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SPEECH-MEDIATED RETENTION IN DYSLEXICS[1]

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Summary.—Dyslexics (6 to 9 yr. old) and a control group of 12 normal readers (second-graders) were tested on a memory task with rhyming and nonrhyming items. The most important finding is that both groups were penalized by rhyme, indicating speech coding. It was observed that the dyslexics were not less penalized by rhyme than were controls. The present results are compared with those of other recent studies.

A great number of studies indicate a relationship between reading ability and memory for verbal material; see Jorm (1983) for a recent review. Some authors have suggested more specifically that speech coding in memory is the basic determinant of this relationship. Speech coding is inferred when, for instance, letters, words, or drawings presented visually are more difficult to retain if their names sound similar rather than different (Conrad, 1962, 1963, 1971). Subjects at different ages and reading levels have been tested this way. Conrad (1971) presented children from 4 to 9 yr. of age series of pictures whose names could rhyme or not. Better performance for the nonrhyming series than the rhyming ones appeared from 6 yr. onwards. Later, Alegria and Pignot (1979) succeeded in showing an effect of rhyme at age 4 which, however, was much smaller than that for 9-yr.-olds.

The relationship between the effect of rhyme and reading level was assessed in a series of studies from the Haskins Laboratories (Liberman, Shankweiler, Liberman, Fowler, & Fischer, 1977; Mark, Shankweiler, Liberman, & Fowler, 1977; Mann, Liberman, & Shankweiler, 1980; Mann & Liberman, 1983). Letters, words, and sentences were presented to second-graders, third-graders, and preschoolers. The results showed a substantial effect of rhyme for good readers and a smaller or almost nonexistent one for poor readers. According to these authors, reading difficulties are related to some deficiency in the use of speech codes in memory. More recently, however, testing first-graders, we have observed an effect of rhyme for both good and poor readers (Alegria, Pignot, & Morais, 1982). The effect was of the same size for good and poor readers taught to read according to a whole-word method and significantly smaller in good readers than poor ones among those taught to read according to a phonic method.

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One possible origin of the discrepancy between our data and those of Haskins may be the way of sampling the good and poor readers. Although in each of the experiments mentioned above all subjects were taken from normal classes, Haskins' poor readers might be poorer than ours. Recently, two studies (Hall, Ewing, Tinzmann, & Wilson, 1981; Johnston, 1982) addressed the issue with respect to severely deficient readers given special education. The subjects, called dyslexics, showed effects of rhyme as large as the ones exhibited by the corresponding control groups of normal readers. However, both studies tested dyslexics who were much older than the poor readers considered in either the studies done at Haskins or Brussels. Hall, *et al.*'s dyslexics ranged in age from 15 to 40 yr., while Johnston's were 9, 12, and 14 yr. old. Johnston cautiously comments that the absence of any difference in effect of rhyme as a function of reading level at one particular age cannot necessarily be extrapolated to other ages. Speech coding might be crucial in the early stages of reading acquisition. Deficient readers might finally develop this code, but the failure to use it when it was especially necessary would probably have long-lasting effects on reading ability.

The main questions were whether young severely disabled readers can use a verbal code for mnemonic purposes and whether they can use it to the same extent as normal readers. The present work then examined young (from 6- to 9-yr.-old) dyslexics' scores on a memory task with rhyming and nonrhyming materials. Normal readers from Grade 2 provided a control for age.

METHOD

Subjects

Two groups of children, one of dyslexics and the other of normal readers, were tested in the third and fourth months of the school year. The dyslexics included all the 27 children, 15 boys and 12 girls, who were attending classes at the more elementary level (13 had already attended these classes for one year, and 1 for two years) in a school specializing in dyslexia, dysorthography, and dyscalculy.[2] They had attended normal schools before and had been diagnosed dyslexic-dysorthographic by an official center for psychological examination. All were considered of normal intelligence on the basis of having WISC Full Scale IQs ranging from 80 to 118 ($M = 95$, $SD = 10.3$). About half came from private schools, whose populations are generally issued from medium to high socioeconomic classes and the others from public schools. Mean age was 8.0 yr. (ranging from 6,1 to 9,6; $SD = 0,9$). Reading was taught to these children according to a phonic method. The other group of subjects attended a normal school whose population is mainly of medium socioeconomic

[2]In Belgium, there are special schools for different kinds of learning disability. In principle, children are therefore not classified as dyslexic when they present mental retardation, gross health, sensorial or neurological deficits, or affective troubles.

status and in which the same kind of phonic method was employed. It included 12 second-graders (6 boys and 6 girls), aged from 7,3 to 9,1 yr. (M = 7,8; SD = 0,7), who were selected randomly from their classes. According to their teacher, no child in the control group had any special difficulty with reading.[3]

All subjects were given a reading test which required trying to read aloud a list of 32 monosyllabic and disyllabic words in 1 min.; see Appendix 1 (p. 126). The main purpose of this test was to ascertain that the dyslexics, in contrast to their controls, were almost unable to read single words. The mean score of the dyslexics was 3.4 words correctly read (SD = 4.2); the controls had a mean score of 28.8 (SD = 3.1). Among the dyslexics, 10 subjects were unable to read any word, two read one word, two read three words, six read four words, six read six to 10 words, and one read 18 words. Among the controls, every subject read at least 23 words and seven read at least 30 out of the 32 words. There was therefore no overlap between these two distributions.

Material and Procedure

The material and procedure were the same as those used by Alegria and Pignot (1979) so only a short description is given here. The material consisted of three series of eight black-and-white drawings made on 5- × 5-cm cards. In one of the series (R) the names of the drawings rhymed: drapeau, chateau, chameau, chapeau, bateau, rateau, gateau, and marteau. The other two series were nonrhyming: (1) moto, pelle, scie, ours, tambour, église, vélo, maison; (2) cheval, avion, fusil, vache, pipe, canard, livre, poisson.

The experimenter first showed the child the eight cards from each series and asked him to name them to ensure that he knew the names of the drawings. Then the experimenter showed three cards from one of the nonrhyming series, one at a time for 2 sec. each, while saying the name of the object represented in the card. Each card was placed in a row, face down in front of the subject. As soon as the last card was placed, the experimenter put on the table a strip of cardboard representing the eight cards of the series. The child was asked to push each of the three cards he had just seen, without turning it up, to bring it in front of the corresponding card on the strip. The experimenter then turned over the cards to show the subject any mistakes he had made. This training phase allowed the subject to become familiar with the task and, at the same time, permitted the experimenter to determine the number of cards to be used in the experimental trials. Each subject began the training

[3]Although IQs were not available for this group, one may be confident that all these children were of normal intelligence. Intellectual examination by an official center is obligatory when children enter primary school, and those who obtain low IQs are assigned to special classes.

phase with four cards. If the child gave four correct responses, an additional card was introduced. If the number of correct responses was less than three, one card was eliminated. This procedure was repeated for six to 10 trials to obtain a performance less than perfect but greater than 50%. The experimental phase began immediately after the training phase. During the experimental phase the subjects received a number of stimuli equal to the one used in the last training trial. In the training phase, about half of the subjects in each group were given the nonrhyming 1 series while the others were given the nonrhyming 2 series. The experimental phase of 10 trials utilized nonrhyming series which had not been used during the training phase (Condition Nonrhyming) and 10 trials with the rhyming series (Condition Rhyming). About half of the subjects in each group worked in the nonrhyming-rhyming order, and the others worked in the reverse order.

Results

Table 1 represents the mean percentage of correct responses per condition and group. The mean differences, the *t* tests on each of these differences, and the mean number of items used in each group are also indicated.

TABLE 1

Mean Percentage of Correct Responses for Rhyming and Nonrhyming Series, Difference Between Two Scores, and *t* Test for Each Group

Group	*N*	No. Items		Conditions				Diff.		*t*
		M	*SD*	Nonryhming		Rhyming		*M*	*SD*	
				M	*SD*	*M*	*SD*			
Dyslexics	27	3.9	0.27	59.5	17.4	48.1	13.5	11.4	14.9	3.91*
Controls	12	4.0	0.43	69.7	13.1	54.9	8.2	14.8	13.8	3.54*

*$p < .01$.

The rhyme effect (the nonrhyming-rhyming difference) is positive and significant in each group. Among the dyslexics, only five children showed a negative difference and three a null difference, out of 27 subjects. There is no significant difference between the rhyme effect of the two groups ($t < 1.00$).

Importantly, among the dyslexics, the effect of rhyme was positively correlated with Full Scale IQ ($r = .54$, $p < .01$), which means that the higher the IQ the greater is the detrimental effect of rhyme on mnemonic performance. Because it seems important to establish firmly that the intelligent young children with some reading disability exhibit an effect of rhyme in short-term memory, we took from the group of dyslexics those 13 subjects who were unable to read more than 10 words in the reading test, were aged less than 9 yr., but had Full Scale IQs equal to or higher than 95. The mean age of this

subgroup was 7.9 yr.; mean Verbal and Performance IQs were 100 and 105, respectively; mean number of words read in the reading test was 3.8. Performance on rhyming and nonrhyming items was, on average, 45.6% and 61.9%, respectively. The rhyme effect (16.3%) was significant at $p < .005$ ($t_{12} = 3.28$) and was not smaller than that (14.8%) of the controls. It tended to be greater than the one (6.9%) displayed by a subgroup of nine dyslexics whose IQs were lower than 95 and who were aged less than 9 yr. It is worth noting, on the other hand, that the over-all performance of the dyslexics with higher IQs was superior to that of dyslexics with lower IQs (55% and 46%, respectively; $t_{20} = 1.72$, $p = .05$).

Discussion

The most important conclusion from the present work is that dyslexics, like controls, are more accurate in remembering nonrhyming items than rhyming ones. The effect of rhyme is observed in a group of 6- to 9-yr.-old severely dyslexic children who, despite special instruction, cannot read on average more than 3 or 4 monosyllabic and disyllabic regular words in 1 min. The data show that young dyslexics do spontaneously retain information using a verbal code.

Our group of dyslexics did not display an effect of rhyme significantly smaller than the normal readers of the same age. Therefore, the discrepancy between our previous results and those reported by the Haskins researchers is not linked to their poor readers being poorer than ours.

After the present experiment was run, two relevant studies (Hall, Wilson, Humphreys, Tinzmann, & Bowyer, 1983; Siegel & Linder, 1984) have been published. Hall and his colleagues tested normal and poor readers in Grades 2 to 4 for the recall of rhyming and nonrhyming letters and words. The poor readers did not differ from the normal readers in their susceptibility to rhyme. This result was replicated with a group of poor readers whose achievement in mathematics and a test of general intelligence was low relative to their age-grade peers. The authors suggest that the differences in the effect of rhyme that had been observed in Haskins' experiments might reflect differences in over-all performance between the groups studied. In these experiments, performance was generally much lower for poor than good readers, creating a possible scaling artifact. Hall and his colleagues offer two pieces of evidence in support of this explanation. First, the effect of rhyme exhibited by their children of low ability for four-letter lists was strongly reduced with the more difficult five-letter lists. Second, the subjects who displayed an effect of about 30% at the averaged performance of 55% only displayed an effect of 3% when the insertion of another task decreased performance to 30%. The results presented in this paper support Hall, *et al.*'s interpretation.

Siegel and Linder (1984) presented reading disabled children, arithmetic disabled children, and normally achieving children with lists of letters under three different conditions: visual presentation and written report, visual presentation and oral report, auditory presentation and written report. Three groups of age (7 to 8, 9 to 10, and 11 to 13 yr.) were examined. The youngest reading disabled children did not show an effect of rhyme whatever the condition; the youngest arithmetic disabled children failed to show it with visual presentation but did with auditory presentation; the older learning disabled children and the normally achieving children always displayed sensitivity to rhyme. The authors concluded from these results that the use of phonetic code in short-term memory develops more slowly in children with learning disabilities than in normals. However, an important methodological flaw as well as a scaling artifact may have affected Siegel and Linder's results. First, reading-disabled children would be expected to be at a disadvantage by being tested with letters and asked to transcode them from the written to the oral form or vice-versa regardless of the task. In Siegel and Linder's experiment, reading disabled subjects always had to read or write, and in addition no control for knowledge of letter names is reported. If we want to know whether dyslexics use some verbal mediation for remembering visual information, we should not employ the very material for which they have been diagnosed as abnormal. This creates merely a circular argument and adds little to our understanding of the basis of the reading disorder. Second, the level of performance exhibited by the youngest learning disabled children in Siegel and Linder's experiment is so low (between 15% and 35%) that a floor effect may have concealed the sensitivity to rhyme.

In conclusion, there are now many studies supporting the notion that poor readers and dyslexics can and do use speech mediations to code visual information. The results that do not support this notion are questionable on methodological grounds. However, this does not necessarily refute the claim put forward by the Haskins group according to which good readers make greater or more efficient *use* of speech coding than poor ones. What has been shown here and in other studies is that sensitivity to rhyme, as evidenced in the recall of rhyming and nonrhyming items, does not differentiate the groups This is not to suggest that other types of tasks cannot demonstrate group differences. For example, Byrne and Shea (1979) and Byrne and Ledez (1981) have clearly shown that deficient readers prefer semantic to speech-coding strategies but that they use speech coding to the same extent as normal readers when task properties strongly invite it. Byrne and Shea used a recognition task (Mark, Shankweiler, Liberman, & Fowler, 1977). For word lists, they found many semantic but almost no rhyming false positive recognition errors in poor readers, while good readers made both kinds. For nonword lists,

however, poor readers' errors were predictable from rhyme. Byrne and Ledez have also used the word and nonword recognition task, plus the task of recall of either rhyming or nonrhyming items. In this experiment, subjects were adults, either good or poor or very poor readers. Again, on the word-recognition task, poor and very poor readers made more semantic than rhyming errors, while good readers displayed the reverse pattern; in the nonword recognition task, all the three groups made more rhyming than nonrhyming errors and they did not differ regarding this effect. The recall task showed an effect of rhyme in each group, and no interaction with group. These results strongly suggest that poor readers (and presumably dyslexics) are able to use speech codes in memory, but that they tend to prefer semantic codes whenever possible. By contrast, a good reader prefers to retain visual information in a speech-based way. This might be an example of causality operating both ways. The tendency to use speech-coding might favour success in reading, and success in reading might reinforce the tendency to use speech-coding.

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APPENDIX 1

Word reading list

nu, os, dur, fil, mur, sac, clé, blé, pli, film, mars, parc, truc, bloc, ami, été, épi, demi, mari, café, agir, égal, unir, naïf, abri, venir, tenir, finir, métro, mardi, degré, glacé.