Applied Psycholinguistics 11 (1990), 237–252
Printed in the United States of America

Rhyme, language, and children's reading

PETER BRYANT, MORAG MACLEAN, and LYNETTE BRADLEY
University of Oxford

ADDRESS FOR CORRESPONDENCE
Peter Bryant, Department of Experimental Psychology, University of Oxford, South Parks Road, Oxford OX1 3UD, England

ABSTRACT
It has been shown that there is a strong relation between children's phonological skills and the progress that they make in reading. But there is some uncertainty whether this is a specific connection or whether it is just a byproduct of variations in general language ability. We report evidence from a longitudinal study showing that the relation between children's sensitivity to rhyme and alliteration and their success in reading is highly specific and cannot be accounted for in terms of general language ability. In this study measures were taken of a group of children's linguistic and metalinguistic skills when they were 3 and 4 years old. The linguistic measures were of the children's vocabulary, their receptive and expressive use of grammar, and their ability to imitate sentences. The metalinguistic measures were of their ability to detect rhyme and alliteration and of their awareness of syntax. Two to three years later, when the children were 6;7, we measured their progress in reading and spelling. The children's rhyme and alliteration scores were related to their reading two years later even after controls for differences in linguistic skills and also for differences in intelligence and in social background. The other metalinguistic task – syntax awareness – did not predict reading after these controls. Awareness of rhyme, we argue, makes a distinctive contribution to reading by helping children to form spelling categories.

Preschool children are reasonably good at producing rhymes and at detecting whether words rhyme or not (Chukovsky, 1963; Dowker, 1989; Lenel & Cantor, 1981; MacLean, Bryant, & Bradley, 1987). Their ability to do so is interesting for two reasons. First, it demonstrates that preschool children can analyze the constituent sounds in words. If they understand that *cat* and *hat* rhyme, they recognize that these two words have a speech segment – the rime /at/ – in common.

The second reason why young children's rhyming abilities deserve attention is that there is a powerful connection between these abilities and the progress that children make later on when they learn to read and write. The performance of 3-, 4-, and 5-year-old children, who cannot yet read, in tests of sensitivity to rhyme and alliteration predicts their success in learning to read over the next three to four years even after controls for differences in

intelligence, vocabulary, and social background (Bradley & Bryant, 1983, 1985; Bryant, MacLean, Bradley, & Crossland, 1990; Ellis & Large, 1987; MacLean et al., 1987). Furthermore, this connection is a specific one. The children's early rhyme scores predict their progress in reading and spelling later on but not in arithmetic (Bradley & Bryant, 1983; MacLean et al., 1987).

One possible reason for a connection between rhyme and reading is that children's experiences with rhyme allow them to form categories of words that share common sounds, and that later on they make a connection between these categories and words that share common spelling patterns. The knowledge that *light, fight,* and *might* rhyme might help children grasp the fact that the words share a common spelling sequence as well as a common rhyme. There is evidence that children do link rhyming categories with spelling categories as soon as they begin to learn to read and spell (Goswami, 1986, 1988).

The fact that measures of sensitivity to rhyme, taken before children learn to read, predict their progress in reading suggests a causal connection. The idea of a causal link is supported to some extent by the discovery that training in rhyme does have a beneficial effect on reading (Bradley & Bryant, 1983). However, it is always possible that a predictive relationship might not be a causal one: the relationship might be due to the fact that both the predicting and the predicted variables are determined by some other, unknown, and therefore unmeasured, factor.

Recently Bowey and Patel (1988) made the interesting suggestion that children's general language abilities might determine both children's sensitivity to rhyme and also their reading performance. They ran a correlational study with 60 children whose average age was 6 years. They gave these children an oddity rhyme and alliteration test based on the one used by Bradley and Bryant (1983). They also gave the children a syntactic awareness task, in which they had to "detect and correct" mistakes in ungrammatical sentences that were read to them. Bowey and Patel refer to the rhyme and alliteration tests and the syntax awareness task as "metalinguistic" tasks, since both involve a degree of awareness to an aspect of language. As well as this, the children were given two standardized linguistic tests, one a test of vocabulary (the well-known PPVT) and the other a sentence imitation test (a subtest of TOLD-P) in which they had to repeat a set of sentences of increasing semantic difficulty. Bowey and Patel also gave the children a standardized reading test. They did not measure the children's IQ.

The experimenters found a significant relationship between the two metalinguistic tests, rhyme and syntactic awareness, and the children's reading levels. But they also showed that this relationship was no longer significant when the effects of differences in the children's performance in the two linguistic tasks, vocabulary and sentence imitation, were partialled out. On the other hand, these two linguistic tests were significantly related to the children's reading comprehension even after differences in the two metalinguistic tasks were controlled. Bowey and Patel concluded that the most important variable here was the children's general language ability, as mea-

sured by the two linguistic tests, and that this factor controlled the children's rhyming and syntactic abilities as well as their success in reading.

Bowey and Patel's data are extremely valuable and interesting, but they need to be extended. The children in Bowey and Patel's study were relatively old, and the study was not a longitudinal one. In studies that have shown a connection between rhyme and reading, the rhyme measures were given when the children were 3, 4, or 5 years old. There is also evidence from two studies (Lundberg, Frost, & Petersen, 1988; Stanovich, Cunningham, & Cramer, 1984) that by 6 years the relationship between scores in a rhyme task and in reading tests tends to be low. So it is quite possible that tests of rhyme given to 4-year-old children would continue to predict children's reading later on, even after the stringent controls for general language ability which are quite rightly advocated by Bowey and Patel.

We needed a study that measured children's sensitivity to rhyme (and also their ability to correct and detect mistakes in ungrammatical sentences) at an earlier age (say 4 years), which included measures of IQ and of social background, and which, pace Bowey and Patel, introduced a wide range of language measures including standardized tests of the children's receptive and expressive language, of their ability to understand sentences of varying grammatical complexity, and of their ability to imitate sentences.

We now report a longitudinal study of 65 children, which included all these tests as well as measures of the children's progress in reading and spelling over the following two years.

METHODS

Subjects

Ages. There were 66 children in this project, but we shall report data on 65. One child left the country halfway through the project. All but one of the children came from native English-speaking backgrounds. The exception was a boy whose mother is Swedish; although English is the language spoken in his home, he knew a certain amount of Swedish as well.

At the time of the first tests that we shall report, the average age of the 65 children (31 boys, 34 girls) was 3;4 (*SD* = 2.8 months; range = 2;10–3;9). We shall report data over a period of 3 years; when the last measure was taken, the average age of the 64 children was 6;7 (range 5;9–6;10).

All the children were at school by the time the project ended. In all, the children were distributed over 28 different schools. The practices involved in teaching reading varied between schools and even between different classrooms in the same school. However, on the whole the teachers adopted a mixture of "phonic" and "whole word" approaches in teaching children how to read words.

Intelligence levels. At 4;3 the children were given the full WPPSI. The mean IQ was 111.1 (*SD* = 12.31). At 6;7 (range = 6;2–7;1) the children were

given the short version of the WISC/R either just before or just after the final session. The four subtests given were Similarities, Vocabulary, Block Design, and Object Assembly. The mean IQ was 112.2 (SD = 16.49).

Social background. The children came from a wide range of backgrounds. Our measures of the home background included social class and the educational level of the parents. We decided to use mothers' educational level as our main measure of the children's background. We could not use social class because the project included several single-parent (mother) families to whom we decided not to apply the social class index because it is based on the father's occupation.

PROCEDURE

The data for this article come from a longitudinal study of the 65 children, which started when their mean age was 3;4 and finished when it was 6;7. Parts of this study have been reported in other papers (Bryant et al., 1990; Kirtley, Bryant, MacLean, & Bradley, 1989; MacLean et al., 1987). We shall report data from six sessions, when the children were 3;4, 3;5, 4;5, 4;7, 4;11, and 6;7.

In the first five of these sessions, we measured the children's linguistic abilities, and also their sensitivity to rhyme and alliteration and their awareness of syntax. In the last session we measured their reading and spelling levels.

We shall describe the three kinds of measures – of linguistic ability, of metalinguistic skills (rhyme, alliteration, and syntax awareness), and of reading and spelling levels – separately.

Linguistic measures

Vocabulary. When the children were 3;4, we administered the British Picture Vocabulary Scale (BPVS; the most modern British version of the Peabody Picture Vocabulary test, it is standardized in Britain). The mean ratio score for the group on the BPVS was 104.7 (SD = 12.68). The average for the population was 100.

Expressive and receptive language. One month later we administered the Reynell Developmental Language Scale (Reynell, 1983). This test assesses expressive language and receptive language (verbal comprehension) separately.

In the expressive part of the test, the child has to talk about scenarios acted out with toys or about scenes in pictures. For example, the child sees a boy who is sitting by a table being knocked off his chair and has to say what happened. The child's responses are scored in terms of their grammatical sophistication (the use of pronouns, prepositions, and tenses).

The receptive scale requires no speech from the child. The child is given

some toys and has to respond to sentences of increasing difficulty about them. An example of a simple sentence is "Where is the chair?" In a slightly more complex question, "Which one do we cut with?", the child has to choose from a bed, chair, pot, pen, and knife. A difficult sentence is "Put one of the little pigs beside the man."

The mean standardized Expressive score was 0.937 (SD = 0.797) and the mean Receptive score was 0.988 (SD = 0.863). The average standardized score for the population was 0 in both cases.

Sentence imitation. When the children were 4;11 we gave them a sentence imitation task. We read out a series of 12 sentences of increasing complexity, beginning with "Dave likes cars" and ending with "Tom drank his milk because he likes to play with Bart when he's home." Our instructions to the child were: "I want you to say just what I say." This task was based on one devised by Jorm, Share, Maclean, and Matthews (1984) and differed from their task in one detail only. We substituted the sentence "He drank a glass of cold milk" for "He drank a glass of cold beer" because our children were younger than those tested by Jorm and colleagues and might have been less familiar with beer. The mean score in this task was 7.0 (SD = 2.12).

Metalinguistic measures

Rhyme and alliteration oddity tasks. In the session when the children were 4;7 we gave them a version of the rhyme oddity task that was used in a previous study (Bradley & Bryant, 1983). Before the trials began, we asked the children if they knew the nursery rhyme "Jack and Jill" and recited the first two lines: "Jack and Jill went up the . . . yes *hill, Jill, hill*, they sound the same, they rhyme, can you tell me another word that sounds like *hill*? . . . *fill*. Now we're going to play a game about words that sound the same, about words that rhyme."

In the test proper we used pictures in order to remove the memory load. This was necessary because each trial involved three words. The rhyme test consisted of two practice trials and then ten experimental trials. In each trial the child was given three words with pictures, two of which rhymed while the third did not (e.g., *peg, cot, leg; fish, dish, book*). The children's task was to tell us the one that did not rhyme. Their mean scores were 6.22 (SD = 2.63) out of 10 in this test (chance level = 3.33).

We also measured the child's sensitivity to alliteration using the same methods. The children had to judge which of three words began with a different sound (e.g., *pin, pig, tree*). The children's mean scores were 6.53 (SD = 2.44) in this alliteration oddity test.

Syntax awareness. Our task was a slight adaptation of one developed by Tunmer, Nesdale, and Wright (1987), and it was very similar to the task used by Bowey and Patel. The children were told "I've got some puppets here who haven't quite learned how to talk properly. What they say is wrong. I want you to show them what to say." They were then introduced to one puppet who produced eight sentences (two of which were practice items) in which

there was a missing morpheme. Two such sentences were "Andrew drink juice every day" and "Sandra is paint a picture." After that they were introduced to another puppet who produced eight sentences in which the word order was incorrect (e.g., "Patted Bill the dog" and "Susan the bike rode").

Each trial was scored as correct or incorrect. We adopted Tunmer and colleagues' "strict" procedure. For example, for "Sandra is paint a picture" we accepted "Sandra is painting a picture" as correct, but judged "Sandra paints a picture" as incorrect because in this case the child did not produce the correct missing morpheme.

The missing morpheme questions were a great deal easier than the jumbled order questions. The mean scores for the two sets of questions were respectively 47.25% correct (*SD* = 26.86) and 31.57% correct (*SD* = 25.50). One possible reason for this difference is that the jumbled order questions make particularly difficult demands on the children's memory. We decided to combine the scores for the missing morpheme and jumbled order sentences for two reasons. One was that the distribution of the combined score was much nearer normality than the two separate scores. The second was that each of the separate scores was only based on six trials, and we felt that this was not a sufficient base for a predictive test. The mean combined score was 37.05% correct (*SD* = 25.60). Bowey and Patel combined missing morpheme questions with other questions in their test and used a combined score in their analyses.

Reading

When the children had a mean age of 4;5 (i.e., 2 months before we gave our first metalinguistic tests), we gave them some words to read to check whether any of them were precocious readers. The standardized reading tests were plainly too difficult to be appropriate, and so we gave the children twelve simple, highly frequent words to read. The words were: *on, the, car, dog, and, my, girl, was, boy, you, put.* Only 13 children could read any words at all. Of these, 5 could read one word only, and 8 could read three words or more.

In the final session (age 6;7) we gave the following three standardized tests:

1. France Primary Reading Test: a multiple choice test with 48 items arranged in ascending difficulty to assess the understanding of words and simple sentences. The items that involve sentences depend on the child understanding the meaning of these sentences, and so this test measures the child's comprehension as well as his or her ability to read single words. The group's mean reading age on the test was 7;6 (*SD* in months = 17.24).
2. Schonell Graded Word Reading Test: involved reading single words. The group's mean reading age on the test was 7;2 (*SD* in months = 15.27).
3. Schonell Spelling: tested spelling, using Form A. The group's mean spelling age on the test was 6;4 (*SD* in months = 14.4).

RESULTS

Correlations

Our first step was to check that the individual phonological and linguistic tests that we gave the children in the first half of the project were related to their reading and spelling level at the project's end and to look at the other correlations between the different variables. Table 1 gives the correlation matrix. The table shows several interesting patterns.

First, the relations of the language measures, and particularly of the Expressive and Receptive (Reynell) scores, to the metalinguistic measures are quite high. This supports Bowey and Patel's suggestion that the metalinguistic tests may be no more than a measure of language proficiency.

The second interesting point is that the correlations between the metalinguistic variables and the reading/spelling measures were appreciably higher than the relationships between the language measures and reading and spelling. The correlations between the metalinguistic measures and reading and spelling varied in size from .63 to .80. The correlations of the language measures with reading and spelling ranged from .31 to .59. The relative strength of these correlations suggests that rhyme and alliteration should be related to reading and spelling even after controls for differences in the children's scores in the other linguistic tests.

Third, there is the question of whether the linguistic and the metalinguistic scores measure the same thing as intelligence tests. It should be noted that the two IQ scores correlate well with both kinds of measure, and with the reading and spelling scores as well. Thus, any relationship between the linguistic or metalinguistic measures and reading could be attributed to the variance that the linguistic and metalinguistic variables share with intelligence. As a result, it is essential to carry out fixed order multiple regressions that partial out the influence of differences in intelligence before charting the relationship between the linguistic and metalinguistic scores and reading.

Multiple regressions

Our next question was whether the children's early rhyme and alliteration scores and their performance in the syntax awareness test would predict their reading and spelling levels later on, even after the effects of differences in general linguistic ability had been partialled out. We ran two sets of multiple regressions to see whether this relation was significant.

Regressions without the social background and IQ scores. The regressions in the first set were very similar to the ones run by Bowey and Patel. They did not enter IQ or social background into their regressions and nor did we in this first set, which is presented in Table 2. The first five steps in all of these regressions were the same. We simply entered the children's age as the first step, and then we entered our four measures of general linguistic ability as the next four steps. The sixth and final step in each regression was one of the three metalinguistic measures – rhyme, alliteration, or syntax awareness.

Table 1. *Correlations between the main variables in the study*

	Wp	Ws	Voc	EL	RL	SI	SA	Al	Rh	R-F	R-S	Sp
Mother's education	.62	.47	.43	.58	.50	.44	.65	.53	.59	.63	.58	.61
WPPSI (WP)		.71	.35	.64	.57	.43	.66	.66	.58	.71	.67	.66
WISC (WS)			.33	.47	.40	.34	.59	.60	.59	.67	.68	.67
Vocabulary (Voc)				.38	.31	.34	.45	.29	.31	.45	.41	.39
Expressive language (EL)					.70	.48	.64	.55	.52	.59	.55	.47
Receptive language (RL)						.50	.59	.36	.44	.46	.40	.34
Sentence imitation (SI)							.57	.51	.45	.50	.51	.45
Syntax awareness (SA)								.59	.53	.63	.63	.63
Alliteration (Al)									.75	.77	.80	.73
Rhyme (Rh)										.69	.69	.64
Reading (France) (R-F)											.95	.84
Reading (Schonell) (R-S)												.89
Spelling (Sp)												

Table 2. *R^2 change in nine fixed order multiple regressions*

	Outcome measure		
Steps in regression	Reading France test	Reading Schonell test	Spelling Schonell test
Extraneous variables			
1. Age at test of reading	.003	.031	.039
Linguistic variables			
2. Vocabulary (BPVS)	.201***	.156***	.141**
3. Language (Reynell) expressive	.122**	.115**	.079*
4. Language (Reynell) receptive	.114**	.140***	.102**
5. Sentence imitation	.021	.030	.019
Final step			
6a. Final step rhyme	.144***	.152***	.149***
6b. Final step alliteration	.219***	.251***	.231***
6c. Final step syntax awareness	.046*	.062*	.120***

Note: In each regression the children's general language scores are entered before the metalinguistic score. Each of the three outcome measures is analyzed three times; in each analysis one of the three metalinguistic measures represents the final step.
*$p < .05$; **$p < .01$; ***$p < .001$.

There were three different outcome measures, or dependent variables, which were the children's scores in the France reading test, in the Schonell reading test, and the Schonell spelling test when they were 6;7. This meant that there were nine fixed order multiple regressions in all (three different final steps with three different outcome measures).

Table 2 shows that our results are similar to Bowey and Patel's in one way but different in another. The results of the two studies are similar in that the linguistic measures in both predict reading well. Bowey and Patel reported that their linguistic measures accounted for 41% of the variance in one reading test and 29% in another. Our linguistic measures were even more powerfully connected to reading. As Table 2 shows, they accounted for 45.8% of the variance in the France reading test and 43.1% in the Schonell reading test. Ours probably accounted for more variance because they covered a wider range of linguistic behavior. All the linguistic tests were reasonable predictors of reading. The fact that the Sentence Imitation scores did not account for a significant portion of the variance in reading is merely a result of our entering it as the last linguistic measure in the regression. In other regressions we entered it at an earlier stage and then it became significant.

However, when we consider the final step in each of the multiple regressions, we can see that our results were quite different from Bowey and Patel's. Table 2 shows that all three metalinguistic scores did predict reading even after differences in the children's general linguistic abilities had been partialled out. There is a strong connection between 4-year-old children's sensitivity to rhyme, to alliteration, and to syntax and their reading two years later, which cannot be explained away as a mere symptom of a more general linguistic ability.

Regressions with the social background and IQ scores. However, this first set of regressions did not include IQ scores or measures of differences in social background. So it is possible that the connections between some of our measures and reading could simply have been a byproduct of differences in these important but extraneous variables. We needed multiple regressions in which these variables were entered before either the linguistic or the metalinguistic measures. The second set of nine multiple regressions, which are presented in Table 3, took this form.

The regressions had two extra steps. The children's social background (measured by their mothers' educational level) was entered as the second step. In these regressions we treated mothers' educational level as a categorical and not a continuous variable. The children's IQ was entered as the third step. We had two IQ scores for the group – the WPPSI scores when they were 4;3 and the WISC scores when they were 6;7. We decided to use the WPPSI scores because the test was given in the early part of the project at the time of the other predictive measures. (Table 1 shows that the WPPSI and the WISC scores were equally strongly related to reading.) Otherwise, the multiple regressions were the same as before.

It can be seen from Table 3 that the presence of the social background and

Table 3. *R^2 change in fixed order multiple regressions in which social background and IQ are controlled as well as general language abilities*

Steps in regression	Outcome measure		
	Reading France test	Reading Schonell test	Spelling Schonell test
Extraneous variables			
1. Age at test of reading	.003	.031	.039
2. Mothers' educational level	.444***	.392***	.413***
3. IQ (WPPSI)	.178**	.198***	.158***
Linguistic variables			
4. Vocabulary (BPVS)	.008	.002	.000
5. Language (Reynell) expressive	.000	.000	.000
6. Language (Reynell) receptive	.016	.026	.007
7. Sentence imitation	.004	.009	.002
Final step			
8a. Final step rhyme	.048**	.056**	.034*
8b. Final step alliteration	.085***	.110***	.069***
8c. Final step syntax awareness	.001	.000	.000

*$p < .05$; **$p < .01$; ***$p < .001$.

the IQ measures in these regressions makes a striking difference in two ways. First, these two variables account for a large proportion of the variance. Second, the linguistic variables are no longer good predictors of reading and spelling. In fact, the vocabulary and the expressive and receptive language measures, which were significantly related to reading and spelling in the first set of regressions, now account for a tiny proportion of the variance in reading and spelling and fall far short of significance. So it seems that the previous connection between these linguistic measures and reading could simply have reflected differences in social background or in intelligence, since these variables were not controlled in the first set of regressions.

Exactly the same point can be made about one of the metalinguistic scores - syntax awareness. This was an excellent predictor of reading and spelling in the first set of regressions. In the second set it accounted for hardly any variance at all in the children's reading or in their spelling.

But our third point about these regressions is that the other metalinguistic measures - rhyme and alliteration - withstood the effect of partialling out differences in social background and IQ, as well as in general language abilities, extremely well. Even after controls for all these variables, both rhyme and alliteration accounted for a significant proportion of the variance in all three outcome measures. The children's alliteration scores were particularly powerful predictors of reading and spelling.

We should like to make a final remark about the second set of regressions.

The combination of the "extraneous variables" and the linguistic and metalinguistic measures accounts for an impressive amount of the variance in the children's reading and spelling. For example, the multiple regressions in which the final step was the children's alliteration scores accounted for 73% of the variance in the France reading scores, 78% in the Schonell reading scores, and 68% in the Schonell spelling scores.

Precocious readers and outliers. Our main concern in this article has been with the possible importance of the age at which the children's sensitivity to rhyme is tested. Our argument is that tests given in the preschool years are likely to be more powerful predictors of reading than tests given after children have reached school. However, this raises the question whether tests of rhyme and alliteration are a powerful predictor of reading when they are given only to children who cannot yet read. It is certainly important to check whether the powerful relationships that we have reported between the rhyme and alliteration measures and reading two years later would be the same if we confined our analysis to children who could not read at the time of the original rhyme and alliteration tests. So we ran further analyses in which we excluded children who, on the basis of the results of the simple reading test that we gave to the children when they were 4;5, appeared to be precocious readers at the time of the original tests of rhyme and alliteration.

As we reported earlier, 8 children could read three or more words in our first reading test. We decided to exclude these 8 children from our analysis on the grounds that they must have made definite progress in reading in order to be able to read that many words. However we felt we could not count the 5 children who only managed to read one word in our test as precocious readers, because being able to read only one word of the simple and very common words in the test did not seem to us enough to warrant that description. So we did not exclude those 5 children from our further analyses, which were designed to establish whether the relationships between the metalinguistic measures and reading would be the same when the sample consisted only of children who had made no substantial progress in reading at the time of the metalinguistic tests. The new sample consisted of 57 children.

Table 4 gives the correlation matrix, and Table 5 gives the equivalent multiple regressions to those already presented in Table 3, for this reduced sample. The pattern of correlations in Table 4 was very similar to the correlations obtained from the total sample. The correlations between rhyme and alliteration were slightly smaller in the smaller sample, but still very strong. Table 5 shows that rhyme and alliteration continued to predict reading and spelling after the effects of differences in age, social background, IQ, and of the various linguistic measures were removed. Thus, the relationships that we found in our total sample are not the product of differences in reading skills in the preschool period.

Another possibility is that the very strong relation between our rhyme and alliteration scores and reading could be explained partly by the existence of "outliers," i.e., children not particularly representative of the rest of the

Table 4. *Correlations between the main variables in the study after exclusion of precocious readers (N = 57)*

	Wp	Ws	Voc	EL	RL	SI	SA	Al	Rh	R-F	R-S	Sp
Mother's education	.58	.61	.35	.55	.53	.36	.61	.40	.50	.50	.43	.50
WPPSI (WP)		.67	.31	.62	.56	.38	.63	.61	.53	.69	.63	.67
WISC (WS)			.26	.42	.38	.26	.56	.49	.51	.56	.57	.60
Vocabulary (Voc)				.32	.38	.33	.43	.16	.23	.36	.31	.34
Expressive language (EL)					.74	.47	.66	.51	.49	.59	.55	.51
Receptive language (RL)						.49	.59	.36	.44	.49	.40	.33
Sentence imitation (SI)							.54	.46	.40	.45	.46	.41
Syntax awareness (SA)								.55	.49	.60	.58	.59
Alliteration (Al)									.70	.71	.74	.70
Rhyme (Rh)										.62	.62	.58
Reading (France) (R-F)											.93	.82
Reading (Schonell) (R-S)												.87
Spelling (Sp)												

Table 5. *R^2 change in fixed order multiple regressions of the 57 children who were not precocious readers*

	Outcome measure		
Steps in regression	Reading France test	Reading Schonell test	Spelling
Extraneous variables			
1. Age at test of reading	.000	.011	.001
2. Mothers' educational level	.284***	.216***	.258***
3. IQ (WPPSI)	.272**	.287***	.275***
Linguistic variables			
4. Vocabulary (BPVS)	.005	.001	.003
5. Language (Reynell) expressive	.030	.030	.017
6. Language (Reynell) receptive	.001	.002	.029
7. Sentence imitation	.003	.009	.004
Final step			
8a. Final step rhyme	.041**	.060*	.036*
8b. Final step alliteration	.090***	.121***	.076**
8c. Final step syntax awareness	.000	.000	.000

Note: Social background and IQ are controlled as well as general language abilities.
*$p < .05$; **$p < .01$; ***$p < .001$.

sample. To find who could be counted as outliers, we used standardized residuals from the regression of the alliteration score and the Schonell reading level (the strongest relation of all in our total sample). This analysis produced 5 children who were clear outliers. We ran further analyses in which these 5 children were excluded.

The exclusion of these outliers led to even stronger correlations than before between rhyme and alliteration on the one hand and reading and spelling on the other. The correlations of rhyme to the France reading test, to the Schonell reading test, and to the spelling test were, respectively, .71, .73, and .68. The equivalent figures of alliteration were .79, .83, and .76. Not surprisingly, given these correlations, the exclusion of the five outliers in further multiple regressions made no difference to the relationships of rhyme and alliteration to reading or to spelling that we reported in Tables 2 and 3. These relationships cannot be attributed to the presence of outliers.

DISCUSSION

Our study produced four main results. First, the measures that we gave the children when they were 3 and 4 years old accounted for an extremely high proportion of the variance in their reading single words, their comprehension, and their spelling at the age of 6;7.

Our second discovery was that the children's scores in rhyme and alliteration tests given to them at 4 years predicted their reading and spelling levels at 6 years after stringent controls for general language ability as well as for social background and intelligence. The connection between children's sensitivity to rhyme and alliteration at 4 years is not a mere byproduct of some broader linguistic ability.

Third, the children's scores in our other metalinguistic test – the syntax awareness task – were also related to their reading after the differences in general language ability had been partialled out, but this relationship dropped out when social background and IQ were entered into the equation. So we conclude that the connection between awareness of syntax and reading merely reflected differences in these extraneous variables.

Our fourth result concerns the linguistic measures (vocabulary, expressive and receptive language, and sentence imitation). The children's scores in these tests were related to their reading levels, but this relationship also became non-significant after the two extraneous variables, social background and intelligence, had been included in the regression. It seems that the connection between the linguistic measures and reading was simply due to the fact that both were determined by differences in intelligence and in background. Of course we cannot be sure whether the same pattern would have applied to the children tested by Bowey and Patel, because they gave their language measures to 6-year-olds, whereas we gave ours to 4-year-olds. There is a clear need to repeat Bowey and Patel's study with 6-year-olds, but this time to include measures of IQ and social background.

The clearest difference between our results and those of Bowey and Patel is in the power of the rhyme and alliteration tests as predictors of reading.

Their rhyme and alliteration measures failed to predict reading after controls for general linguistic ability. In complete contrast, there was a highly significant relationship between our measures of rhyme and alliteration after similar controls. There seem to be two reasonable explanations for this difference. One, which we favor (mentioned in the introduction), is that our rhyme and alliteration measures were given to 4-year-olds, while Bowey and Patel's were given to 6-year-olds.

It may be much more important, from the point of reading, to know how aware a child is of rhyme at 4 years than at 6 years. Why should this be so? Our answer is that at 4 years one gets a relatively pure measure of the child's ability to categorize words by sounds, because he has not begun to read. At 6 years, on the other hand, the child will have had quite a lot of experience with reading, and his judgments about rhyme might now be affected by his knowledge about spelling. So, children might use their knowledge that two words do or do not have a common spelling pattern to help them judge whether the words rhyme. Thus, when the test is given to preschool children, one is measuring their ability to form categories that will help them to read later on, but when it is given to older children one might be picking up effects of the experience of reading as well.

The second possibility is that the difference in results is due to the fact that our tests of rhyme and alliteration took a different form than Bowey and Patel's. In our test the odd word had no phonemes in common with the other two words (*peg, cot, leg; pin, pig, tree*). In theirs, the odd word had one phoneme in common with the other words (*sun, gun, rub; hat, cot, pot; bun, rug, bus*). There is evidence that our version is easier than theirs (Lenel & Cantor, 1981), and our reason for adopting the easier version was that we were working with young children and wanted to be sure that the task would not be too difficult for them. The fact that we adopted an easy test of rhyme and alliteration, while Bowey and Patel adopted a hard one could explain the difference in results, but it is hard to see why. Neither study suffered from floor or ceiling effects, and there seems no reason why an easy test should be a better predictor of reading than a difficult one. In fact, the overall error rate in the rhyme and alliteration tasks seems to have been much the same in the two studies, presumably because the children in the Bowey and Patel study who were given the harder task were also two years older than the children in our study. So we prefer the first possible explanation to the second.

The fact that the odd word shared a phoneme with the other two in Bowey and Patel's task raises another issue. Throughout their paper, they refer to their rhyme and alliteration tests as "phonemic awareness" tests. They use this term because one phoneme told the odd word apart from the other two in their tests. For example with *sun, gun*, and *rub*, the first two words share a final phoneme /n/ which the other words does not possess. But, in our view, this does not mean that the children were responding to the presence or absence of a single phoneme. There is good evidence that children of this age are aware of a speech unit called the "rime" (Kirtley et al., 1989;

Trieman, 1985). In single syllable words like *sun*, the rime consists of the vowel and the following consonant – *un*. Kirtley and colleagues showed that 6-year-old children find it extremely difficult to say which is the odd word in *mop, lead*, and *whip*, and yet quite easy in *top, rail*, and *hop*. In the former case, the odd word can be detected only on the basis of the fact that it lacks a single phoneme which is present in the other two. In *sun, gun*, and *rub* (the Bowey and Patel example) two words share a common rime that the odd word out does not possess. So it is likely that the children who produced the correct answer in Bowey and Patel's rhyme tasks did so on the basis of the words' rimes, which contained two phonemes, rather than on the basis of a single phoneme.

The point seems an important one to us, because we (Bryant et al., 1990) hold the view that awareness of rhyme makes a distinctive contribution to reading. Words that rhyme often share spelling sequences as well (e.g., *light, might, fight*). By forming categories of words that rhyme, the child might be preparing himself for learning spelling categories later on. Note that the unit here is not the single grapheme–phoneme relation. The connection is between sounds with more than one phoneme (rimes) and strings of letters. There is some evidence that this kind of association plays an important part in learning to read. We have shown (Bryant et al., 1990) that children's rhyme scores do make a separate contribution to children's reading even after their scores in phoneme detection tasks have been partialled out, which suggests that the connection between rhyme and reading concerns more than the learning of grapheme–phoneme correspondences. In addition, Goswami (1986, 1988) found that beginning readers make inferences about spelling patterns on the basis of rhyme. If they know how to read the work *beak*, for example, they will often use this knowledge to work out what a new word like *peak* means.

This idea is speculative. We still need to know a lot more about the relationship between the children's knowledge of spelling patterns and their judgments about rhyme. But our data certainly demonstrate that there is a powerful and specific connection between 4-year-old children's sensitivity to rhyme and the progress that they eventually make in reading and spelling. This connection is not a byproduct of differences in general linguistic ability.

ACKNOWLEDGMENTS

This research was supported by a grant from the Medical Research Council. We are very grateful to the teachers and staff of several local schools for letting us visit the schools and see the children there. The schools are Bernwood, Botley, Church Cowley, East Oxford, Greycoates, Headington Quarry, Kennington, Larkrise, New Marston, Meadow, Our Lady's, Pegasus, St. Andrew's, St. Ebbe's, St. Francis, St. John Fisher, St. Joseph's, St. Mary and St. John, St. Nicholas, St. Thomas More, Sandhills, Speedwell, Speenhamland, The Crescent, The Queen's Dyke, Windmill, Wolvercote, and Wood Farm.

REFERENCES

Bowey, J. A., & Patel, R. K. (1988). Metalinguistic ability and early reading achievement. *Applied Psycholinguistics, 9*, 367–383.

Bradley, L., & Bryant, P. E. (1983). Categorising sounds and learning to read – A causal connection. *Nature, 301*, 419–521.

(1985). Rhyme and reason in reading and spelling. *I.A.R.L.D. Monographs, 1*. Ann Arbor: University of Michigan Press.

Bryant, P. E., MacLean, M., Bradley, L., & Crossland, J. (1990). Rhyme and alliteration, phoneme detection and learning to read. *Developmental Psychology* (in press).

Chukovsky, K. (1963). *From two to five*. Berkeley: University of California Press.

Dowker, A. (1989). Rhymes and alliteration in poems elicited from young children. *Journal of Child Language, 16*, 181–202.

Ellis, N., & Large, B. (1987). The development of reading: As you seek so shall you find. *British Journal of Psychology, 78*, 1–28.

Goswami, U. (1986). Children's use of analogy in learning to read: A developmental study. *Journal of Experimental Child Psychology, 42*, 73–83.

(1988). Children's use of analogy in learning to spell. *British Journal of Developmental Psychology, 6*, 21–33.

Jorm, A. F., Share, D. L., Maclean, R., & Matthews, R. (1984). Phonological confusability in short term memory for sentences as a predictor of reading ability. *British Journal of Psychology, 75*, 393–400.

Kirtley, C., Bryant, P., MacLean, M., & Bradley, L. (1989). Rhyme, rime and the onset of reading. *Journal of Experimental Child Psychology, 48*, 224–245.

Lenel, J. C., & Cantor, J. H. (1981). Rhyme recognition and phonemic perception in young children. *Journal of Psycholinguistic Research, 10*, 57–68.

Lundberg, I., Frost, J., & Petersen, O. (1988). Effects of an extensive program for stimulating phonological awareness in preschool children. *Reading Research Quarterly, 23*, 263–284.

MacLean, M., Bryant, P. E., & Bradley, L. (1987). Rhymes, nursery rhymes and reading in early childhood. *Merrill-Palmer Quarterly, 33*, 255–282.

Reynell, J. K. (1983). *Developmental Language Scales*. East Windsor: NFER-Nelson.

Stanovich, K. E., Cunningham, A. E., & Cramer, B. R. (1984). Assessing phonological awareness of kindergarten children: Issues of task comparability. *Journal of Experimental Child Psychology, 38*, 175–190.

Treiman, R. (1985). Onsets and rimes as units of spoken syllables: Evidence from children. *Journal of Experimental Child Psychology, 39*, 161–181.

Tunmer, W. E., Nesdale, A. R., & Wright, A. D. (1987). Syntactic awareness and reading acquisition. *British Journal of Developmental Psychology, 5*, 25–34.

Wise, B. W., Olson, D. K., & Treiman, R. (1990). Subsyllabic units as aids in beginning readers' word learning: Onset-rime versus post-vowel segmentation. *Journal of Experimental Child Psychology* (in press).