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ABSTRACT

This paper examines the use of elaboration and overt rehearsal as strategies for increasing kindergarten children's retention and recall of shape names. The study is part of a large scale investigation concerned with improving the school achievement of Hawaiian and part-Hawaiian children. Twenty-four kindergarten children enrolled in a demonstration school of the Kamehameha Early Education Program(KEEP) participated in the study. Each child was assigned to one of three treatment conditions: (1) elaboration, in which a shape name was associated with a common object and included in a story; (2) rehearsal, in which the child repeated the shape name until a new shape was introduced; and (3) control, in which the child was asked to trace the shape and say its name. Recall was examined immediately after training, two hours later, and one week later. Results indicated no significant differences between the groups on immediate recall. Elaboration subjects, however, had superior recall on the long-term (one week later) test. Across groups, subjects' scores were positively related to IQ and to number of acquisition trials, and negatively related to delay of testing after training. The educational implications for using elaboration as an instructional strategy are discussed. (BD)

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The Kamehameha Early Education Program

The Kamehameha Early Education Program (KEEP) is a research and development program of The Kamehameha Schools/Bernice P. Bishop Estate. The mission of KEEP is the development, demonstration, and dissemination of methods for improving the education of Hawaiian and Part-Hawaiian children. These activities are conducted at the Ka Na'i Pono Research and Demonstration School, and in public classrooms in cooperation with the State Department of Education. KEEP projects and activities involve many aspects of the educational process, including teacher training, curriculum development, and child motivation, language, and cognition. More detailed descriptions of KEEP's history and operations are presented in Technical Reports #1-4.

Abstract

Two promising strategies for expediting recall are elaboration and overt rehearsal. In a study with both theoretical and curriculum-development implications, these two instructional strategies were compared in their facilitation of kindergarteners' retention of shape names. Elaboration refers to the association of two unconnected stimuli (a shape name and a common object) in a meaningful context (a familiar story). Induced overt rehearsal involves repetition of the shape names. A third condition, which held other elements of instruction constant, served as control.

While groups did not differ in the number of correct labels produced on a short-term (immediate) test, elaboration subjects had superior recall on a long-term (one week later) test. Across groups, subjects' scores were related to IQ, number of acquisition trials, and negatively related to delay of testing after training. Implications of the results are discussed in terms of the elaboration construct.

Technical Report #31

The Effects of Elaboration and Rehearsal on

Long-Term Retention of Shape Names by Kindergarteners^{1,2}

Ronald Gallimore David J. Lam Gisela E. Speidel Roland G. Tharp

Elaboration is the mediational process through which previously unconnected verbal or pictorial stimuli are related by being embedded within a common context. Thus, children perform better on a paired associate task when supplied with an elaborative prompt (e.g., a sentence or picture), which embeds each stimulus pair within a meaningful context. This phenomenon has been reliably demonstrated with both normal children (Rohwer, 1971) and retarded children (Jensen and Rohwer, 1963).

Rohwer (1971) has suggested that complex, naturally occurring tasks, as well as simple paired associate trials, are influenced by the elaboration process. However, Bender and Taylor (1973) noted that Rohwer's proposition remains largely untested; their study extended analysis of elaboration effects to recognition measures, a common classroom task. They compared educable mentally retarded students on accuracy of posttraining recognition of pictures of common objects, animals, and people, and found that students in the elaboration condition recognized significantly more associative groupings than

¹Tom Ciborowski, Violet Mays, and Larry Loganbill are due our appreciation for contributions to this experiment. A version of this paper was presented at the annual meeting of the Hawaii Psychological Association, Honolulu, May, 1973.

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those in two comparison groups.

The crucial research operations used by Bender and Taylor included two elaboration-activating components: (1) a story told by the experimenter which integrated pictures that were later to be recognized in a display; and (2) an instruction to students to "think about the picture and the story." Rohwer (in press) describes such a procedure as an "augmented explicit prompt", in which items to be coupled are presented in the context of a story or sentence, or depicted graphically to suggest a connecting event.

The present experiment extended analysis of elaboration effects to yet another complex and commonly used classroom task, recognition-recall. In this instance, kindergarten children were taught, and subsequently asked, to verbalize the names of various geometric shapes, a task typical in kindergarten reading readiness lessons. Elaboration activation consisted of stories about familiar things in which the shape names were embedded. Thus, the stories acted as augmented explicit prompts. Elaboration was expected to produce significantly better long-term recall than a second instructional condition or a control group.

The second experimental condition stemmed from the work of Flavell and his associates (Flavell, Beach, and Chinsky, 1966; Keeney, Cannizzo, and Flavell, 1967). They have shown that inducing children to overtly rehearse facilitates retention in serial recall tasks. Specifically, Keeney et al. found that brief training sufficed to induce nonrehearsers to rehearse; this resulted in recall scores that were almost indistinguishable from those of spontaneous rehearsers. They concluded that a child's unmediated behavior is due to a failure to produce an appropriate mediator such as rehearsal (i.e., a production deficiency) rather than an inability to use it effectively (i.e., a mediation deficiency). In the present experiment, the children were made

to overtly rehearse by requiring them to say the name of the shape several times while looking at a slide picture of the stimulus. A third condition, described in Method, served as a control.

Another feature of the present study was its investigation of the effects of instructional conditions (elaboration and rehearsal) over time. In addition to immediate posttraining testing, intermediate (two hour posttraining), and long-term (one week posttraining) recall-recognition were measured and compared.

This research was part of a large-scale investigation concerned with enhancing the school achievement of a minority culture (Hawaiian and part-Hawaiian), and is related to the larger question of cognitive activation. The present study is an example of how curriculum design can be guided by basic experimental findings. For instance, the experimental conditions represented a close analogue of an actual classroom in several ways, including: a) the use of repeated instruction sessions, and b) the concern with immediate, intermediate, and long-term retention. If elaboration strategies indeed prove superior, actual curriculum adjustments can follow. The experimental stimuli were chosen not only for their theoretical interest, but also because they are relevant to prereading instruction.

Method

Subjects

Twenty-four kindergarteners enrolled in a demonstration school (Kamehameha Early Education Program) participated in the study. They averaged 5.5 years (range = 4 to 5) and came from diverse ethnic backgrounds (about 75% were part-Hawaiian). Families invited to enroll their children were randomly selected in such a way as to insure that the project school would be representative of

a typical public school kindergarten class in an urban area of greater Honolulu.

Procedure

Students were blocked by Wechsler Preschool and Primary Scale of Intelligence (WPPSI) IQ scores and randomly assigned to one of the three treatment conditions. IQ ranges were: high (103-128); medium (85-97); and low (63-81). In the first week, subjects participated during a single day in three individual lessons (spaced at about 45 minute intervals), following each of which they were immediately tested (short-term memory). Testing was repeated approximately two hours after the last acquisition session (intermediate-term memory), and a third time after a week had elapsed (long-term memory). This procedure was replicated during the second and third weeks. The design thus involved four experimental variables: two fixed factors of treatment condition and IQ block, and two repeated measures of test and week, with three levels to each factor.

The items to be learned were 12 names of shapes, ranging from easy to intermediate to difficult. The shapes are presented in the description of the elaboration condition.

Four shapes were shown in each lesson, which was presented by a synchronized slide-cassette program. Order of presentation, time allotted to each lesson, and inter- and intratrial intervals were held constant, as were the behaviors required of the students (tracing the shape, and saying its name). The tracing and naming of the shapes was an important element of experimental control. This step occurred in all groups immediately after each shape was presented on the screen and named by the "teacher" on the tape; it insured that students attended to the appropriate stimulus and could actually verbalize the shape name. All training was conducted with individual students.

Elaboration condition. The stories in which the shape names were embedded contained brief references to objects, places, and persons familiar to the children. For instance, in one story a fictitious part-Hawaiian kindergartener was on his way to school (in the same neighborhood as the school attended by students in the experiment); he came to an intersection and would not cross the street until the green light was on. The story made the point that the street light had the shape of an arrow. Similar "stories" linking the shape name to a common object were written for each shape. Specifically, the pairs were: ('easy') circle-plate, square-TV screen, triangle-a piece of pie; ('intermediate') rectangle-story book, oval-wash basin, cross-two band-aids, arrow-street light, clover-cookie, crescent-slice of watermelon; ('difficult') rhombus-napkin, octagon-stop sign, and trapezoid-work table.

Rehearsal condition. The student traced and verbalized each shape name as did students in other groups. Then the "teacher" on the tape instructed the child to continue looking at the shape, and to keep saying its name "out loud" until the next shape came on the screen. The shape appeared on the screen for a fixed interval of time, identical to elaboration and control conditions. This condition controlled for repeated association of the shape name and the graphic representation of the shape in the absence of the embedding story. It also provided a comparison of another facilitative strategy for early childhood learning derived from child development research (Flavell et al., 1966; Keeney et al., 1967).

Control condition. In this condition students simply traced each shape and said its name as it appeared on the screen after hearing its name on the tape. Again, each shape remained on the screen for an interval identical to the two experimental conditions, but no further response was required of the child, nor were additional instructions or cues presented on the tape.

The dependent measure was number of correct verbal labels produced by the child upon the successive presentation of shapes (on 5" x 8" cards) by the tester. As during acquisition, testing was conducted individually with the order of presentation held constant; also, the tester was blind to the student's treatment condition. For analysis, the three short-term test scores (four shapes each) were summed for each student for each week of the experiment; the intermediate- and long-term tests covered all 12 shapes at the same time. Thus, 12 was the maximum score for each of the three tests. All lessons were supervised by an experimenter who performed technical functions, escorted the children, and recorded their behaviors while sitting to the side, but did not otherwise interact with the children.

In only a few instances did children fail to comply with instructions to trace and name the shape (all conditions), and repeat the shape name three times (rehearsal only). The experimenter prompted the children in those cases, and they then exhibited the required acquisitional behaviors.

Results

A 4-way repeated measures analysis of variance was run, yielding significant terms presented in Table 1. The experimental condition was nonsignificant as a main effect ($F = 1.4303$, n.s.) but IQ, test, and week all were significant ($F_s = 15.9876$; 23.3230 ; 33.0413 , respectively, $p < .01$). Condition did interact significantly with test ($F = 2.6756$, $p \approx .05$), as well as with all of the other three experimental variables ($F = 2.4589$, $p < .05$). The test x week term was also significant ($F = 3.5676$, $p < .05$).

Inspection of the data reveals that, as expected, test score was a direct function of the student's IQ [Mean High (7.3951) > Mean Medium (5.9259) > Mean Low (4.5741)]. Also, not surprisingly, students' performance improved with

Table 1

Results of 4 - Way Analysis of Variance Denoting Significant Terms

Source	df	Sum of Squares	Mean Square	F
B	2	263.7160	131.8580	15.0876**
S(AB)	15	131.0926	8.7395	
C	2	54.3611	27.1806	23.3230**
AC	4	12.4722	3.1181	2.6756*
S(AB)C	30	34.9629	1.1654	
D	2	69.9153	34.9577	33.0413**
S(AB)D	30	31.7407	1.0580	
CD	4	7.2236	1.8059	3.5676*
ABCD	16	19.9148	1.2447	2.4589
S(AB)CD	60	30.3705	0.5062	
Total	215	809.8333		

* p < .05

** p < .01

A = Experimental condition

B = IQ block

C = Test

D = Week

progressive trials[(Mean 1st Week (5.483) < Mean 2nd Week (6.111) < Mean 3rd Week (6.8472)]; scores were higher on the short-term test (Mean 6.8472) than either the intermediate-term (Mean 5.8194) or long-term (Mean 5.7500) tests, which did not differ from each other.

With regard to significant interactions, both test x week and condition x test were of the divergent type. In the former, short-, intermediate-, and long-term tests all showed positive gains across weeks but the rate of such gain was not parallel. A plot of the test x week (figure 4) indicates that the short-term test had the steepest slope.

Test effects were also not uniform across the three experimental conditions; here, control and rehearsal conditions evidenced decreasing (negative) slopes.

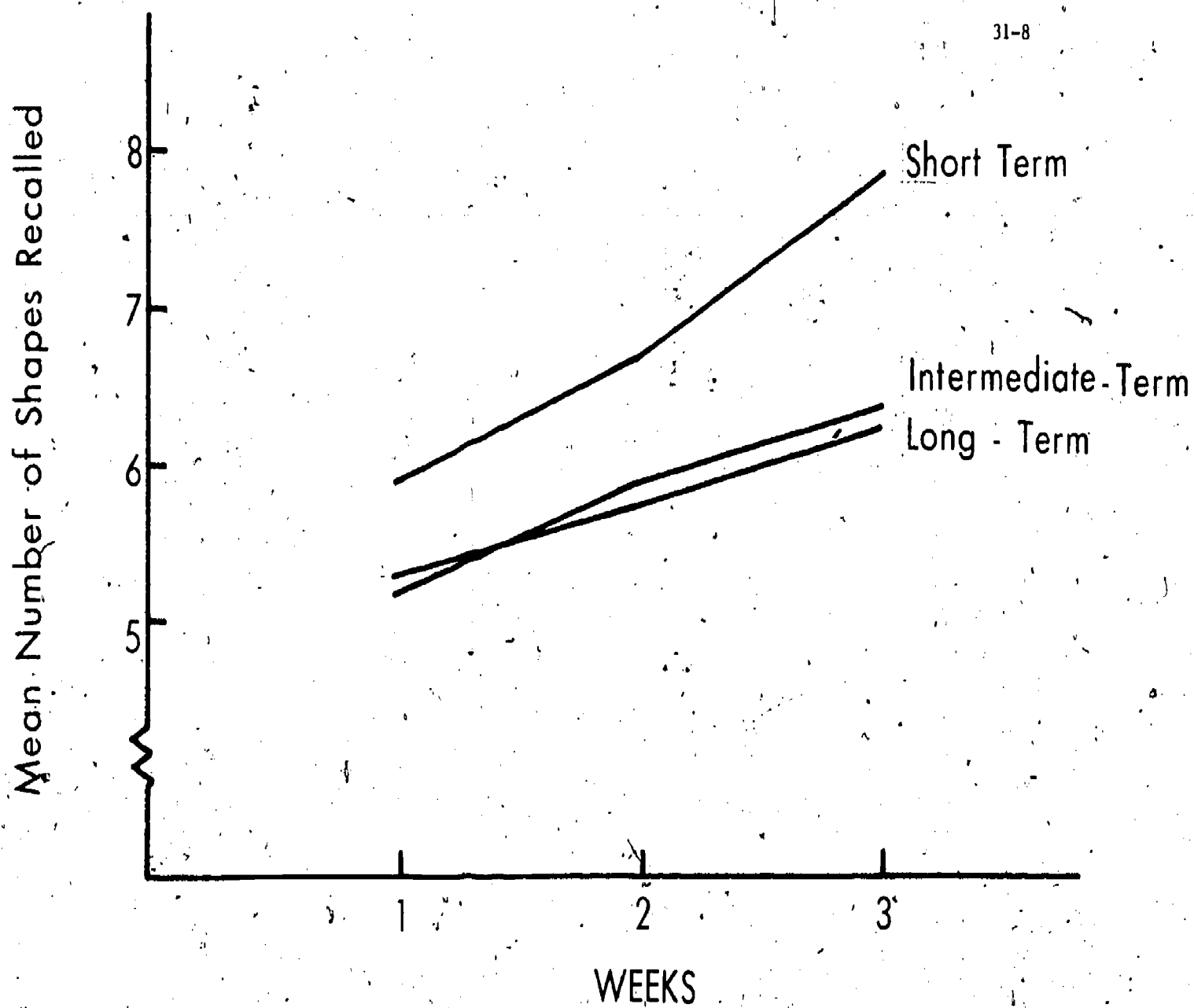


Fig.1. Mean Number of Shapes Recalled: Test \times Week Interaction

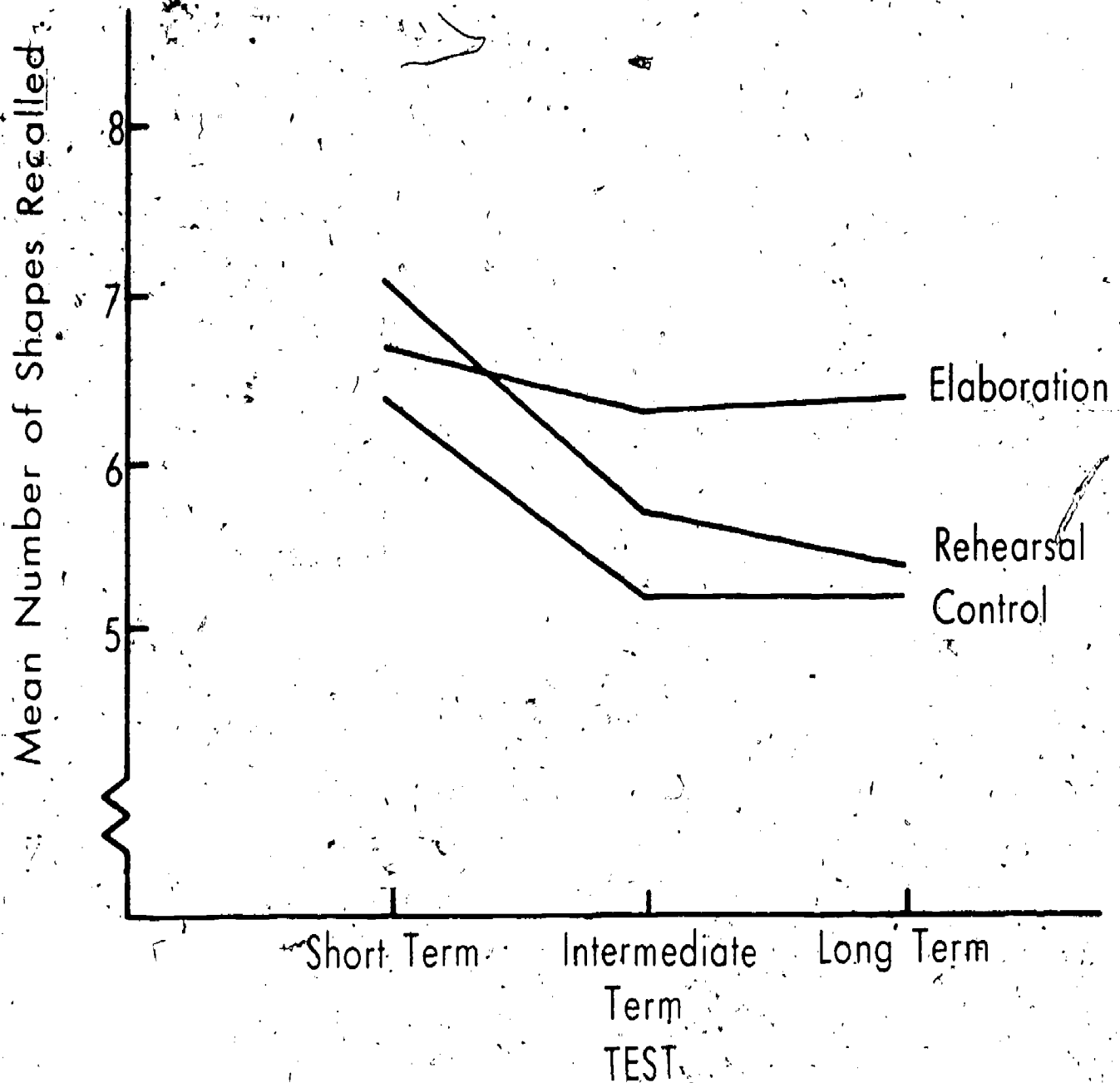


Fig. 2 Mean Number of Shapes Recalled: Treatment \times Test Interaction

as subjects were tested progressively longer after the lessons; however, subjects in the elaboration condition showed virtually no loss of retention (figure 2). The superiority of elaboration emerges on the intermediate test, and becomes more pronounced on the long-term test as further decay occurs in the other two conditions.

The effect of experimental conditions on the long-term retention of shape names was of greatest practical import. Multiple t -tests comparing the three experimental conditions, collapsing across IQ blocks and weeks, yielded significant differences in long-term recall, favoring the elaboration condition. The overall mean long-term test scores were 5.33, 5.46, and 6.46 for control, rehearsal, and elaboration conditions. Comparison of control and rehearsal long-term test scores yielded no reliable difference ($t=0.2254$, $df=45$, n.s.). The elaboration condition, however, yielded long-term scores of significantly greater magnitude than the control condition ($t=2.0289$, $df=45$, $p < .05$). Elaboration also produced marginally superior long-term retention than rehearsal ($t=1.8034$, $df=45$, $.05 > p > .10$). All p values are two-tailed; a pooled variance estimate was used to compute the standard error of a single mean since the means included both within and between subject variability.

Discussion

The results add to the growing evidence in support of Röhwer's elaboration construct, most notably, the superior long-term retention of the children in the elaboration condition.

Plausible alternative interpretations include a nonspecific motivation effect associated with the story and other features of the elaboration manipulation. Thus, superior performance might be attributed to greater student interest or attention. However, the effects of the elaboration manipulation were sufficiently specific to produce relatively frequent intrusions of the

familiar-linked item on the postexperimental retention tests. For example, some children in the elaboration condition said (during testing) "bandaid" rather than "cross", or "watermelon" rather than "crescent."

Also, it is possible that children in the elaboration condition could have been prompted to rehearse the object-shape connection by exposure to relevant stimuli at home and in the community. Since this is an extension of the elaboration hypothesis, it can be entertained without contradiction of the proposed interpretation of the results.

The present experiment closely approximated common classroom practices. The children were given three-a-day lessons, once a week for three weeks, with retention tests given as long as one week after training sessions. To conduct this and other relatively extended, realistic evaluations of strategy-based teaching requires a degree of school and teacher cooperation that is not always possible to obtain. However, the present results appear to point clearly to the need for extended assessment periods, since performance differentials were revealed only on the long- and intermediate-term retention tests.

The children in this study are members of low income cultural minorities residing in urban Honolulu. The study was part of a larger effort to improve the educational achievement of this population. In the absence of appropriate control groups, no social or cultural inferences can be made. However, the study is consistent with the observation that minority children exhibit a production rather than a mediation deficiency (Flavell, et al., 1966). That is, performance in a variety of school-like tasks can be enhanced by manipulations which activate cognitive processes, such as elaboration. Thus, as Cole and Bruner (1971) have noted, education of children from underachieving minorities need not be based on creating "new" cognitive structures, but on helping children apply skills already possessed to the tasks at hand.

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