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Phonetic coding in dyslexics and normal readers

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Young normal readers and older severely deficient readers showed markedly and similarly poorer recall for rhyming vs. nonrhyming letter strings. This result is contrary to recent proposals attributing a phonetic code deficiency to deficient readers.

We are reporting data relevant to an explanation of specific reading disability that has been proposed by Shankweiler, Liberman, Mark, Fowler, and Fischer (1979). Three experiments reported by Shankweiler et al. constituted the main bases of their proposal. The experiments were designed to examine the notion that poor readers are less likely than are normal readers to recode visual information (especially letters and words) into a phonetic representation. It was reasoned that if such a phonetic recoding deficiency does characterize poor readers, then such individuals should be relatively unaffected by phonetic similarity among items visually presented for immediate ordered recall. Ordinarily, there is a substantial deficit in recall under such conditions (e.g., Wickelgren, 1966).

Following the above reasoning, in their first experiment, Shankweiler et al. (1979) presented rhyming and nonrhyming letter strings for ordered recall either immediately or after an unfilled interval of 15 sec. The subjects were children in Grade 2 who were either above or below grade level in reading, but who were presumably similar to each other in general intelligence. The predicted interaction was found: The good readers' recall was much lower for the rhyming than for the nonrhyming letters, whereas poor readers appeared to be unaffected. However, the poor readers were substantially lower than the good readers in recall of nonrhyming strings. In fact, on the last three items in the five-item strings, the performance of the poor readers was at or near a chance level. This experiment was then repeated, but with auditory presentation of the letter strings. According to the recoding hypothesis, both the good and the poor readers should suffer the phonetic confusion effect with auditory presentation. However, the results with both simultaneous (Experiment 2) and successive (Experiment 3) auditory presentation were virtually identical to those obtained with visual presentation. Thus, Shankweiler et al. proposed that the phonetic deficiency originally thought to apply to the recoding of visual information extends to the coding of auditory information as well.

Our experiment was conducted as a test of the validity of the general phonetic code deficiency hypothesis just described. It appeared that in the Shankweiler et al. (1979) experiments, the critical interactions that were found may have been the result of a floor effect created by the very low performance of the poor readers even on nonrhyming items. The low performance may have been in part the result of the use of group administration procedures in which the children were required to write down the recalled letters. One might expect that poor readers also tend to be slower and less accurate in writing letters. In our experiment, the subjects were run individually and their responses were oral. A second major difference was that more extreme cases of reading disability were used here. Our subjects were adolescents and adults with long histories of severe reading deficiencies.

METHOD

Subjects

The low reading group consisted of eight individuals ranging in age from 15 to approximately 40 years. The six subjects under age 19 years were enrolled in special education classes in various schools in the Chicago area. They had been recommended by school personnel for participation in the experiment on the basis of severe reading deficiency accompanied by normal general intelligence. Test data confirming normal general intelligence and a reading deficiency of at least five grade equivalents were obtained for all but the two oldest subjects. These were females who were active in community organizations and gave every indication of above-average intelligence, although one was so deficient in reading that she was unable to follow street sign directions and the other reported only slightly less severe difficulty. The histories of reading difficulties went back to early elementary school for all the subjects, and in no case were there "hard" signs of neurological damage. The normal reading group consisted of 15 public school children in Grades 3 and 4 (ages

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8 and 9 years) whose reading achievement scores on the reading scales of the Woodcock-Johnson Psycho-Educational Battery (Woodcock, 1977) placed them at or above grade level. The rationale for this particular normal reading comparison group will be discussed when the results are reported.

Task and Procedure

Rhyming letter strings were constructed from the letters B, C, D, G, P, T, V, and Z, and nonrhyming strings were constructed from H, K, L, Q, R, S, W, and Y. The letters were randomly assigned to form 16 four-letter and 16 five-letter strings, with no letter appearing more than once in a given string. The strings were arranged into four blocks of eight strings each, such that within each block, there were two four- and two five-letter rhyming strings and two four- and two five-letter nonrhyming strings, with the strings randomly ordered within blocks.

The letters were presented at a rate of 1 letter/sec, using a tape recorder. A tone announced each string, and a second tone immediately following the final letter signaled the beginning of the recall period. The subjects gave their responses orally; responses were recorded by the experimenter. The task was fully explained at the beginning of the session, and a practice block of eight three-, four-, and five-letter strings was given before presentation of the four critical blocks.

RESULTS AND DISCUSSION

Recall was scored simply by crediting the child with each letter recalled in its correct serial position. This position score reflects both item and order information. An order information score was also derived, by dividing the number of items recalled in the correct position by the number of items recalled correctly independently of position (after Wickelgren, 1966). Because the pattern of results and the conclusions implied by them were identical for the two types of scores, only the position data are reported here. The relevant means and standard deviations are summarized in Table 1. The total possible scores were 32 for four-item strings and 40 for five-item strings.

Before it is possible to fully address the question of differential effects of phonetic similarity on recall, certain conditions must obtain. First, the data must be free of serious ceiling or floor effects. The data based on the five-letter strings meet this criterion, whereas performance on the nonrhyming four-letter strings was near maximum for both groups (see Table 1). Thus, only the data for the five-letter strings warrant analysis with respect to possible group differences. A second point pertains to potential scale differences. If the good and poor readers were to differ markedly in their recall of the nonrhyming letters, as they did in the Shankweiler et al. (1979) experiments, the interpretation of differential effects produced by phonetic similarity would be complicated. The ideal situation is one in which normal and deficient readers are similar in performance on the nonrhyming items. Only then is it possible to unequivocally interpret the Group by String Type (rhyming vs. nonrhyming) interaction. It is for that reason, and based on the results of pilot testing, that we used much younger normal readers for our comparison group. The result was that the two groups were reasonably similar in their mean recall of the five-letter nonrhyming strings, as shown in Table 1.

Table 1
Position Recall Score Means and Standard Deviations

	Nonrhyming Strings				Rhyming Strings			
	Four Letters		Five Letters		Four Letters		Five Letters	
Group	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Normal	27.87	6.58	29.73	6.86	16.40	5.07	13.53	6.23
Dyslexic	29.75	2.55	25.38	9.47	16.10	5.74	11.63	5.66

We turn now to the central question of the experiment: Did the severely deficient readers show any indication of not encoding or retrieving phonetic information? The data summarized in Table 1 suggest a negative answer. Both groups showed a large and highly reliable ($p < .01$) decrement in recall of rhyming in comparison with nonrhyming letters. The values of t were 9.05 ($df = 14$) for the good readers and 8.04 ($df = 7$) for the poor readers. Looking at it another way, all eight of the poor readers and 14 of the 15 good readers performed more poorly with the rhyming than with the nonrhyming strings. Although there was a slightly greater difference between item type within the good reading group, the interaction between group and item type did not approach significance.

These results offer no support for the phonetic code deficiency hypothesis proposed by Shankweiler et al. (1979); the dyslexic subjects were highly sensitive to phonetic similarity, as were the normal readers. Yet, of course, these results do not disprove the hypothesis. It is possible that the phonetic code deficiency hypothesis is correct for the population of poor readers sampled by Shankweiler et al. (1979), but not for the present population. It seems just as plausible that the critical interaction obtained in the Shankweiler et al. studies was spurious, for the reasons outlined earlier, and that their hypothesis simply is not correct. Clearly, some modification, if not a rejection, of that hypothesis will be required.

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