DOCUMENT RESUME

ED 082 141 CS 000 731

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TITLE	Imagery in Transfer.
INSTITUTION	Wisconsin Univ., Madison. Research and Development Center for Cognitive Learning.
SPONS AGENCY	National Inst. of Education (DHEW), Washington, D.C.
REPORT NO	TR-249
PUB DATE	Apr 73
CONTRACT	NE-C-00-3-0065
NOTE	16p.; Report from the Semantic Components of Concept Learning Project
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Cognitive Development; *Cognitive Processes; *Communication (Thought Transfer); Educational Research; Elementary Education; *Imagery; Negative Forms (Language); *Paired Associate Learning; *Response Mode; Semantics; Stimulus Behavior

ABSTRACT

Second- and fourth-grade children learned two 25-item, paired-associate mixed lists under three experimental conditions: instructed imagery, imposed imagery, and control. Four specific transfer paradigms and a reference paradigm were represented in the lists. The specific transfer paradigms were constructed such that a first list stimulus term (a pictured, multiple-meaning word) was represented in a second list as an identity or changed with respect to its image, function, or meaning. Analysis of the specific effects revealed monotone-decreasing negative transfer across the change paradigms. The effect was more pronounced for second-grade subjects. (Author)

Technical Report No. 249

IMAGERY IN TRANSFER

by

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Report from the Semantic Components
of Concept Learning Project

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April 1973

Published by the Wisconsin Research and Development Center for Cognitive Learning, supported in part as a research and development center by funds from the National Institute of Education, Department of Health, Education, and Welfare. The opinions expressed herein do not necessarily reflect the position or policy of the National Institute of Education and no official endorsement by that agency should be inferred.

Center Contract No. NE-C-00-3-0065

Statement of Focus

Individually Guided Education (IGE) is a new comprehensive system of elementary education. The following components of the IGE system are in varying stages of development and implementation: a new organization for instruction and related administrative arrangements; a model of instructional programing for the individual student; and curriculum components in prereading, reading, mathematics, motivation, and environmental education. The development of other curriculum components, of a system for managing instruction by computer, and of instructional strategies is needed to complete the system. Continuing programmatic research is required to provide a sound knowledge base for the components under development and for improved second generation components. Finally, systematic implementation is essential so that the products will function properly in the IGE schools.

The Center plans and carries out the research, development, and implementation components of its IGE program in this sequence: (1) identify the needs and delimit the component problem area; (2) assess the possible constraints—financial resources and availability of staff; (3) formulate general plans and specific procedures for solving the problems; (4) secure and allocate human and material resources to carry out the plans; (5) provide for effective communication among personnel and efficient management of activities and resources; and (6) evaluate the effectiveness of each activity and its contribution to the total program and correct any difficulties through feedback mechanisms and appropriate management techniques.

A self-renewing system of elementary education is projected in each participating elementary school, i.e., one which is less dependent on external sources for direction and is more responsive to the needs of the children attending each particular school. In the IGE schools, Center-developed and other curriculum products compatible with the Center's instructional programing model will lead to higher student achievement and self-direction in learning and in conduct and also to higher morale and job satisfaction among educational personnel. Each developmental product makes its unique contribution to IGE as it is implemented in the schools. The various research components add to the knowledge of Center practitioners, developers, and theorists.

Acknowledgments

We are grateful to Pat Divine-Hawkins and Jim Horvitz for collecting the data.

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Abstract

Second- and fourth-grade children learned two 25-item paired-associate mixed lists under three experimental conditions: instructed imagery, imposed imagery, and control. Four specific transfer paradigms and a reference paradigm were represented in the lists. The specific transfer paradigms were constructed such that a first list (A-B) stimulus term (a pictured, multiple-meaning word) was represented in a second list as an identity (A-C) or changed with respect to its image (A^I-C), function (A^F-C), or meaning (A^S-C). Analysis of the specific effects revealed monotone-decreasing negative transfer across the change paradigms. The effect was more pronounced for second-grade Ss.

I
Introduction

Information about encoding processes in learning can be obtained by tests of transfer (Postman, 1971). Using a variety of specific transfer paradigms, Davidson (1972) attempted to establish the relationships between verbal (sentence) and imagery encodings in paired-associate (PA) learning. In one of these--a semantic change paradigm, A-B, A^S-C (hereafter A^S-C)--the stimulus term, a multiple-meaning word, was manipulated by sentence context or by a change in pictorial representation to signal a different meaning for the term across lists. For example, the stimulus term "bat" might be rendered as a flying mammal and as a baseball bat in sentences or pictures over lists. This kind of manipulation has been found to produce marked negative transfer (Davidson, Schwenn, & Adams, 1970). Negative transfer under the A^S-C paradigm is surprising on two counts. First, on the basis of a number of theoretical arguments (Davidson, 1972), A^S-C should function as a control (A-B, C-D) paradigm. That is, the stimulus term is semantically or conceptually different over lists (e.g., the two definitions of "bat"); yet despite the difference in meaning and despite a pictorial rendering of that difference, the Ss are led into negative transfer. Second, the negative transfer in A^S-C is surprising in view of the findings of Cramer (1969) and Postman and Stark (1969) that Ss have the ability to "turn off" conditions of interference.

On the other hand, negative transfer in the A^S-C paradigm has always been found under experimental conditions wherein the experimenter or subject was required to label aloud the stimulus terms. Thus, overt verbalization or a verbal encoding of the stimulus terms may have been sufficiently powerful to produce negative transfer in spite of meaning differences or Ss' ability to turn off conditions of interference.

The present experiment, then, was designed to provide additional support to the Ss to avoid verbal encoding (labeling) while maintaining the specific transfer conditions that were shown to produce negative transfer. To that end children were presented pictures of common objects under two experimental conditions designed to encourage imagery encoding--subject-generated imagery and experimenter-imposed imagery (Davidson & Adams, 1970; Levin, 1972). The training conditions and the task requirements for the imagery manipulations were such that the S was not required to verbalize the names of the objects while generating an image or observing a pictorial interacting "image." Under such conditions the negative transfer that is assumed to follow from verbal encoding would be minimized.

A major objective of the experiment was to extend the study of transfer to two new paradigms--paradigms that vary the original stimulus term in different ways. For example, the exact semantic content of the stimulus term might be retained but the exact (retinal) image (physical features) would change over lists (e.g., latch key in first-list learning; skeleton key in the second list). The paradigm is A-B, A^I-C (A^I-C). Or the stimulus term might be changed with respect to some aspect of its function while remaining a member of the same semantic class (e.g., tire pump and water pump). The paradigm is A-B, A^F-C (A^F-C). The specific effects of these transfer paradigms were to be evaluated in terms of paradigms used in earlier studies--i.e., the traditional reference (control) paradigm, A-B, C-D (unrelated stimuli and unrelated responses over lists); the traditional negative-transfer paradigm, A-B, A-C (identical stimuli and unrelated responses); and the complete semantic change paradigm, A^S-C. Under the assumption that negative transfer is, in part, a function of verbal encoding, and with the additional assumption that the imagery manipulations would minimize the verbal encoding, then the transfer effects observed should be solely a function of the degree of similarity (imaginal or semantic) between the original and transfer stimulus. Thus, in the context of this experiment monotone-decreasing negative transfer is predicted as the stimulus terms in transfer share fewer physical and/or semantic features with the original stimulus.

Finally, the ages of the Ss could be an important variable relating verbal encoding to performance in transfer. Relatively older children might spontaneously and covertly label or syntactically mediate the item pairs while younger children might not. Thus differentially greater negative transfer would characterize the performance of older Ss under the change paradigms.

II
Method

Subjects

A total of 96 second- and fourth-grade children from one rural school were assigned at random to one of three independent treatments.

Experimental Conditions and Materials

All Ss learned the same PA items under one of the three experimental conditions: instructed imagery (S generation of an interacting image of side-by-side pictured objects), imposed imagery (S observation of an E-composed interacting "image"), and control (normal PA instructions for side-by-side pictures).

Each of the five transfer paradigms (C-D, A-C, A^I-C, $A^{\bar{I}}$-C, A^S-C) was represented by five PA items, yielding 25-item lists. Figure 1 shows examples of the paradigms under the imposed imagery condition. For the remaining experimental conditions exactly the same pictured objects were depicted side-by-side. The pictures were mounted on 6" x 9" cards and bound in three-ring binders.

The 25 pairs were randomized in mixed lists for both the original and transfer tasks. Three random orders of each list were prepared.

Procedure

The Ss participated individually. Prior to first-list learning, the task was described and S was given practice following instruction appropriate to his experimental condition.

A study-test recognition procedure was used. Study time was 5 sec. per pair followed by a subject-paced test. During the test the unlabeled picture of the stimulus item was shown, and the S tapped his response choice with the eraser end of an unsharpened pencil. A vertical 19" x 24" card depicting all 25 response items was within easy reach of the S.

First-list learning criterion was 23/25, and the second list was presented for three study-test trials. The S was moved to the transfer list immediately upon reaching criterion. Following transfer, each S was asked to name the stimulus items for both lists.

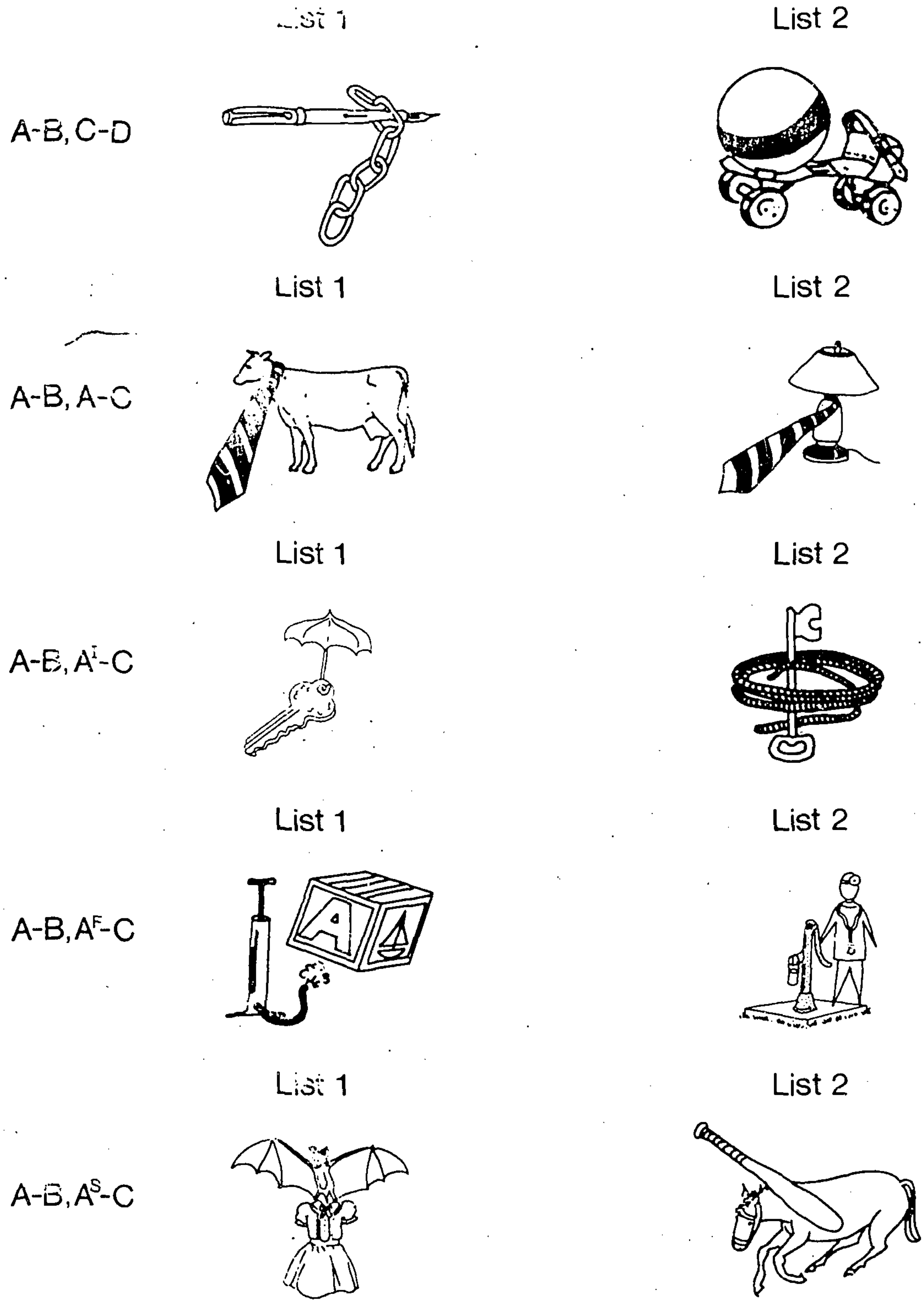

Fig. 1. Examples of the materials used for the five paradigms.

III
Results

Although it was intended that the present experiment be developmental in its scope (i.e., that transfer effects for second- and fourth-graders be compared), this was only partially accomplished. The reason for this stems from subject attrition in the second-grade sample, where several Ss in all but the E-imposed imagery condition failed to reach the first-list criterion (despite the fact that up to 15 study-test trials were provided). On the other hand, all fourth graders in all conditions reached criterion. Thus, the data were analyzed in two phases in order to avoid grade-by-attrition confounding.

In the first phase only the data of the intact fourth-grade sample were considered. In the second phase the data of the intact second-grade condition (E-imposed imagery) were compared with those of the corresponding fourth-grade condition.

Analysis of Fourth-Grade Data

Acquisition: List 1 and List 2

Performance in List 1 acquisition varied as a function of experimental condition. In terms of trials to criterion, an average of 6.7, 4.9, and 2.8 trials were required in the control, S-generated, and E-imposed conditions, respectively. For number of errors over the first two trials, the corresponding figures were 35.44, 23.56, and 17.00. Analysis of variance on these latter data revealed a significant conditions effect ($F = 11.79$, $df = 2/45$, $p < .001$). Tukey post hoc comparisons ($\alpha = .05$) detected a significant difference between the control and each imagery condition, but not between the two imagery conditions. The general pattern of these results agrees with those of Wolff and Levin (1972), who compared the same three conditions in a third-grade sample.

The conditions effect was still present in List 2 acquisition when errors over the three transfer trials were analyzed ($F = 12.99$, $df = 2/45$, $p < .001$). Tukey post hoc comparisons ($\alpha = .05$) revealed that the E-imposed imagery condition was superior to S-generated imagery, which in turn was superior to the control (an average of 13.81, 26.62, and 39.00 errors, respectively).

Specific Transfer Effects

The major questions of the present experiment focused on the five within-S transfer paradigms. In particular it was of interest to determine which of the four experimental paradigms (A-C, A^I-C, A^F-C, and A^S-C) were significantly inferior to the reference paradigm (C-D). Additionally, a monotonic decrease in negative transfer had been predicted among the experimental paradigms as the pictured stimulus term of A-B was rendered identically (A-C) and then changed with respect to its image (A^I-C), function (A^F-C), and meaning (A^S-C), respectively. To investigate the former question, each experimental paradigm was compared with the control paradigm using Dunnett's multiple comparison procedure ($\alpha = .05$, one-tailed) adapted to correlated observations. To investigate the second question, a contrast defining a monotonic relationship in the experimental paradigms was tested with $\alpha = .05$, one-tailed. Deviations from monotonicity within the experimental paradigms were tested multivariately with $\alpha = .05$.

The data bearing on these questions are plotted in Figure 2, where the control (C-D) paradigm mean has been subtracted from the mean of each experimental paradigm, and therefore may be taken as a transfer index. Although only the A^I-C (and not A-C) represents a statistically significant negative transfer effect, the test for monotonicity was significant

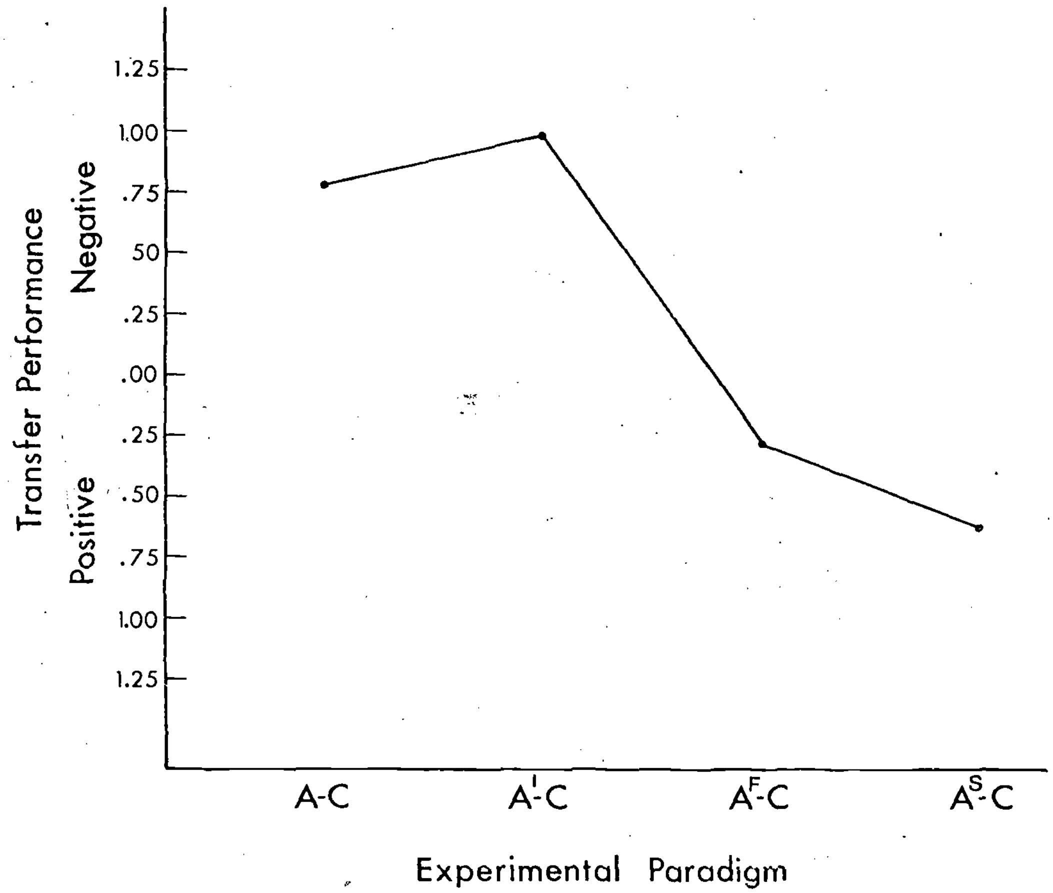

Fig. 2. Transfer performance as measured by the differences between the reference paradigm (C-D) and each experimental paradigm.

in the predicted direction ($t = -4.14$, $df = 45$, $p < .001$). In addition, no significant departures from monotonicity were detected ($F = 2.72$, $df = 2/44$, $p > .05$).

Although there were effects due to conditions and paradigms (as previously indicated), the two factors did not interact (all p's $> .10$). Interestingly, this finding, which implies that the two factors functioned independently in this experiment, is consistent with that of Horvitz and Levin (1972), who were able to manipulate S-generated imagery independently of sentence meaning in a sixth-grade sample.

A multivariate test of the trials effect was significant ($F = 128.57$, $df = 2/44$, $p < .001$), although trials did not interact with either the conditions or paradigms factors (all p's $> .10$).

Comparison of Second- and Fourth-Grade Data

Acquisition: List 1 and List 2

A comparison of second- and fourth-grade performance in the E-imposed condition was made. No significant grade differences in total performance were found on either List 1 or List 2 (F's < 1).

Specific Transfer Effects

Across grades on List 2, the transfer effects paralleled those of the fourth-grade data alone. In this case, however, both A-C and A^I-C resulted in significant negative transfer according to Dunnett's test, while

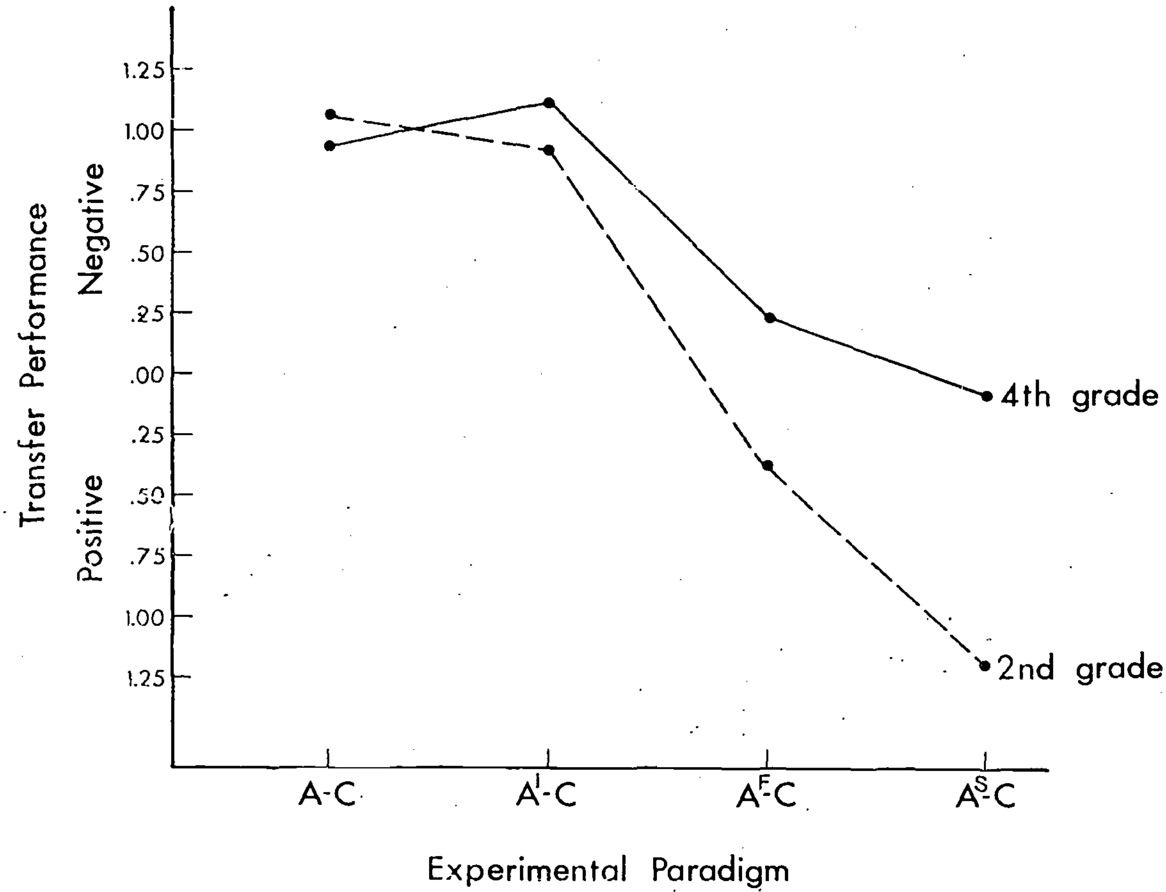

Fig. 3. Transfer performance for second- and fourth-grade Ss in the imposed-imagery condition as measured by the differences between the reference paradigm (C-D) and each experimental paradigm.

A^{F}-C and A^{S}-C did not. As before, a significant monotonic decrease in errors for the experimental paradigms was detected ($t = -5.44$, $df = 30$, $p < .001$) with no significant departures from this relationship ($F < 1$).

It will be recalled that stronger List 2 paradigm effects had been predicted for second graders than for fourth graders, since it was argued that Ss in the former sample would be less likely to label covertly the stimulus items. The data relevant to this prediction are plotted in Figure 3, where it may be seen that the negative monotonic relationship is more pronounced in the second-grade sample than in the fourth-grade sample. Statistically, the interaction was significant in the predicted direction ($t = 1.91$, $df = 30$, $p < .05$), with deviations from the monotonic interaction test being nonsignificant ($F < 1$).

A significant paradigms by trials interaction was also obtained ($F = 2.69$, $df = 8/23$, $p < .05$) which revealed that the monotonic relationship among the experimental paradigms was more pronounced on Trial 1 than on Trials 2 and 3. The three-factor interaction involving paradigms, trials and grades was nonsignificant ($F < 1$).

IV
Discussion

While it is impossible to say with any certainty that Ss did not encode the stimuli with verbal labels or sentences, the data suggest that such activities were minimized in this experiment. In particular, the use of unlabeled picture pairs shows that the A^S-C paradigm per se was sufficient to reduce negative transfer. This finding contrasts sharply with the results reported by Davidson (1972) and Davidson, Schwenn, and Adams (1970), but it follows directly the prediction for the A^S-C paradigm. That is, varying the physical and semantic features of unlabeled stimuli from one list to the next proved to be all that was needed for A^S-C to be functionally C-D. The inclusion of an "imagery" context (either E-provided or S-generated) did not produce additional reductions in interference beyond that associated with the experimental conditions main effect.

However, the experimental procedures used to encourage imagery encoding also allowed the S to label (covertly) List 1 and List 2 stimuli with different labels if he were so inclined. Posttransfer inquiry indicated that 25 percent of the stimulus terms were, in fact, given different names--e.g., "pump" in the first list and "well" in the second. But the error percentage on items labeled "different" was 51 percent overall as compared with 54 percent on items labeled "same." Analyses for each of the change paradigms revealed little association between performance (error or no-error) and item labels ("different" or "same")--$\phi(A^I-C) = .12$; $\phi(A^F-C) = .03$; $\phi(A^S-C) = .07$.

Of course it is possible that Ss performed a simultaneous verbal and imagery encoding of the items, and that imagery encoding was sufficiently powerful to overcome any negative transfer that results from verbal encoding. This possibility seems unlikely in light of prior studies which show that both verbal (sentence) encoding (Davidson, Schwenn, & Adams, 1970; Schwenn & Davidson, 1970) and concomitant verbal-imagery encoding (Davidson, 1972) act to reduce negative transfer in A-C relative to C-D. In the present study A-C played its traditional role as a negative transfer paradigm.

The sytematic reduction of negative transfer for pictured items that share fewer imaginal or semantic features with the original stimulus terms agrees with the results of Levin and Horvitz (1971) which show that performance in a single-list, printed-word experiment was a function of decreasing semantic similarity. The usefulness of the transfer experiment to answer questions about what is learned (Postman, 1971) is clearly demonstrated in the present study. Indeed, subsequent exploitation of the method might permit a detailed analysis of a variety of semantic and/or imaginal features for words, sentences, and pictures.

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GPO 803-391-2