1992; Wagner & Torgesen 1987). Importantly, deficits in phonological awareness have been identified as the critical factor underlying the severe word decoding problems displayed by reading disabled individuals (Bruck 1990, 1992; Galaburda 1988; Høien

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et al. 1989; Katz 1986; Liberman & Shankweiler 1991; Lundberg & Høien 1989; Lundberg & Høien 1992; Manis, Custodio & Szeszulski 1993; Olson et al. 1990; Pennington et al. 1990; Rack et al. 1992; Siegel 1988, 1989; Siegel & Ryan 1988). Collectively, the research data provide convincing evidence that phonological sensitivity is a powerful determinant of the speed and efficiency of reading acquisition (Goswami & Bryant 1990).

The term phonological awareness is used to cover the range of phonological abilities presumed to underlie efficient reading acquisition. It refers generically to the ability to abstract and manipulate segments of spoken language (Bentin 1992; Liberman 1973; Liberman et al. 1974; Mattingly 1972; Morais, Alegria & Content 1987; Morais et al. 1979; Tunmer & Hoover 1992). Investigators have used various tasks in order to tap aspects of phonological awareness: rhyming tasks, syllable and phoneme counting tasks, segmentation tasks, blending tasks, substitution tasks, and deletion tasks. Although many of these tasks have been shown to relate to reading performance, little attention has been paid to the question of processing relationships among various phonological tasks.

The various tasks that have been used as indicators of phonological awareness may, in fact, reflect one or several underlying constructs. For example, it may be that the various phonological tasks are simply differentially sensitive or differentially age-appropriate indicators of a unitary construct of phonological sensitivity. Stanovich (1992) suggests this when arguing that phonological sensitivity might be viewed as a continuum or hierarchy ranging from 'shallow' to 'deep' sensitivity. Deeper levels of phonological sensitivity are thought to require more explicit analysis of smaller-sized phonological units and shallow sensitivity a shallower form of analysis involving larger units. Thus, rhyming skills could be regarded as representing the shallow end of the phonological sensitivity continuum, phoneme segmentation the deep end of the continuum, and the syllable segmentation perhaps an intermediate level but closer to rhyme.

Alternatively, it could be the case that various phonological tasks in fact reflect different basic constructs. For example, Bentin (1992) has suggested that there are two qualitatively different forms of phonological awareness: early phonological awareness characterized by sensitivity to rhyme and syllables, and phonemic awareness characterized by sensitivity to phonemes. Similar to Bentin, other investigators have argued for the necessity of differentiating rhyme awareness from phonemic awareness (Bryant et al. 1990; Goswami & Bryant 1990).

Although researchers have speculated on the nature of the relationships for some time (see Lundberg 1978), only recently have investigators attempted to empirically address the question of the underlying structure of the phonological awareness concept. Lundberg, Frost & Petersen (1988) demonstrated with a confirmatory factor analysis the separability of a phoneme factor and a syllable factor. Using a small sample, Bryant et al. (1990) found that rhyming ability explained unique variance in word recognition after phoneme analysis ability had been partialled. Thus, at least from this one small-sample study there is some evidence for separable components of phonological awareness skill. However, Bryant et al. (1990) were not able to test a full version of Bentin's (1992) hypothesis because their study did not test whether syllable segmentation abilities were separable from rhyme and phonemic segmentation. The classic study by Liberman et al. (1974) found syllable counting to be easier than phoneme counting (Fox & Routh 1975; Hardy, Stenett & Smythe 1973; Leong & Haines 1978; Treiman & Baron 1981), but this difference in level of difficulty is itself not evidence of a separable syllabic component of phonological awareness. The difference might be a simple consequence of the differential discriminating power of tasks lying on a continuum of ability.

Wagner and colleagues (Wagner et al. 1993; Wagner et al. 1994) have conducted some sophisticated studies of the factorial structure of phonological abilities. Their focus, however, was on testing the differentiability of phonological awareness, phonological memory, and naming skills. In contrast, the focus of the two Norwegian studies reported here is on the factorial structure underlying different types of tasks within the domain of phonological awareness. It should be noted that the Norwegian language has a fairly shallow orthography, where a large number of high-frequency words have a close grapheme-phoneme correspondence.

Both studies examine different levels of phonological awareness utilizing a sample that is considerably larger than that employed in any extant study of a similar type. The large sample size employed in Study 2 allows for an extremely sensitive test of whether phonological awareness skills at various levels (rhyme, syllable, phoneme) should be considered separate constructs or are instead aspects of a unitary underlying construct.

The necessity of differentiating more than one phonological awareness construct will be examined in two ways. First, we investigate the correlational structure within the set of phonological awareness tasks. This analysis is replicated in two samples of children using overlapping tasks. One sample was somewhat older than the other but both were in the age range where phonological processing skills have been found to be of considerable importance. Thus, any structural relationships that replicate will have been shown to be robust across a critical age range in the acquisition of early literacy. In Study 2, which utilizes a very large sample, we examine the differential validity of the different levels of phonological awareness as predictors of early word decoding skill.

STUDY 1

METHOD

Subjects. A total of 128 preschool children (64 girls and 64 boys) were included in the study. They were all attending public preschool classes in the area of Stavanger (both urban and suburban).

In the Norwegian school system children do not start their formal education until August the year they become 7 years old. Approximately only 60 percent of the Norwegian children attend kindergartens or preschools. As they are not ordinarily taught any letter knowledge in preschools, the majority of the children, have not acquired any reading skills at the time of the school start.

The children ranged in age from 6 years, 5 months to 7 years, 5 months, with an average of 6 years, 11 months. The approximate number of children in each preschool group was 11. Their mother tongue was Norwegian; children with foreign language background were excluded from the study.

Tests

The following six types of tests of phonological awareness were used in this order: rhyme recognition, syllable counting, initial-phoneme matching, initial-phoneme deletion, phoneme blending and phoneme counting. All of them were designed as group tests with only written response modes (pencil markings).

Rhyme recognition. The children were presented with a set of pictures of well-known objects. One picture was used as a target picture. The children had to select, among three alternative pictures, the one depicting a word which rhymed with the word on the target picture. The teacher presented orally each target word and the children's task was to mark the correct alternative. After two practice trials, with an assistant teacher present, eleven items were presented. A pilot test had shown that each picture included in the test was correctly interpreted and was given the intended verbal label by children in the tested age group. The reliability of the test (split half with Spearman-Brown correction) was 0.92. However, when children with maximum score were excluded, the reliability was estimated to be 0.65.

Syllable counting. The syllable-counting test consisted of 16 items. At each item a picture was presented depicting an easily recognized word. The children's task was to count the number of syllables in the word and mark each syllable by a pencil stroke in an empty box below the picture. For example, the word 'telephone' should be marked with 3 strokes. Before the proper testing, four practice items were presented. The experimenter pronounced the practice words by strongly emphasizing each syllable and simultaneously marking them by clapping the hands. The test words, however, were pronounced in a normal way without particular stress on the syllables. The number of syllables varied from 1 to 4 randomly distributed across the test. The reliability (split-half) of this test was 0.91.

Initial-phoneme matching. The children were presented with a row of three pictures and were asked to select the picture in the row which started with the same sound as was pronounced by the experimenter. Two practice examples were given, and the test had 10 different items. Both vowels and consonants were target phonemes and were pronounced not as letters but as sounds. The following sequence of phonemes was used: [m, s, a, e, v, f, b, ʃ, l, f]. The split-half reliability of the test was 0.76.

Deletion of initial phonemes. The child was first presented with a row of three pictures. The experimenter pronounced a word and told the children that, if the first sound of this word was deleted, one of the pictures would match the resulting word (for example, rice – ice). Two practice examples clarified the task. The test included 10 items. The following sequence of initial consonants was used: [f, k, t, ʃ, b, b, m, s, r, b]. The reliability of the test (split-half) was 0.70.

Phoneme blending. Once again, the children were presented with a row of three easily interpreted pictures. The experimenter pronounced isolated phonemes with an interval of about 1/2 sec between successive sounds. The children were asked to select the picture which matched the resulting word. Two practice trials were given. The main test included 10 items. The length of the words varied from two to four segments and were randomized across the sequence of items. Great care was taken to ensure that all children attended to the task across all trials. The split-half reliability of the test was 0.68.

Phoneme counting. The phoneme-counting test had a format similar to the syllable test. The task now, however, was to segment words into phonemes and count the number of them. Each word was presented with an easily recognized and unambiguous picture. The experimenter read the word with normal speed and articulation, and the children marked the number of phonemes by pencil strokes in an empty box below the picture. The test consisted of six items. The number of phonemes varied from two to four. Split-half reliability of this test was 0.67.

RESULTS

Table 1 presents means and standard deviations of the subtests. The first column gives the maximum score on each test. Obviously, there is a marked

Table 1. Descriptive data on test scores from Study 1

Test	Max. score	Mean	SD	Skewness
1. Rhyme recognition	11	10.04	1.55	–1.947
2. Syllable counting	16	13.31	3.42	–1.558
3. Initial phoneme matching	10	8.68	2.28	–2.321
4. Initial phoneme deletion	10	6.63	2.63	–0.832
5. Phoneme blending	10	7.82	2.48	–1.699
6. Phoneme counting	6	3.36	2.08	–0.049

ceiling effect on all subtests. In Figure 1 histograms of the score distribution for each task is displayed.

Skewed distributions were expected since the tasks were also designed for screening purposes, where the main focus is on the low scores. However, the consequences for further analyses of the underlying structural relations were not considered to be serious, especially since all subtests showed about the same amount of skewness, and the fact that the method used for structural analysis (principal component analysis) is robust to deviations from normality.

The intercorrelations between the tests are shown in Table 2. Significant correlations were mainly obtained within the group of subtests involving demands on the phonemic level.

In order to further examine the underlying structure, a principal component analysis was performed, using varimax orthogonal rotation. Table 3 presents the results after rotation. A 3-factor solution gave a clear and easily interpreted structure. On the first factor, strong loadings were obtained for 'phoneme blending', 'phoneme deletion', 'initial-phoneme matching', and 'phoneme counting'. No doubt, this is a clear phoneme factor. This factor accounted for 38.6% of the variance observed.

On the second factor, only one strong factor loading was observed, i.e. 'syllable counting' with a loading of 0.89. To some extent, also 'initial-phoneme matching' loaded on the second factor (0.41), but its main loading was undoubtedly on the first factor (0.73). Thus, factor 2 may be interpreted as a syllable factor, accounting for 18.4 of the variance. Finally, the third factor had also only one strong loading which in that case refers to 'rhyme recognition' (0.94), accounting for 17.6% of the variance observed. The small amount of variance accounted for by rhyme task might be due to the fact that it was measured with a very small number of trials.

DISCUSSION

In summary the principal component analysis of the test battery on phonological awareness in preschool yielded three clear factors, a phoneme factor, a syllable factor, and a rhyme factor. This structure is in agreement with that

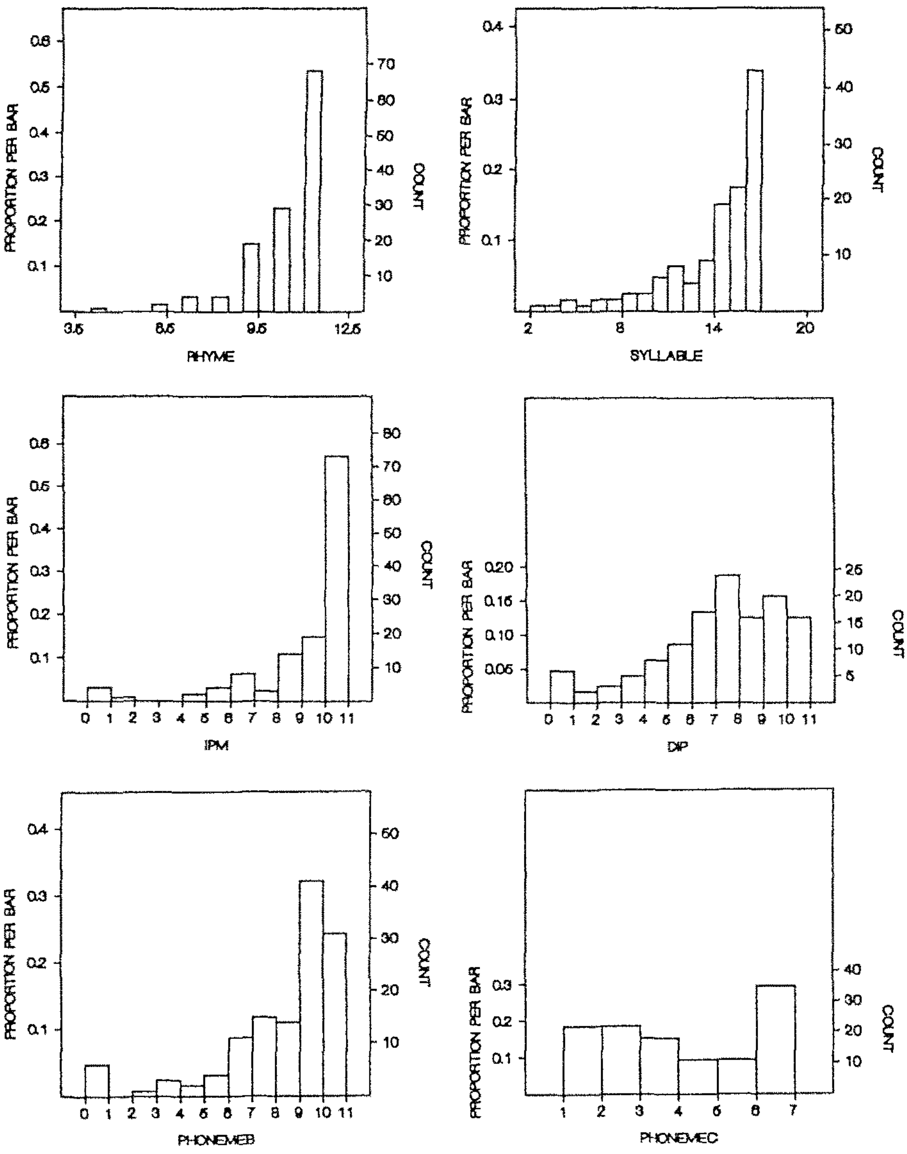

Figure 1. Histograms of the score distribution for each task employed.

reported by Lundberg et al. (1988). The unique characteristic of phonemic awareness and its emergence as a distinct factor within the domain of phonological sensitivity may be related to the fact that phonemes as basic linguistic units are not explicit control units in speech perception or speech production in the same way as syllables and word-units. They are rather abstract and elusive and seem to require special attentional resources to be grasped

Table 2. Intercorrelation among tests in Study 1

Test	1	2	3	4	5	6
1. Rhyme recognition						
2. Syllable counting	0.121					
3. Initial phoneme matching	0.159	0.179				
4. Initial phoneme deletion	0.218	0.094	0.512			
5. Phoneme blending	0.177	–0.010	0.498	0.506		
6. Phoneme counting	0.200	–0.010	0.189	0.436	0.545	

For correlations above 0.17, $p < 0.05$.

Table 3. Rotated factor loadings for the phonological tasks

	Factor		
	1	2	3
1. Rhyme recognition	0.112	0.135	<u>0.937</u>
2. Syllable counting	0.019	<u>0.888</u>	0.134
3. Initial phoneme matching	<u>0.732</u>	0.412	–0.111
4. Initial phoneme deletion	<u>0.793</u>	0.125	0.121
5. Phoneme blending	<u>0.845</u>	–0.110	0.099
6. Phoneme counting	<u>0.652</u>	–0.312	0.349

(Liberman & Liberman 1990). This study indicates that a considerable number of preschool children without any formal reading instruction and with very limited informally acquired reading skill are able to deal with phonemes as explicit linguistic units. This has also been reported by Lundberg & Høien (1990).

The results reported in Study 1, although suggestive, certainly require cross-validation. Once a clear structure of the domain of phonological awareness has been established, a critical step of external validation involves an examination of the possible differences between the factors in the ability to predict reading skill. A well grounded hypothesis is that the phonemic factor has a much stronger predictive power than the syllable and the rhyme factor. Phonemic awareness seems to be the essential element in grasping the alphabetic principle. The next study to be reported involves a test of the hypothesis on the differential predictive power of the factors by studying a sample of children who have started school. The number of subjects in this study is also far greater than in earlier studies in the field. The invariance of the structure found in study 1 is also examined by modifications of the task. If the same, invariant structure emerges in a new sample of subjects at a higher stage of literacy development and with a number of task modifications, one could safely conclude that the structure proposed in study 1 is a stable and valid specification of subdomains within the field of phonological awareness.

STUDY 2

In Study 2 we sought converging evidence for the conclusions of Study 1. This study involved a much larger sample size than that in Study 1 (in fact, a sample far larger than that utilized in other studies of this type). Several of the tasks were slightly modified, as we applied a test battery constructed for first-graders. Thus, this study examined whether the factor structure observed in Study 1 would replicate with older subjects and would be robust across slight changes in task requirements. Because the children in this study had started school we were able to assess early reading skill. This allowed us to investigate differences between factors in the ability to predict reading skill. Differences in predictive validity among the factors may provide additional evidence for the conceptual differentiability of the factors.

METHOD

Subjects. In the second study, a total of 1509 children (799 girls and 710 boys) were included. They were recruited from five different communities in the southern part of Norway. No obvious socio-economic or demographic bias characterized these communities. All children attended the first grade in school, and, at the time of the investigation, they had about 9 months of school experience. They ranged in age from 7 years, 4 months to 8 years, 4 months, with an average of 7 years, 10 months. Less than 3 percent of the children had immigrant backgrounds. The approximate number of students in each class was 18.

Tests

The tests used for this sample of children were similar to the tests used for the 6-year-olds. Some of the modifications and additions are described below. Since the children had attended school for almost 9 months, it was now also possible to assess their word-reading skill. During all test sessions an assistant teacher participated, helping children who needed more instruction. For each test at least two practice examples were given.

Rhyme recognition. The rhyme test at this stage had 5 items. The format was slightly changed compared to the preschool test. Instead of an orally presented target word the children had only access to a picture target to be matched with one of the three alternative pictures in the main row according to the rhyming criterion. The distractors were semantically but not phonologically related to the target word. Only monosyllabic words were used as targets. The split-half reliability of the test was 0.88, which is probably an overestimation. The reduced number of items in comparison with the rhyme test used in Study 1, would lead us to suspect a reliability below 0.65.

Syllable counting. The same format as in the first study was used. However, the number of items was reduced from 16 to 11 items. The experimenter read the target words aloud to the children, who also had a picture of the word available. Pilot studies had shown that almost all children interpreted all pictures correctly. The number of syllables to be counted varied from 1 to 4, randomly distributed across the test. The split-half reliability of this test was 0.83.

Phoneme counting. Here, the number of items was increased from 6 to 11. The format was the same as in the syllable-counting test with a pictured target word read aloud by the experimenter and the task to count the number of phoneme segments in the word. The first four items in the test included only mono-syllabic words with two or three phonemes. The remaining items included four to six phonemes in words with one or two syllables. The split-half reliability was 0.85.

Identification of initial phonemes. In the first study, the task in the initial-phoneme test was to match words with the same initial sound. Here, the children were requested to identify the first phoneme of a total of 12 words. Since they had attended school for almost 9 months, the children could all be expected to be able to write most letters of the alphabet with accuracy and automaticity. This fact was used when selecting a feasible response mode in a group setting. Thus, while the children listened to a word which was read by the experimenter and was available pictorially, they simply had to identify the first sound and to write down the corresponding letter in a box adjacent to the picture. The following phonemes were used as targets: [e, f, i, k, l, n, a, d, p, v, h, b]. Split-half reliability was 0.90.

Identification of final phonemes. Here, the format was exactly the same as in the initial-phoneme task with the only exception that the children instead of listening to the first sound had to identify the final phoneme of a set of 12 words. The following target phonemes were used: [o, r, m, y, k, l, t, p, e, n, g, v]. Most words were mono-syllabic. The split-half reliability of the test was 0.89.

Blending of phonemes. The number of items of this task was reduced from 10 to 6 items as compared to the preschool version. To decrease the guessing risk, four alternative pictures were used as basis for response selection. The experimenter presented the target word by pronouncing it phoneme by phoneme with intervals of about 1/2 sec between successive segments. The task was to blend the phoneme sequence and find out which one of the four alternative pictures contained the target word. The number of phonemes varied from 2 to 5. The split-half reliability of this test was 0.75.

Word-picture matching. Two word-reading tests were given. The first one included 18 words printed in lower case with a letter size of 6 mm. Each word was included in a box. To the right of each word box, a row of four pictures was arranged. The children's task was to read the printed words silently and mark the matching picture. The total time for the test was set to 4 minutes, and the performance score was the number of correctly marked alternatives within this time period. All words were high-frequent, concrete words which could be illustrated in an unambiguous way. One of the distractors was semantically similar to the target word and one was phonologically similar. Split-half reliability was 0.91.

Picture-word matching. The second reading task was the reverse of the first one. Now, a picture was presented accompanied by four alternative words printed in a row of boxes to the right of the picture. The children's task was to find the matching word. The number of items in this test was 11, and the time was set to 2 minutes. The experimenter carefully controlled that the children made a pencil mark at the item reached when the stop signal sounded. They were then free to complete the test. Split-half reliability was 0.94.

RESULTS

Table 4 presents the maximum scores, the means and the standard deviations of the tests used in Study 2. As in Study 1 clear ceiling effects were obtained. The amount of variance is, however, clearly sufficient to justify further analyses.

The intercorrelations between the six phonological awareness tests are presented in Table 5. Due to the large number of subjects all correlations are highly significant ($p < 0.001$). As in Study 1 the highest correlations were seen between the phonemic tests.

The rotated loadings based on a principal component analysis of the six phonological awareness tests are presented in Table 6, accounting for 38.7% of the variance observed. The similarity with the earlier structure is striking.

Table 4. Descriptive statistics of test scores in Study 2

Test	Max. score	Mean	SD	Skewness
1. Rhyme recognition	5	4.69	0.88	–3.380
2. Syllable counting	11	8.12	2.96	–0.875
3. Phoneme counting	11	9.11	2.75	–1.702
4. Initial phoneme identification	12	11.69	1.21	–5.691
5. Final phoneme identification	12	11.46	1.55	–4.660
6. Phoneme blending	6	5.84	0.67	–5.916
7. Word-picture	18	16.98	4.81	–3.844
8. Picture-word	11	9.79	2.24	–2.312

Table 5. Intercorrelations between the six phonological awareness variables in Study 2

Test	1	2	3	4	5	6
1. Rhyme recognition	1.0					
2. Syllable counting	0.184	1.0				
3. Phoneme counting	0.205	0.123	1.0			
4. Initial phoneme id.	0.294	0.213	0.363	1.0		
5. Final phoneme id.	0.227	0.179	0.348	0.699	1.0	
6. Phoneme blending	0.266	0.143	0.265	0.464	0.502	1.0

For all correlations $p < 0.001$.

Table 6. Roatated factor loadings for the six phonological awareness tests in Study 2

	Factors		
	1	2	3
1. Rhyme recognition	0.177	0.103	0.959
2. Syllable counting	0.104	0.984	0.090
3. Phoneme counting	0.550	–0.036	0.259
4. Initial phoneme identification	0.840	0.157	0.098
5. Final phoneme identification	0.875	–0.113	–0.004
6. Phoneme blending	0.710	0.038	0.166

The first factor had only strong loadings from the four phonemic subtests, using orthogonal rotation with varimax criterion. The second factor had only a syllable loading which was remarkably strong (0.98), accounting for 17.0% of the variance. The third factor was clearly a rhyme factor, accounting for 17.1% of the variance observed. Thus, exactly the same structure as in Study 1 emerged.*

A principal component analysis of the two word-reading tests revealed that both tests had the same loadings on the common component (0.80). The factor scores based on this word-reading factor were used as the dependent variable in a simultaneous regression analysis with the three phonological factors as independent variables. The results are presented in Table 7.

The multiple correlation was 0.58 which explains about one third of the variance in word reading. Apparently, there are aspects over and above phonological awareness that contribute to success in early reading acquisition. Still, the contribution from phonological awareness is substantial.

The expected primacy of the phoneme factor was confirmed. It explains far more variance than the other two factors. However, it is still clear that

* The independent, non-hierarchical relations between the factors demonstrated by the cross-tabulations in Study 1 were also observed in Study 2.

Table 7. Multiple regression analysis with the word-reading factor as dependent variable and the phonological awareness factors as predictors

Predictor	beta weight
Phoneme factor	0.546***
Syllable factor	0.136***
Rhyme factor	0.143***

Multiple R = 0.581, R_2 = 0.338
*** = $p < 0.001$.

the syllable factor as well as the rhyme factor contribute significantly to an explanation of the variance in reading achievement.

The predictive power of the phoneme factor might be worth a closer analysis. Are there any differences among the subtests within the phonemic factor? Table 8 examines this question. Here the simultaneous regression analysis demonstrated significant contributions from all subtests. However, the strongest predictors were the two tests requiring phoneme identification (initial-phoneme identification, 0.25 and final-phoneme identification, 0.27).

The picture did not change when all subtests of Study 2 entered a multiple regression. The beta weights for rhyme recognition and for syllable counting in the simultaneous regression analysis were low but significant. The two phoneme identification tasks were still the dominant predictors.

Study 2 replicated and extended the findings from Study 1. Despite changes in the subject sample and modifications of the tasks, the same factorial structure emerged. Study 2 also yielded an external validation of the findings of Study 1. Specifically, Study 2 demonstrated that the various tasks were independent predictors of word recognition.

GENERAL DISCUSSION

The two studies reported here support the view that there are different components of phonological awareness corresponding to the different levels of

Table 8. Multiple regression analysis with factor score on word reading as dependent variable and the various subtests involved in the phonemic factor as predictors

Predictor	beta weight
Phoneme counting	0.135***
Initial phoneme identification	0.252***
Final phoneme identification	0.269***
Phoneme blending	0.061*

Multiple R = 0.581, R_2 = 0.338
* = $p < 0.05$; *** = $p < 0.001$.

language analysis required by the task. Individual differences across the levels of language analysis in the tasks utilized in these experiments (rhymes, syllables, and phonemes) were relatively uncorrelated. Furthermore, it was demonstrated in Study 2 that the three components of phonological awareness were separate predictors of early word decoding ability.

Syllable awareness appears to be the component of phonological awareness that is most clearly separable. In both studies, performance on the syllable counting task was nearly independent of performance on the rhyme and phonemic awareness tasks. Although syllable counting did survive as an independent predictor in the regression analysis in Experiment 2, it was clearly the weakest predictor. Furthermore, the unique variance that it explained was quite small and attained significance only because of the extremely large size of the sample. Awareness of syllables appears to develop earlier than phonemic awareness (Fox & Routh 1975; Leong & Haines 1978; Liberman et al. 1974; Treiman & Baron 1981), but it is only weakly related to phonemic awareness and it is of marginal usefulness as a predictor of early reading development if tasks at other levels are available.

Not surprisingly, phonemic awareness proved to be a much more potent predictor of early reading acquisition. Phonemic awareness explained a considerable amount of unique variance after individual differences in rhyme and syllable awareness were partialed out. Because of the size of our sample, we were able to examine relative differences in the predictive power of different types of phonemic awareness. In the regression analysis reported in Table 8, the initial-phoneme matching task and the final-phoneme matching task were by far the most potent predictors. These variables attained beta weights of 0.252 and 0.269, respectively and explained 13.6 percent unique variance even after rhyme performance, syllable counting, and two other phonemic awareness tasks had been entered into the regression equation. The potency of the phoneme identification tasks as a predictor is consistent with the work of Byrne & Fielding-Barnsley (1991) which indicates that the recognition of phoneme identity is more important than phoneme segmentation in early reading acquisition.

Our findings regarding performance on the rhyme task are consistent with the theoretical arguments of Goswami & Bryant (1990) and with the results of the small-scale study by Bryant et al. (1990). In both of our studies, rhyme emerged as a factor separate from syllable and phoneme awareness. Furthermore, in the simultaneous regression analysis, rhyme remained a significant predictor when all of the other variables were in the equation and its beta weight was larger than that for syllable counting. All of these findings are consistent with the arguments of Goswami & Bryant (1990) that rhyming ability is a separable component of early reading skill and that it accounts for reading variance over and above that accounted for by phonemic analysis skills. Nevertheless, it should be noted that rhyme performance was nowhere near as important a predictor as performance on the phoneme tasks. In the simultaneous regression analysis reported in Table 9, two phonemic aware-

Table 9. Multiple regression analysis with factor score on word reading as dependent variable and all subtests of phonological awareness as predictors

Predictor	beta weight
Rhyme recognition	0.092***
Syllable counting	0.022**
Phoneme counting	0.46***
Initial phoneme identification	0.187***
Final phoneme identification	0.174***
Phoneme blending	0.068*

Multiple R = 0.590, R_2 = 0.338
* = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$.

ness tasks had larger beta weights (0.187 and 0.174, respectively) than that for the rhyme task (0.092). This was true even though there were four phonemic tasks in the equation, each potentially stealing variance from each other. Thus, while a unique role for rhyming skills in early reading acquisition is indicated, phonemic awareness appears to be more tightly interwined with the earliest stages of reading acquisition. An internal analysis of the latter factor pointed strongly to the recognition of phoneme identity as the key aspect of phonemic awareness (see Byrne & Fielding-Barnsley 1991 for further discussion and converging evidence for this conclusion).

In summary, it has been known for some time that phonological processes, broadly-defined, are related in important ways to reading acquisition and to reading disability. Recently, however, micro-analyses of the internal structure of the phonological factor appear to be converging on a coherent picture of which aspects of phonological processing are critical. Both studies of young, normally achieving children (Wagner et al. 1993; Wagner et al. 1994) and studies of older disabled readers (Pennington et al. 1990) have given consistent indications that phonological awareness is a separate factor from naming speed and phonological short-term memory (see also Bowey, Cain & Ryan 1992; Hansen & Bowey 1994). Further, the phonological awareness factor seems itself to yield the separable components of syllabic, rhyme, and phonemic awareness. The latter two are the most potent predictors of early reading acquisition, with phonemic awareness being of particular importance. Finally, of the various tasks that indicate phonemic awareness, phoneme identity measures seem to have a unique status as predictors.

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