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ABSTRACT

Several experiments involving approximately 130 6-year-old children were conducted to examine the effects of overt illustration on first graders' learning from oral prose. In all experiments, experimental Ss heard prose selections after or during which they illustrated selection content with plasticized figure cutouts and background scenes while control Ss copied or colored geometric forms during the illustration period. After hearing three or five passages, Ss orally recalled passage content and answered simple factual questions about each passage. Results showed that illustration facilitated prose learning only when the child was given the correct pieces for his illustration or had the illustration done for him. When children selected the pieces for each illustration out of a common pool of 20-30 cutouts, the illustration activity had either a negative or no effect. (Author/SB)

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strategies in reading comprehension IV: pictures and young children's learning from oral prose

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WISCONSIN RESEARCH
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CENTER FOR
COGNITIVE LEARNING

Technical Report No. 328

STRATEGIES IN READING COMPREHENSION IV: PICTURES AND YOUNG CHILDREN'S LEARNING FROM ORAL PROSE

by

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Report from the Project on Conditions
of School Learning and Instructional Strategies

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ABSTRACT

We report several experiments examining the effects of overt illustration on first graders' learning from oral prose. In all experiments, children heard prose selections after (or during) which they illustrated selection content with plasticized figure cutouts and background scenes. Control subjects copied or colored geometric forms during the illustration period. After hearing three or five passages, subjects orally recalled passage content and answered simple factual questions about each passage. Illustration facilitated prose learning only when the child was given the correct pieces for his illustration or had the illustration done for him. When children selected the pieces for each illustration out of a common pool of 20-30 cutouts, illustration activity had either a negative or no effect.

I

INTRODUCTION

The major purpose of this study was to examine the extent to which the existing literature on the facilitative effects of imagery and pictures in the domain of children's associative learning could be extended to the domain of children's aural prose comprehension. We were particularly concerned with six-year-old children, who are just beginning to expand their aural comprehension skills to the print medium and who are generally preoperational in their cognitive development.

The associative-learning literature suggests that whereas children as young as five years of age benefit from either observing or constructing external pictorial mediators (e.g, McCabe, Levin, & Wolff, 1974; Rohwer, 1967), children at the same age are not able to construct analogous internal pictorial mediators; that is, they are unable to benefit from instructions to form visual images (e.g., Montague, 1970; Wolff & Levin, 1972). On the other hand, (a) children at about age seven are able to do so (e.g., Levin, Davidson, Wolff, & Citron, 1973), and (b) children between ages five and seven can acquire this skill with appropriate kinds of training (e.g., Varley, Levin, Severson, & Wolff, 1974).

While the role of pictures and images in young children's associative learning has been studied extensively, research on the effects of these variables on prose learning has been limited to studies of slightly older children. Thus, it has been demonstrated that children at about age nine or ten recall more details from an orally-presented prose passage when the passage has been accompanied by pictures (Rohwer & Matz, in press; Harris & Rohwer, 1974). As for internal imagery generation, it has been noted that under certain conditions (cf., Lesgold, Curtis, DeGood, Golinkoff, McCormick, & Shimron, 1974) children of the same age are able to profit from imagery instructions in prose-learning tasks (Levin, 1973; Levin & Divine-Hawkins, 1974; Levin, Divine-Hawkins, Kerst, & Guttmann, 1974; Shimron, 1974) whereas six- and seven-year-olds cannot (Shimron, 1974).

II

EXPERIMENT 1

In this study, we wished to determine whether children who are assumed to be too young to utilize a covert imagery generation strategy (see the preceding discussion) are able to improve their prose learning through overt construction of pictorial mediators, just as they are in associative learning. Ordinarily, prose-learning studies are not conducted with children as young as age six, because of their inability to read well. However, following the lead of other investigators, we have eliminated the problem of decoding inadequacy in this research by presenting the connected discourse orally. Overt picture construction was made possible through the use of plasticized background scenes and cutout objects which could be placed on them, thus eliminating the need for our subjects to have drawing skills.

METHOD

Materials

Five single-episode stories of 30-75 words were prepared to be easily understandable to first graders. Each was recorded on tape by a male professional speaker. For each story, an 11" x 17" (28 cm x 43 cm) background scene and a set of cutout objects were prepared such that every action of the story could be illustrated by placing some of the cutouts on one of the backgrounds. The backgrounds and cutouts were drawn by a professional artist with a black felt-tip pen and then colored in. Two of the stories shared the same background.

Subjects

Twenty-four children participated in this experiment. They came from an urban public school serving lower-middle-class black families. All were first graders. Their exact ages were not available, but all first graders in the school at the time of the experiment were within six months of age six years, ten months. Subjects were randomly assigned in equal numbers to either the Picture condition or the Control condition.

Procedure

Subjects were tested individually. The child was first instructed that he would be asked to recall everything that happened in the stories and, therefore, that he should try carefully to remember them. Picture subjects were told in advance that they would be required to illustrate what happened in each story by making a picture with the cutouts. The child then listened in turn to five stories, doing the relevant task for his condition after each. If in the Picture condition, the child constructed

a picture of each story immediately after hearing it. He did this by selecting a background and about six cutouts from a standard randomized arrangement (of four backgrounds and over 30 cutouts) and using them to assemble an illustration of the story just heard. The child's construction was then photographed and the pieces returned to the standard arrangement. All of this was done at the child's own pace. In a pilot study[1] the average time to complete a picture was two minutes. Control subjects spent a two-minute interval after each story doing simple geometry problems. These problems were stated nonverbally to avoid semantic interference with the stories. (For example, given pictures of a square and a circle, subjects were to draw a picture of one superimposed upon the other.) After hearing every story and doing the picture or control task after each, the child was given a clue (i.e., a theme or potential title) for each story in turn and asked to retell the story without regard to its exact wording. Recall was recorded on tape for later scoring.

Scoring

Each passage was analyzed for its propositional content, and a checklist was printed listing all of the verbal, adjectival, nominal, and second-order propositions contained in the passage. For example, in analyzing the sentence:

Mary is a star quarterback because she eats grits.

We would make the following checklist:

1. Mary is a quarterback
2. Star (quarterback)
3. Mary eats grits
4. (1) because (3)

This procedure is highly reliable (see Lesgold et al., 1974). When a protocol was scored, it was examined for each proposition on the checklist. Each was classified as not recalled, recalled verbatim, recalled in synonym, incompletely recalled, or over-specified. For example, if Sentence 5 below were in the original passage, then the same noun and verb wording in a protocol would be called verbatim recall, Sentence 6 would be called synonymous recall, Sentence 7 would be incomplete, and Sentence 8 over-specified:

5. The officer patched the roof.
6. The officer repaired the roof.
7. The officer fixed the house.
8. The officer replaced some shingles.

(See Anderson, 1974, for a discussion of such sentential transformations.)

An attempt was also made to score photographs of the pictures constructed by experimental subjects. A five-point scale was used in which one point was given for each of the following criteria: (a) use of the correct background scene; (b) appropriate placement of items on the background (e.g., monkeys on monkey island and not on the picnic table); (c) at least one character or object from the story illustrated with a cutout figure; (d) no irrelevant cutouts; and (e) reasonable representation of the main idea of the story.

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[1] A pilot study with as many subjects as in Experiment I, but with several design problems, produced an identical pattern of results and thus functions as a partial replication (Lesgold et al., 1974). It was conducted within a campus laboratory school, serving a primarily middle-class population.

RESULTS AND DISCUSSION

The proportion of propositions recalled by each subject at the verbatim or synonym levels was calculated for each passage and then averaged across passages. Analysis of the data revealed that control subjects recalled significantly more propositions (32 percent) than did picture subjects (21 percent), t (22) = 2.40, $p < .05$. Previous associative-learning data (e.g., Wolff, Levin, & Longobardi, 1972) and intuition suggest that the adequacy of the illustrations assembled by picture subjects should be related to recall adequacy. Thus, even though the illustration task had a negative effect, we would expect a positive relationship between picture adequacy and proposition recall. In fact, despite the small number of Ss employed here, this is the case: $r = .57$, $p \doteq .05$.

These data indicate that when an accurate illustration was achieved, recall was better than when the illustration was inadequate. However, the illustrations were generally poor: Only 48 percent were rated as conveying the main idea of the passage, almost one-third contained irrelevant cutouts, and an additional 8 percent had wrong backgrounds. The results, therefore, can be summarized as follows for these children: The illustration task produced poorer recall. While the illustrations were often incomplete or inaccurate, the better the illustration, the better the recall.

The present results were surprising, since they are in direct opposition to the illustration (pictorial mediation) results in paired-associate learning. Our finding is compatible with findings that pictures may interfere with the acquisition of a reading vocabulary (Samuels, 1970), but it is incompatible with findings that in older children (Rohwer & Matz, in press) and adults (Bransford & Johnson, 1973) pictures facilitate comprehension of aural prose. It might, therefore, be concluded that either (a) our six-year-old subjects were simply too young to benefit from pictorial augmentation of aural prose, or (b) we failed to provide an experimental context that would produce the effect. The experiments below support the latter interpretation, in that we find that pictorial facilitation is possible under different circumstances.

III

EXPERIMENTS 2A AND 2B

Given the extent of wrong and incomplete illustrations in Experiment 1, we tentatively concluded that a major source of poor performances by Picture subjects was their inability to make good pictures. By requiring the subject to keep in mind a whole story while searching over 30 cutouts for the six he needed, interference with passage-content storage may have resulted. Similarly, presenting five different stories may also have increased interference problems during retrieval. In the remaining experiments, our strategy was to minimize retrieval difficulty by cutting back from five stories to three. We manipulated the extent to which the choice and/or assembly of cutouts was done for the subject to determine how much of the illustrating the subject could beneficially do for himself.

An additional variable that was manipulated was whether mediation took place after each sentence or after the whole passage as in Experiment 1. Previous work on associative (Wolff & Levin, 1972) and prose (Levin, 1973) learning has shown benefits when mediation was in close temporal proximity to the presentation of the material to be learned. Similarly, mediation has been found to be more effective in retardates of a mental age close to that of our normal subjects when a mediation response was elicited after each word pair (Taylor, Josberger, & Whitely, 1973). Thus, picture production after each sentence (rather than after each passage) was expected to improve performance.

METHOD

Materials

Three stories were chosen from the set used in Experiment 1 and modified to contain five sentences, each of which could be illustrated. The stories, each with an appropriate title, were recorded on tape. Each story had a unique background and a set of eight cutouts similar to those of Experiment 1. Control materials were simple geometric shapes to be colored in.

Subjects

In Experiment 2a, 48 subjects were used, 12 per condition. In Experiment 2b, 24 subjects were used, also 12 per condition. The children were from a semirural midwestern community and were all first graders. Subjects were randomly assigned to the conditions within each experiment, subject to the constraint that there be equal numbers of each sex in each condition.

Procedure for Experiment 2a

Children were tested individually. First, they were told about the reading, picturing or figure-coloring, and test components of the experiment. After instructions were given, each child received a practice sentence to listen to, a chance to illustrate that sentence with background and cutouts (if they were in a picture group), and a sample test question.

In the study phase of the experiment, the child heard each of the passages once. Picture After (PA) and Control After (CA) subjects heard a complete passage and then either illustrated it with background and cutouts (PA) or colored in five geometric forms with a felt-tip marker (CA). Picture During (PD) and Control During (CD) subjects either illustrated with cutouts (PD) or colored in one form (CD) after each sentence. In contrast to Experiment 1, Picture subjects here received only the correct background and only those cutouts needed to illustrate the sentence (PD) or passage (PA) just presented. Thus PD subjects generally had to deal with one or two cutouts at a time, while PA subjects had to deal with eight.

Following presentation and activity for the three stories, the child was asked to recall, self-paced, everything he could remember from each story, given its title as a cue. After recalling a given story, the child was asked five short-answer questions, one about each sentence of the story. All instructions and questions were presented on tape and all responses were recorded. All illustrations during the study phase were photographed.

Procedure for Experiment 2b

One condition of this experiment was identical to the Picture During condition of Experiment 2a. In the other condition, instead of giving the subject the cutouts to place on the background, the experimenter did the placement himself. All other aspects of the procedure were identical to Experiment 2a.

RESULTS

Experiment 2a

The free recall and cued recall results are shown in Table 1. Both free and cued recall proportions were analyzed via 2 (Activity: picture vs. control) x 2 (Timing: during vs. after) analyses of variance. For both measures, doing the illustration helped, in contrast to the results of Experiment 1, both p's $< .01$. For neither measure was Timing or the interaction significant, each $p > .05$. As a result of the present procedures, there were almost no inadequate picture constructions, so analysis of picture adequacy was fruitless.

Experiment 2b

The two conditions were not different on either dependent measure, each $t < 1$ in absolute value. Indeed, the Experimenter-Construct subjects obtained mean free recall scores that fell between the means for the Subject-

Construct treatment of this experiment and the identical Picture-During condition of Experiment 2a.

DISCUSSION

These experiments established that it is possible to improve children's prose recall with auxiliary illustration activity. The differences between these experiments and Experiment 1 were the number of stories, the timing of illustration, and the number of cutouts from which the subject had to pick his cutouts (the set in Experiment 1 included extraneous and potentially interfering cutouts). Timing was shown not to matter, leaving the number of stories and the amount of cutout selection required as the possible differences between the inhibitory picture effects in Experiment 1 and the positive effects in Experiment 2a. We conducted Experiment 3 to account further for potential sources of variability in illustration effectiveness.

TABLE 1

MEAN PROPORTION CORRECT ON FREE AND CUED RECALL
EXPERIMENTS 2A AND 2B

(Standard deviations in parentheses)

Condition	Free Recall	Cued Recall
Experiment 2a		
Picture During[a]	.30(.18)	.86(.14)
Control During	.19(.09)	.69(.16)
Picture After	.23(.16)	.78(.15)
Control After	.12(.08)	.60(.17)
Experiment 2b		
Subject Constructs[a]	.27(.15)	.92(.06)
Experimenter Constructs	.29(.13)	.94(.09)

Note: n = 12 in each condition.

[a]These two conditions were identical in treatment but different in subject samples.

IV

EXPERIMENT 3

As will be seen, Experiment 3 in part rules out the number-of-stories variable by getting both positive and null effects with the same number of stories (three). Similarly, it tends to rule out a simple general interference explanation, since the whole set of backgrounds and cutouts were in front of subjects in both a facilitative and non-facilitative condition. What differed between conditions was whether the experimenter or the subject selected and assembled the pictures. Since assembly by experimenter vs. subject was shown not to matter in Experiment 2a, the critical difference consisted of whether the subject or the experimenter had to select the appropriate cutouts for an illustration.

METHOD

Subjects

Thirty-six first graders from the same source as in Experiment 2 were assigned in equal numbers, by sex, to three experimental conditions.

Materials and Procedure

The materials were identical to those in Experiment 2, except that all backgrounds and cutouts were visible to the subjects in the two picture conditions. Similarly, the procedures corresponded to Experiment 2 except as follows: The children in the Subject-Construct condition chose their background and cutouts and illustrated after each passage; the Experimenter-Construct subjects had the choosing and illustrating done for them; and Control subjects colored in five forms after each passage.

RESULTS

If choosing of cutouts is the critical factor in the effectiveness of illustration, then subjects in the Experimenter-Construct condition should do better than Control subjects, while the Subject-Construct mean should be no higher than the Control mean and perhaps lower. We tested these predictions using Dunnett's test with $\alpha = .05$.

For free recall, there were no significant deviations from the Control subjects' mean level of 18 percent recall, though the observed differences were in a direction consistent with the above hypothesis: 24 percent for Experimenter-Construct and 16 percent for Subject-Construct. In cued recall, Experimenter-Construct was significantly better than Control (83 percent vs. 54 percent), while the Subject-Construct group (68 percent)

did not differ from Control. Within the Subject-Construct condition, picture adequacy (as scored in Experiment 1) correlated .40 with free recall and .47 with cued recall, not statistically significant with only 10 degrees of freedom, but comparable to the correlation of .57 observed in Experiment 1 with more stories and more cutouts.

V

GENERAL DISCUSSION

The experiments reported here indicate that illustration activity facilitates acquisition of orally-presented prose by six-year-old children when the choice of objects to be used in the illustration is not left to the child. However, if the child must make inter-object decisions (concerning which objects are appropriate and which are not), no effect, or even inhibition, is observed.

At the same time, it might be argued that illustration (when it works) for six-year-olds merely provides a second rehearsal of the passage content, rather than a more efficient means of cognitive processing. Although this possibility cannot be definitively ruled out (since it was not directly tested for here), on the basis of available data the argument is not very compelling. In the first place, in associative-learning and comprehension studies where subjects are given opportunities for multiple rehearsal of the same content, performance is not appreciably improved and under certain conditions (see Bower, 1972) it is even worsened. These results have been obtained in both adult and child populations (see Levin, 1974). Somewhat akin to these findings, extra rehearsals or item repetitions are found to help primarily when such inputs are spaced rather than massed. However, as may be seen in Table 1, a simple rehearsal explanation will not suffice inasmuch as the massed illustration "repetitions" (PD) were at least as beneficial as the spaced ones (PA).[2] We prefer to interpret the present facilitative effects of illustration in terms of the higher-level cognitive processes that are likely evoked by subjects' participating in or observing the constructive activity and/or their dual verbal-imaginal encoding of the subsequent product. A teasing apart of the possible components attributed to picture construction would be desirable and, fortunately, seems experimentally plausible.

A developmental pattern is emerging which shows that imagery effects in prose learning appear to lag a few years behind imagery effects in associative learning. Children at age seven will benefit from imagery instructions in associative learning without training (Levin et al., 1973), while nine-year-old children still need training to benefit from imagery instructions in their prose recall (Lesgold et al., 1974). Six-year-old children can benefit from observing or constructing illustrations for paired associates (McCabe et al., 1974; Rohwer, 1967), while they are limited in their ability to benefit from construction in prose learning, according to our results here. However the imagery or overt mediation strategy has less potential for interference in associative learning. Hence, it would be advisable to directly compare associative and prose learning before insisting upon the developmental lag hypothesis. (But see Reese, 1972.)

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[2] Paivio's (1974) account of picture-word differences and the spacing effect is also relevant here.

At the same time, though, the consecutive stages of elaborative ability are remarkably similar for associative learning and for prose learning. This suggests that it is only the extra central computing capacity (in the sense of Pascual-Leone, 1970) that prose requires which produces a developmental lag relative to paired-associate mediation, and not a qualitative difference in the order of appearance of the mediation skills. Pascual-Leone (1970) has presented evidence of a linear increase in general processing capacity throughout the childhood years. Ability to keep track of several information codes or processes simultaneously improves over the period from five to eleven years. The overall context or theme of a prose passage may be one extra thing to keep track of in prose learning, which may account for prose-learning skills being about two years behind associative-learning skills.

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