Imagery in paired-associate learning in 5-year-old children

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Characteristics of stimulus materials which affect the degree to which visual or verbal processes facilitate learning in a paired-associate task were investigated. Forty-five kindergartners were presented with four lists of five paired associates each in a one-trial study-test procedure. Materials were presented visually using color slides or black outline drawings and verbally as sentences. Recognition was tested with color slides, line drawings, and words. Presentation of colored slides resulted in performance superior to the presentation of line drawings or words, while response mode did not have a significant effect. Several current hypotheses on imagery for these results were discussed.

The present study was undertaken to determine characteristics of stimulus material that may have an effect on the degree to which visual or verbal processes facilitate learning in a paired-associate task. In addition, the generality of recent experiments investigating non-verbal memory processes in preschoolers was examined.

At the present time, a controversy concerning the facilitative use of imagery in learning exists. Experiments with older children and adults indicate that objects or pictures of objects presented as paired associates result in recall superior to that when words are used (Paivio, 1971; Wicker, 1970). To account for these results, Wicker suggests that a difference in encoding or discrimination of the picture and word stimuli exists. Other studies in which instructions were used to control the use of imaginal or verbal mediators also support the finding that imagery is more facilitative than verbal processes in learning tasks (Anderson & Hidde, 1971; Bugelski, 1970; Levin & Kaplan, 1972; Paivio & Yuille, 1969).

Conversely, Milgram (1967) and Rohwer (1970) obtained results with younger children which support the hypothesis that pictorial stimuli are used less well than verbal stimuli in recall. Milgram suggested that his results depended upon covert encoding of the picture in a verbal form.

Results from other studies concentrating on a different age group (preschoolers) could not be interpreted as to the greater effectiveness of either imaginal or verbal processes (Horvitz & Levin, 1972; Reese, 1965, 1970a).

Rohwer (1970) defines a transition period from the use of verbal to visual storage mechanisms as occurring at about the age of 4½ to 5 years. He states that this transference takes place because the recall of images is dependent on the child's ability to apply a verbal label to the image during storage; this ability increases with age.

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It has become generally accepted that adults and children beyond the transitional age level suggested by Rohwer show greater recall for pictorial than verbal items. Disagreement still exists, however, over the generalization of these findings to younger subjects.

Recently, a study by Jones (1973) has shed important light on the debate concerning younger children's ability to use imagery in a way that facilitates learning. Using 3-year-olds, Jones presented paired associates verbally as sentences, visually as pictures, and both verbally and visually in a combined condition. The children were required to respond either to pictures or to words as test items. Jones' results indicated that the combined (picture-word) condition resulted in performance which was superior to visual material alone. Furthermore, visual items resulted in superior performance over verbal items in both the presentation mode and the response mode. These results are obviously contradictory to those of Milgram (1967), Reese (1970b), and Rohwer (1970) mentioned above.

One problem with previous studies, pointed out and corrected by Jones, was that of inadequately detailed stimuli. Reese (1970b) had discussed a leveling hypothesis to account for the necessity of stimuli which contain sufficient detail to insure that imagery is used in a facilitative way by young children. He suggests that images lose detail in memory and that greater detail in the original stimuli retards this fading process. Although Jones did, in fact, use more detailed stimuli than previous studies (color slide photographs as opposed to line drawings), her test of the leveling hypothesis was less than adequate. A better test would be to include detailed stimuli (pictures) along with stimuli similar to those used in previous studies (line drawings) in conjunction with a verbal (word) condition.

Therefore, the addition of a line drawing condition was made in the present study to determine the effect of varying the detail of visual stimuli and to decide whether the leveling hypothesis could have operated in previous investigations concerning nonverbal processes.

If the line drawing condition differed significantly from the picture condition, the leveling hypothesis would be supported, and validity of previous studies using line drawings as the only type of visual stimuli could be questioned.

METHOD

Three stimulus modes and three response modes were used. The stimulus modes involved presenting stimuli visually as color slides, visually as black and white line drawings on index cards, or verbally as spoken sentences. Response modes involved presenting choices as color slides, line drawings, or spoken words. Combining each stimulus mode with each response mode yielded nine experimental conditions: (a) picture-picture (P-P), (b) picture-line drawing (P-L), (c) picture-word (P-W), (d) line drawing-picture (L-P), (e) line drawing-line drawing (L-L), (f) line drawing-word (L-W), (g) word-picture (W-P), (h) word-line drawing (W-L), and (i) word-word (W-W). A one-trial study-test method was used in which items were tested by a recognition procedure. In the recognition task the subjects were presented with the picture, line drawing, or word designated as the stimulus and required to match it with one of three items designated as a response. The response items were presented sequentially in order to better equate the verbal and visual conditions. Subjects were required to respond "yes" or "no" to each response choice in turn.

Stimuli

The pictorial stimuli were 20 pictures presented as 35-mm color slides which showed two objects interacting. One object was always a toy animal (rabbit, cow, etc.) and the other a toy or object common to children of this age (telephone, boat, etc.). The majority of objects and the interactions expressed between the stimulus and response items were taken from Jones. She showed that the objects and interactions between them were familiar to children whose ages averaged 42 months. It was assumed that these same objects could be used with the 5-year-olds of the present study. Animals and toys that had not been used by Jones were judged to be familiar to 5-year-olds by three independent judges.

The study items were made by placing an animal toy or common object in a pose depicting some preplanned interaction and photographing it against a neutral background. Each animal and toy was also photographed alone to be presented in the recognition task.

Black and white line drawings were made to match the slides in the picture condition. Drawings were made both of the objects interacting and of the animals and toys alone. The size of the drawings presented on index cards corresponded approximately to the size of the picture that appeared when the slide was shown with a hand viewer.

The verbal stimuli were sentence equivalents of the pictured interactions in the study procedure (House, Note 1). In the recognition test, for all conditions the animal named in the sentence was designated as the stimulus and the toys or familiar objects as the response probes.

The 20 interactions were divided into four lists of five items each. Four orders of presentation were determined for the lists, and the order in which the lists were tested was random within these four orders. Within each list, five orders of presentation and five orders of testing were constructed. The order in which the paired items were presented was random, as well as the order in which they were tested, with two restrictions. At least one item, either presentation or test, had to occur between the presentation of an item and the test of that item, and the order of testing could not be the same order used in presentation. Distractor items for each test were randomly selected from the same study list, with the requirements that each response be used twice as a distractor and each response item be presented

in each of the three test positions. No test position was correct more than three times on a given list, and each test position was correct an equal number of times over the four lists.

Subjects

A total of 45 children, 27 girls and 18 boys, was tested. Their ages ranged from 4 years 11 months to 6 years 4 months, with a mean age of 5 years 8 months. Children were assigned randomly to the nine test conditions with the restriction that two boys and three girls were assigned to each condition. The children were obtained from the kindergarten at Villa Maria Academy and the Randolph-Macon Nurse School in Lynchburg, Virginia.

Apparatus

A Gaf Pan Viewer automatic slide viewer was used to view the slides in the picture condition. The projector was placed on a low table in front of the child, about 12 in. (30 cm) away. The projected image was 2.5 x 2.5 in. (6.35 x 6.35 cm). The experimenter was seated to the right of the child. Line drawings were presented on 3 x 5 in. (7.62 x 12.7 cm) index cards. Cards, in the correct sequence, were laid face down on the table approximately 12 in. (30 cm) from the child and at eye level. The experimenter held up cards one at a time, thus equating the procedure with that used in presenting the slides.

Procedure

At the beginning of the experimental session, the subject was shown each object alone and asked to name it; each child was presented with 50 objects. If the subject failed to label the item as it was described in the word condition, the experimenter provided the correct label and a brief explanation of the object (e.g., for the saw, the child was told that this was used to cut wood). After all the pictures were presented, the child was again shown those items he had labeled incorrectly and asked, "Do you remember what this was?" Only a few of the stimuli were labeled incorrectly, and in all cases the child gave the correct label on the second presentation. The above procedure was used to make sure the child understood the stimuli used. Failure to name the objects as they were used in the test sentences could have resulted in a lower score even though the child remembered the object pair.

Pretraining Task

Following the naming of the stimuli, the child was given pretraining on the actual task according to the experimental condition in which he had been placed. Five stimulus pairs were used in pretraining. Animals and a toy or a familiar object were used in the pretraining task, but none of these animals or toys appeared in the experimental task.

The subjects in the conditions involving presentation of pictures or line drawings were told that they would see pictures of two things playing together and that they should try to remember the two things. In the word condition the children were told that the experimenter would read some sentences about two things playing together and they should try to remember what the two things were.

In the test conditions in which the slides or the line drawings were used, the child was told that he would see a picture of one of the things by itself and that he should try to decide whether the objects that the experimenter would show him had been paired with the picture in the original presentation. In the verbal condition the child was told that the experimenter would ask him if some of the objects had been paired with the stimulus. Care was taken to assure that it was not indicated to the child that there was always one correct choice among the response probes.

Following the pretraining task, the children were allowed to color for 10 min. This interval provided a rest period and assured that the duration of the session would not overtax the children's attention.

Experimental Task

At the end of the coloring period, the procedure of the experiment was re-explained to the subject. The experimenter

made sure the child understood the task by asking him questions. The four lists were then presented according to the order to which the child had been assigned. Each picture or line drawing was presented for approximately 5 sec, with 1 sec between each presentation. In the verbal condition, the experimenter read the sentence and asked the child to repeat it after her, which also took about 5 sec with 1 sec between sentences.

Immediately following the presentation list, the subject was shown the first test stimulus. The picture or line drawing was presented while the experimenter asked, "What went with this? Was it this [first response choice shown]? Was it this [second choice shown]? Was it this [third choice shown]?" Each response alternative was presented until the child responded "yes" or "no." (Responses such as "I don't think so" were considered no, and "I guess so" as yes.) In the word condition the experimenter asked, "What went with the [name of animal]? Was it the [name of response object]?" etc., until the three response choices had been given. Each stimulus pair of the list was tested in this manner and each list, in turn, was presented and tested. Throughout the experiment, the experimenter spoke in a moderate and even tone; care was taken not to indicate correct responses by voice inflection.

At the end of the testing period, the child was given the picture he colored during the rest period and allowed to choose a candy lollipop to take with him. Total time for the experimental session was 30-45 min. All subjects were very cooperative and showed no hesitancy about coming.

RESULTS

Since items in the recognition test were presented successively, the usual method of scoring recognition data (whether the subject correctly matched the response with its paired stimulus) was not used. This method involves a subject's response to the correct item and ignores his response to the two distractor items. Therefore, in order to receive credit for a given item, the subject had to respond correctly to each of the three probes presented for each stimulus. In other words, the subject must have responded yes to the correct response item and no to the two incorrect probes to receive credit.

The total correct score for each subject (maximum possible correct = 20) was used to perform a 3 (Presentation Mode) by 3 (Test Mode) analysis of variance to determine the main effect of conditions. A significant main effect was found for Presentation Mode, $F(2,36) = 22.23$, $p < .001$. In order to establish the locus of the difference, a Newman-Keuls test for individual comparison was performed on the means of the three presentation modes. Results showed that there were significantly more correct responses when pictures were presented as stimuli than when line drawing or sentences were presented. The line drawing and sentence conditions did not differ significantly from each other. Nonsignificant results were obtained for both Test Mode and the interaction of Presentation by Test.

Inspection of Figure 1 shows more clearly the relationship of the presentation and response modes. Although the only significant effect exists in the picture mode of presentation, a definite trend exists toward fewer and fewer correct responses with the presentation conditions of line drawings and sentences, respectively.

Figure 1. Proportion correct for each study test condition. Each bar represents 100 observations.

In addition to testing for main effects, a 3 (Presentation Mode) by 3 (Test Mode) by 4 (List Order) analysis of variance for repeated measures was performed to determine if the test position had an effect on performance. Neither the main effect of Test Position nor interaction with the Presentation and Test Modes was significant. From this it may be assumed that fatigue or loss of attention was not operating to a significant degree. Conversely, neither is there evidence for a practice effect.

In summary, the main effect of Presentation Mode was found to be significant, pictures being superior to both line drawing and sentence conditions, with the latter two not showing a significant difference.

DISCUSSION

The above results support Jones' finding that the presentation of pictorial stimuli resulted in better performance than when verbal stimuli were used. Her results were produced by making methodological changes which she considered to have been confounding factors in previous experiments. Since these changes to reduce procedural bias were also employed in the present study, further support is given to the general finding that nonverbal processes can facilitate learning.

The inclusion of a line drawing condition in the present experiment was made to delineate the contribution of one of the changes made by Jones. She suggested that stimuli containing a minimum of detail had been used in previous studies (Milgram, 1967; Reese, 1965, 1970a; Rohwer, 1970), and had resulted in the failure of children to use imagery effectively. Reese (1970b) offered a leveling hypothesis (discussed above) to account for the results of previous experiments in which minimally detailed stimuli were used. The results of the present investigation are consistent with this hypothesis, since the line drawing condition did not differ significantly from the verbal condition. In other words, it is possible that the line drawings both in the present investigation and in previous studies contained too little information or detail to override leveling that may have occurred.

Wicker (1970) has suggested that pictures cause less intralist interference because they are more easily distinguished from distractors in the recognition procedure. He further points out that the distinctiveness of pictures may be acquired through differential encoding as opposed to being more easily distinguished in a perceptual test. Line drawings, on the other hand, produce less encoding variability. If this is the case, then the drawings may have appeared to offer too few cues to be easily discriminated

from each other. This analysis would lead to the conclusion that colored photographs were sufficiently detailed to enable the subjects to discriminate between them easily and use them effectively as mediators.

Another factor which may have contributed to better performance in the picture condition has been given by Rohwer (1970), who states that the ability to profit from pictorial stimuli relies on the child's ability to provide a verbal label for the stimuli during presentation. Although it was observed that several children did, in fact, say the names of the stimuli throughout both presentation and test, it would seem that this factor would also operate in the line drawing condition. So, even if Rohwer's hypothesis could be used to explain why the picture and verbal conditions differed, it does not shed light on why the line drawing task was not superior to the verbal task.

Since response modes did not cause a significant difference in the ability to use verbal or nonverbal modes, the present results cannot be interpreted to support the use of a different retrieval mechanism in operation apart from that of encoding or storage. Paivio (1970, 1971, 1972) has offered several hypotheses based on storage, encoding, and retrieval processes which can be used to account for the present results. Paivio has found that vividness of an image is an important factor in determining performance, although he states that an operational definition of this factor is unclear. In his view of vividness, Paivio assumes that verbal representations may also be images (auditory). He recognizes the possibility of comparing visual and verbal stimuli on a "vividness of imagery" scale. If Paivio's hypothesis is correct, the results of the present study could be due to a high vividness value of the photograph items as opposed to a low vividness value of the line drawings and verbal items. It is clear, however, that vividness needs to be made operationally distinguishable from other possible factors before a definite conclusion can be reached concerning the importance of this concept.

In addition to factors which may influence storage of imaginal and verbal codes, Paivio offers a dual-coding or trace-redundancy hypothesis which states that high-imagery material increases the probability that both verbal and nonverbal processes will become involved in mediation of item retrieval. This suggests that during the study of nonverbal stimuli, some items will be named implicitly and will be stored in both codes. Such dual coding would enhance the probability of recognition of the correct item in the test. This hypothesis also includes the understanding that a naming response is more likely to pictures than an image response to verbal stimuli. The present results are consistent with this model if it can be assumed that the line drawing condition resulted in fewer names being implicitly attached to the stimuli during presentation and, thus, a lower probability that both memory codes were available for mediation in the recognition task.

A third alternative discussed by Paivio centers around the degree of "figural unity" contained in an image. Assuming that the stimulus-response association is stored as a compound image which is reinstated by the stimulus cue in recognition, one might conclude that visual items may be more quickly decided and analyzed for response than verbal items. This assumption follows from the view that sentences presented as paired associates must be stored as a string of words which results in a greater "mental load" than a single picture which expresses the same interaction. Thus, a longer search time and less efficient use of verbal mediators would result.

Again, it must be remembered that visual presentation of line drawings did not result in significantly better performance than presentation of words. However, this trend is evident and is in line with the above explanations offered by Paivio. It might also be noted that if similar means were obtained with more than five subjects per cell, the difference existing between line drawing and sentence conditions would likely be significant.

One further reason for the present results has been suggested by Jones. It is possible that the stimuli used in the present study accounted for the superiority of the picture condition simply be-

cause the pictures were more colorful and more interesting than the sentences.

To summarize, the present indication is that stimuli presented visually result in better performance than those presented verbally. This appears to be due to characteristics of the stimuli which effect the storage and encoding of both the visual and verbal items. In light of this, it seems that further research should make an attempt to explore and separate the contributions of the various processes that have been explained above. As a direct corollary to the present experiment, a design employing stimuli which are more accurately separated in degrees of measured detail could determine more clearly the application of the leveling, vividness, and attentiveness hypotheses to the understanding of the use of images as mediators in learning.

REFERENCE NOTE

1. House, C. *Imagery in paired-associate learning in 5-year-olds*. Unpublished honors thesis, Randolph-Macon Woman's College, 1974.

REFERENCES

- ANDERSON, R. C., & HEDDE, J. L. Imagery and sentence learning. *Journal of Educational Psychology*, 1971, 62, 526-530.
- BUGELSKI, B. R. Words and things and images. *American Psychologist*, 1970, 25, 1002-1012.
- HORVITZ, J. M., & LEVIN, J. R. Semantic and imaginal factors in learning as related to age. *Journal of Experimental Child Psychology*, 1972, 14, 11-20.
- JONES, H. R. The use of visual and verbal memory processes by three-year-old children. *Journal of Experimental Child Psychology*, 1973, 15, 340-351.
- LEVIN, J. R., & KAPLAN, S. A. Imaginal facilitation of paired-associate learning: A limited generalization? *Journal of Educational Psychology*, 1972, 63, 429-432.
- MILGRAM, N. A. Verbal context versus visual compound in paired-associate learning by children. *Journal of Experimental Child Psychology*, 1967, 5, 597-603.
- PAIVIO, A. On the functional significance of imagery. In H. W. Reese (Chm.), *Imagery in children's learning: A symposium. Psychological Bulletin*, 1970, 73, 385-392.
- PAIVIO, A. *Imagery and verbal process*. New York: Holt, Rinehart & Winston, 1971.
- PAIVIO, A. A theoretical analysis of the role of imagery in learning and memory. In P. W. Sheehan (Ed.), *The function and nature of imagery*. New York: Academic Press, 1972.
- PAIVIO, A., & YUILLE, J. C. Changes in associative strategies and paired-associate learning over trials as a function of word imagery and type of learning set. *Journal of Experimental Psychology*, 1969, 79, 458-463.
- REESE, H. W. Imagery in paired-associate learning in children. *Journal of Experimental Child Psychology*, 1965, 2, 290-296.
- REESE, H. W. Imagery in children's paired-associate learning. *Journal of Experimental Child Psychology*, 1970, 9, 174-178. (a)
- REESE, H. W. Imagery and contextual meaning. In H. W. Reese (Chm.), *Imagery in children's learning: A symposium. Psychological Bulletin*, 1970, 73, 404-414. (b)
- ROHWER, W. D., JR. Images and pictures in children's learning: Research results and instructional implications. In H. W. Reese (Chm.), *Imagery in children's learning: A symposium. Psychological Bulletin*, 1970, 73, 393-403.
- WICKER, R. W. On the locus of picture-word differences in paired-associate learning. *Journal of Verbal Learning and Verbal Behavior*, 1970, 9, 52-57.