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ABSTRACT

The extent to which pictorial presentation would facilitate the comprehension of text-like passages among two populations of fourth-grade students was investigated. Subjects were 64 students each in high-socioeconomic status (SES) white and low-SES black groups. Simple passages amenable to pictorial presentation were read over a programed tape to the subjects. At the same time slides giving a cumulative presentation were projected. In the verbal conditions they were made from photographs of hand drawings. Subjects were tested individually following each passage. Three main effects were significant: population, presentation mode (text versus pictorial), and question type (1 attribute span question versus 2 to 4 attribute span questions). The data also indicated that visual elaboration was significantly more effective in the low-SES black population. It was the researcher's belief that the question-type effect in the low-SES black population indicated the subjects' attempt to transform the passages by processing them conceptually and that equal performance in the memory and inspection conditions in the pictorial mode confirmed that the pictures aided in this conceptual activity. Tables, figures, and references are included. (AW)

Visual Elaboration and Comprehension of Text[1]

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Abstract

In a comprehension task consisting of questions concerned with the logical relationships within each of three passages of text, it was found that samples of 64 Ss each from two populations of fourth grade students benefitted from cumulative pictorial presentation of the information. Low-SES black students obtained significantly more benefit than high-SES white students. The results were attributed to the ability of pictures to aid performance by presenting the material in a manner able to convey the semantic form in which it must be processed in order to be successfully understood.

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Visual Elaboration and Comprehension of Text

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The central purpose of this study was to determine the extent to which pictorial presentation would facilitate the comprehension of text-like passages among two populations of fourth grade students, high-SES white and low-SES black. The prediction of such facilitation was drawn from the assumption that a picture can integrate a group of items within a single functional unit.

Within a Piagetian framework comprehension may be described as an active operative process by which the S forms a union or intersection of the sets of properties, or schemes, within his repertoire of each word in the text through which he is able to assimilate the meaning of the text as a whole. It was hypothesized that the comprehension aspect of reading is similar to more fundamental tasks such as noun-pair learning in that successful performance depends upon the use of a conceptual technique which the learner actively employs to force separate relevant items of information into the same semantic set. For example, given the noun pair A-B, this technique unitizes the nouns within a larger set AB such that the presentation of A implicitly elicits the entire AB which then yields the required overt response B (Horowitz & Prytulak, 1969).

Previous research has shown that a potent external analogue of the product of such a conceptual technique is a picture of an interaction involving the objects named by the two nouns (Rohwer, 1970). In the present investigation it was thought that cumulative interacting pictorial presentation would act in a symbolic manner to coordinate the second order

relationship between the relations expressed externally in the text and the relations of the internal representations which form the new semantic unit, or cognitive structure. While the semantic system may be partially embodied imagistically or lexically, it must actually consist of more elementary patterns of organization (cf. Quillian, 1966; Chafe, 1970). To paraphrase Jerry Fodor, neither words nor images refer to things; persons refer to things.

A pilot study showed that low-SES black students do not perform as well as high-SES white students on a comprehension task, but they do perform equivalently in noun pair learning (Rohwer, 1967). If successful, performance on both types of tasks taps the same basic ability, a major cause of the deficit of the low-SES black students in reading comprehension may be that they have not learned an appropriate tactic for applying conceptual activity to the task. Since it was assumed that in the pictorial conditions a stimulus situation was provided which would evoke the kind of conceptual processing that leads to comprehension with a higher probability than text stimuli alone, the major prediction of the study was an interaction of population and treatment such that the low-SES black students would benefit to a greater extent from the presentation of visual elaboration of the passages.

In addition, the effects of other independent variables were investigated. The Ss were partitioned into memory and inspection conditions to determine whether pictorial elaboration would improve comprehension performance in the "realistic" situation in which the students could inspect the text to answer questions as well as under laboratory-like conditions where the necessary information must be retrieved from memory. The degree

of structural remoteness within the text of the items involved in the questions was varied in order to detect the conditions in which remote relationships would be most difficult.[2] Also varied was the direction of the relationship between the items involved in each question in terms of the sequential order of the items within the passage. Finally, two sets of questions were used in order to sample more fully from the possible questions given by the structure of each passage.

Method

Materials and procedure. The textual materials used were lexically simple passages, each containing two paragraphs. One of the passages is shown in Table 1.

Insert Table 1 about here

The stories were written in order to be amenable to pictorial presentation such that the information of each paragraph could be combined within one picture. The stories were also written with the constraint that the characters and events portrayed would be equally familiar to the two populations.

Within each passage the paragraphs developed two related concepts whose attributes differed across arbitrarily conceived dimensions. Each paragraph involved five classes of information which were arranged logically so that each universally implied the next. In addition, extraneous information was included to make the passages more realistic and difficult. In general, then, the verbal materials resembled passages from classroom texts in which new concepts are contrasted and accretively given meaning.

[2] The general form of the verbal materials used in this study was suggested by Frase (1969).

The classes from the first paragraph of the passage in Table 1 form a series of assertions which may be labeled A) banana tree monkeys, B) curly tails, C) watch children, D) afraid of humans, E) busy. The structural distance among the classes of each paragraph in terms of the inferences that may be drawn between any two is shown below.

$$A \longrightarrow B \longrightarrow C \longrightarrow D \longrightarrow E$$

$$A' \longrightarrow B' \longrightarrow C' \longrightarrow D' \longrightarrow E'$$

This structure makes possible questions which span either one, two, three or four essential attributes. Each question may also be either forward or backward and either yes or no. For example, a "three attribute, backward, no" question would be: "The monkeys that like to watch their children have long straight tails. Yes No".

In each presentation mode the passages were read over a programmed tape to the Ss in order to achieve equality of input registration. For each story one or two words with which all Ss may not have been equally familiar were defined prior to the start of the passage. In the conditions slides made from typed copies were projected onto a large screen, using a Kodak Carousel slide projector synchronized with a Wollensak Slide-Sync Cassette recorder. The presentation was cumulative; each successive sentence or pair of sentences describing an attribute was added to the ones preceding it on a separate slide. This method was used in order to equate the number of presentations of each item of information between the verbal and pictorial modes.

In the pictorial conditions the slides were made from photographs of hand drawings. Each successive sentence or pair of sentences describing an attribute was represented by the addition of pictorial information to

all the information that preceded it. Again, there was a separate slide for each attribute (including extraneous attributes) within a passage. In the pictorial inspection condition the Ss were given two 9-1/2" x 6-1/2" photographs mounted on the inside leaves of a manila folder. Each picture was an enlargement of the final slide for each paragraph of the preceding passage. An example is displayed in Figure 1. In the text condition

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Insert Figure 1 about here
- - - - - - - - - - - - - - -

the Ss were given a typed copy of the entire passage. Ss in these conditions were instructed that they could make use of the pictures or typed copy to help answer the questions.

The passages were read at a rate of approximately five seconds per sentence. Testing followed each passage after a delay of approximately twenty five seconds for E to prepare the apparatus. Each S answered eight questions for each passage. The Ss were given twelve seconds to respond yes or no orally to each question. The Ss were allowed to change their responses. Correct answers of yes and no were counterbalanced with the attribute span of the questions. The direction of the question, forward or backward, was counterbalanced with these variables between Ss within each question set.

Each S was tested individually. The essential feature of the instructions was a very simple warm up passage followed by three questions. For each S the warm up was presented in the same manner as the other passages.

Design. The design of this study comprised a 2 x 2 x 2 x 2 x 3 x 4 factorial with repeated measures on the last two dimensions. The factors were populations (low-SES black vs. high-SES white), presentation mode

(text vs. pictorial), test condition (memory vs. inspection), question set (set I vs. set II), practice (passage I vs. passage II vs. passage III), and question type (1 attribute span questions vs. 2, 3, and 4 attribute span questions).

Results

The most prominent results are shown in Figure 2 and Table 2, where the means are reported in terms of the mean number of correct responses.

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Insert Figure 2 about here
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Insert Table 2 about here
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Hypotheses were tested at $p < .01$. Three of the main effects were significant: Population, $F(1,112) = 77.46$, $p < .01$; Mode, $F(1,112) = 64.81$, $p < .01$; and Question Type, $F(3,336) = 10.13$, $p < .01$. The Population x Mode interaction was also significant, $F(1,112) = 15.12$, $p < .01$. An additional result shown in Table 2 is that the inspection condition of testing did not significantly improve performance for either population in either mode.

The main effect of Question Type reveals a consistent pattern. Questions of one attribute span were the least difficult and questions that spanned four attributes were the most difficult. Figure 3 shows the mean number of correct responses per question type for the verbal and pictorial modes respectively. This figure demonstrates that there was no tendency for a Population x Question Type interaction.

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Insert Figure 3 about here
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Several of the interactions involving Question Set were significant. However, these need not be described because they did not interact with the variables of interest. Similarly, preliminary analysis revealed that in many cells of the design one of the stories was less difficult than the other two, but the pattern of results was the same for all of the stories. Contrary to expectations, preliminary analysis showed that backward questions were never more difficult than forward questions.

Discussion

The major prediction of the investigation was confirmed. Visual elaboration was significantly more effective in the low-SES black population. Performance in this group was improved by approximately twenty percent, bringing it within the range of the high-SES white group. The improvement of twenty percent gains even more luster when it is realized that the improvement is measured against a baseline where Ss are correct fifty percent of the time by chance.

The presence of the Question Type effect in the low-SES black population indicates that these Ss were attempting to transform the passages by processing them conceptually. Figure 3 shows that the attribute span effect was very strong for the low-SES black pictorial group. This effect demonstrates that performance was not improved because the pictures aided the Ss merely to remember which items of information belonged in each paragraph. Such a rote strategy would of course enable a S to respond correctly without any logical understanding of the relationships implied in the passages. Nevertheless, if the Ss were using this strategy, the four attribute span questions would not be more difficult than the one attribute questions. The four attribute questions necessarily involve the first

and last items in each paragraph, and the primacy and recency effects which must be expected in a rote situation would make a correct response to these questions very probable. In this respect it is interesting to note the cross modal similarity of the attribute span curves for the two populations shown in Figure 3. This similarity provides evidence for the hypothesis that pictorial presentation enabled the low-SES blacks to process the passages in the same manner that the high-SES white Ss have learned to do without pictorial presentation.

The equality of performance in the memory and inspection conditions for the low-SES black Ss in the pictorial mode confirms that in this task pictorial presentations is only effective when the perception of the pictures reflects central conceptual activity. If the Ss had been able simply to read off the correct answers from the pictures provided at the time of test, performance would surely have been for better in the inspection than in the memory condition.

It is known from recent experiments in free recall learning that information to be used in retrieval must be stored at the time of input (cf. Thomson & Tulving, 1970). Results in the present task are consistent with the presumption that the locus of conceptual activity was the initial presentation of the stories during which the Ss stored the material in semantic sets. Suppose that of the items A, B, C, D, and E, a S was only able to form A, B, and C into the set ABC during the initial presentation. At the time of test, or retrieval, presentation of the pictures may cue the S to some properties in his repertoire corresponding to D and E, but the properties are not congruent with any of the properties of ABC. Thus, the S cannot answer questions which involve these items.

The results of this study may be further tested in a number of ways. For example, a discrete pictorial control group could be used in which each successive picture conveys only the information given in each sentence of the text. Some explanations for the effectiveness of imagery in noun-pair learning would predict equal performance in the cumulative and discrete conditions, but the present explanation would favor superior cumulative performance. In another direction, it would be worthwhile to test for learning to learn effects from a cumulative pictorial passage to a verbal passage which is not amenable to pictorial presentation.

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Table 1

SOME MONKEYS

ONE TYPE OF MONKEY LIVES IN BANANA TREES. THE BANANAS ARE VERY GOOD TO EAT. ALL THE BANANA TREE MONKEYS ARE KNOWN FOR HAVING CURLY TAILS. THESE MONKEYS WITH CURLY TAILS WANT TO WATCH THEIR CHILDREN. THEY ALWAYS CARRY THEIR CHILDREN ON THEIR NECKS OR KEEP THEM AT THEIR SIDE. THESE WATCHFUL MONKEYS ARE AFRAID OF HUMANS. THEY HIDE WHEN PEOPLE COME NEAR. THESE MONKEYS THAT ARE AFRAID ARE VERY BUSY ALL DAY LONG. THEY LIKE TO GATHER SMALL STICKS AND MAKE DESIGNS WITH THEM ON THE GROUND.

A DIFFERENT TYPE OF MONKEY LIVES IN COCONUT TREES. THESE MONKEYS BREAK OPEN THE COCONUTS BY DROPPING THEM ON THE GROUND FROM HIGH IN THE TREES. THESE COCONUT TREE MONKEYS HAVE LONG STRAIGHT TAILS. THESE MONKEYS WITH STRAIGHT TAILS LIKE THEIR CHILDREN TO TAKE CARE OF THEMSELVES. THEY LIKE THEM TO WANDER OFF ALONE AND BE FREE. THESE MONKEYS WITH CHILDREN WHO WANDER OFF ALONE ARE VERY FEARLESS WITH HUMANS. THEY COME RIGHT NEXT TO PEOPLE AND ASK FOR FOOD.

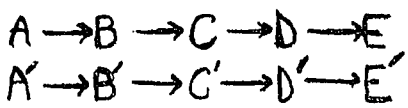

Figure 1. An Example of the Final Picture for the First Paragraph of "Some Monkeys."

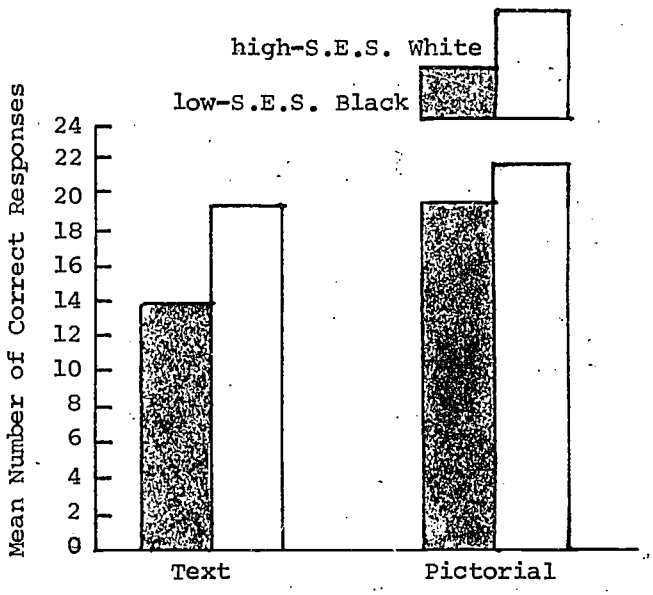

Figure 2. Preformance of Populations in Text and Pictorial Modes

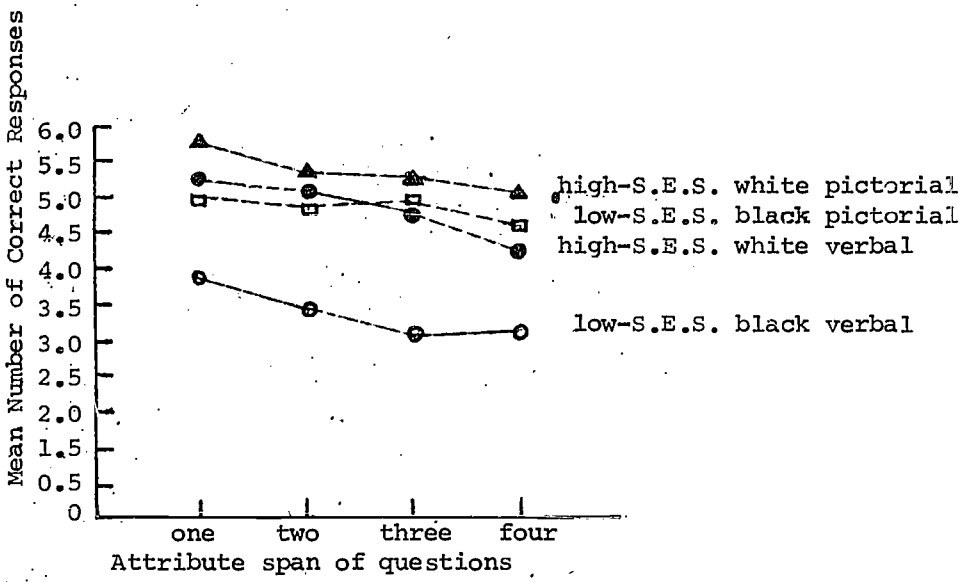

Figure 3. Performance per Question Type

Table 2.
Mean Number of Correct Responses for Populations, Modes, and Conditions

Modes	Populations			
	High- S.E.S. White		Low- S.E.S. black	
	Conditions			
	Inspectio..	Memory	Inspection	Memory
Text	19.63	19.74	14.12	13.63
Pictorial	22.12	21.06	19.00	19.69