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ABSTRACT

The effects of modeled and instructed rehearsal on serial recall and semicovert rehearsal were evaluated for kindergarten, second-and fourth-grade children following baseline levels for both modeling and instruction groups. Groups observing a model rehearsal rehearsed more than groups observing a silent model. A quadratic relationship was found between children's age and the amount of semicovert rehearsal. The results are discussed in terms of social learning theory and the production deficiency hypothesis. (Author)

Modification of Children's Serial Recall and Rehearsal Processes Through Modeling and Instructions

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INTRODUCTION

Research on social learning theory indicates that modeling can exert a powerful influence on the observational learning of complex rules and conceptual strategies. Bandura and Harris (1966), among others, have demonstrated that children can abstract syntactic styles from observing a complex sequence of modeled behavior. Second grade children were exposed to a model who created passive sentences from a set of nouns and were later instructed to make sentences from a new set of nouns in the absence of the model. The results indicated that children have the capacity to abstract complex rules from a modeled sequence and can generate new behavior according to the rules. Similar results were reported by Odom, Liebert and Hill (1968) in which children's syntax was altered after observing a model produce prepositional phrases.

In addition, children have acquired novel rules from observing a model's performance. Zimmerman and Rosenthal (1972) have reported that children vicariously learned a novel rule which was generalized to different stimulus materials and was maintained over a seven week period. Rosenthal, Alford, and Rasp (1972) have shown that children observationally learned a novel clustering rule involving two dimensions of color and sameness.

Evidence is available to suggest that children can be influenced by a model even when they are unaware of the model's specific function. Bandura and McDonald (1963) have demonstrated that moral orientations of

of children can be modified by a model poised as a naive subject. The model responded to stimulus stories which were opposite to the child's dominant moral orientation. A generalization task, with no directions to copy the model, indicated that changes in moral orientation persisted in a new experimental situation with different materials and in the absence of the model.

Furthermore, the model's influence has been shown to predominate in the absence of external reinforcement to the model or child. Rosenthal, Zimmerman, and Durning (1970) found that question-asking behaviors of Mexican-American children were altered following the observation of models using different styles of question formulation.

Thus, there is extensive evidence to indicate the potential influence that a model's behavior may exert on the subsequent behavior of children. The literature of social learning (Bandura, 1971) indicates that a model's behavior may be vicariously learned without reinforcement to the child or model and may be performed at a later date in the absence of the model. Additional evidence demonstrates the acute capabilities with which a child can abstract rule-governed behavior from a complex series of modeled responses.

A major purpose of this study is to determine whether children's recall and rehearsal processes can be modified by observing a model use verbal rehearsal as a mnenonic strategy on a serial learning task. Atkinson and Shiffrin (1968) have proposed a model of memory in which rehearsal is given a dual role of maintaining information in short-term store and facilitating transfer to long-term store.

The importance of rehearsal to memory processes has been demonstrated in several studies. For one, Rundus and Atkinson (1970) found that subjects who overtly rehearsed while studying a list of items displayed a higher probability of recall as the number of rehearsals increased. Palmer and Ornstein (1971) have shown that directions to use different rehearsal strategies resulted in different levels of recall. Items receiving more rehearsals were recalled more frequently.

From a developmental framework, Flavell and his associates have studied verbal rehearsal in young children. Flavell (1970) has suggested that poor recall frequently displayed in young children can be attributed to two potential deficiencies. The first, a production deficiency suggests that nonmediated behavior occurs when children do not spontaneously rehearse, that is they do not produce the potential mediators. A second explanation, a mediational deficiency, refers to the situation in which rehearsal occurs but fails to mediate recall. Flavell, Beach and Chinsky (1966) found that kindergarten children produced fewer spontaneous semicovert rehearsals (lip movements) than second graders, who in turn produced fewer than fifth graders. Keeney, Cannizzo, and Flavell (1967) found that first graders who rehearsed performed better than first graders who did not rehearse. The two groups were exposed to an experimental condition in which subjects were instructed and trained to rehearse. The previous differences in recall performance were eliminated following the training. However, on a generalization task the children abandoned their rehearsal strategies and recall scores, dropped accordingly.

The research reviewed above underlines the importance of rehearsal for learning. Furthermore, it suggests that spontaneous rehearsal is a developmental phenomena that facilitates recall and that rehearsal processes can be modified through instructions and training.

A second major focus of this study, in addition to investigating the influence of modeling on recall and rehearsal processes, is to measure the effects of instructions on the serial recall and semi-covert rehearsals of kindergarten, second, and fourth grade children. It is hypothesized that modeling and instructions will have a significant effect on both dependent vaiables. It is further believed that the strongest treatment will result from a combination of modeling and instructions. Additional analysis will be conducted to examine the developmental findings reported by Flavell.

METHOD

Sample

From an elementary school serving a middle class residential area, a total of 144 children were selected from kindergarten, second and fourth grades. An equal number of males and females were selected from each grade and randomly assigned to one of four experimental conditions. The rationale for selecting the sample was based upon the developmental findings of Flavell (1970). The author served as the experimenter and an adult female as the model.

Task Materials

Three sets of stimulus cards were prepared. A set contained nine pairs of 10 cm. X 65.6 cm. plasterboard cards with seven 9.4 cm X 10 cm. pictures mounted on each. A single trial involved a presentation and a recall card on which the pictures were identical but the arrangement order was fixed randomly for presentation and recall. A different arrangement for recall was necessary to preclude the spatial position from serving as a memory cue. Different pictures were used for each of the 27 pairs (3 sets of nine trials) of stimulus cards. Stimulus Set A was used for subjects in baseline and training, Set B was used for generalization, and Set C was used by the model in the training phase.

The rationale for the task selection followed procedures outlined in Flavell et al (1966). A pilot study determined a pool of familiar pictures which children from each grade were capable of describing with an appropriate verbal label. These colored pictures depicted objects such as a dog, pumpkin, airplane, penny and hat. Two groups of pictures were randomly selected and assigned in groups of seven for each trial. The remaining pictures were used in the model's set of stimulus cards.

Procedure

Each subject was taken individually from class to a test room by the experimenter and introduced to the model. Subjects were given a baseline, training, and generalization phase in which the former and latter were identical for all subjects. Baseline was administered first and lasted about ten minutes.

During baseline each subject was initially presented a practice trial to familiarize him with the requirements of the task, especially the concept of order. The practice trial which required the subjects to remember three pictures in a designated sequence was repeated until the subject performed the task correctly. All children successfully completed the practice trial within a maximum of three trials.

Subjects were then given the following directions: "We are going to play a game using some pictures like these. Here is a ..." (pictures from Set A were named from the subject's left to right). "I will point to some pictures and I want you to remember the pictures I point to in the same order that I point to them. Let's try this one." The experimenter pointed to the pictures at the rate of approximately one per two seconds. The orders in which the experimenter pointed to the individual pictures were randomly created. When the experimenter had completed pointing at the pictures, the subjects closed their eyes for a delay interval of 15 seconds (timed by a stopwatch). At the end of the delay period, subjects were given the recall card. For trials 1, 2, and 3, subjects were required to recall three pictures; for trials 4, 5, and 6, four pictures had to be recalled; and for trials 7, 8, and 9, five pictures had to be recalled.

Approximately 16 days after baseline, the subjects returned to the experimental room and received oneof the following treatment conditions: a model using overt rehearsal with subjects instructed to rehearse (MR,I), a model not using overt rehearsal with subjects instructed to rehearse (MNR,I), a model using overt rehearsal with subjects not instructed to rehearse (MR,NI), or a model not using overt rehearsal with subjects not instructed to rehearse (MNR,NI).

In the MR,I condition, the subjects were reintroduced to the task and given a practice trial as during baseline. After the task was introduced, the experimenter instructed the subject as follows: "This time, to help you remember the pictures, when your eyes are closed, I want you to say the names of the pictures over and over again as many times as you can, until I tell you to open your eyes. Let's try this one." Following the practice trial subjects were told, "Now it is (the model's) turn to play the game; after she has a turn you will have another turn." No directions were given the subject to watch or copy the model's behavior. The model was given a trial in the same manner as the subject except with different pictures as stimuli and without directions to rehearse. However, during the 15 second delay interval the model overtly rehearsed the names of the pictures in the proper sequence. For each trial the model rehearsed the total sequence four times. When the model finished her trial, the child was given his first experimental trial. The model and child alternated turns for nine trials each.

For the MNR,I condition, the only change from the previous treatment was that the model did not overtly rehearse the names of the pictures

during the retention interval. She closed her eyes and remained silent for the 15 second delay period. Instructions to rehearse were given each subject.

In the MR,NI condition, subjects were given the same directions as the MR,I condition, however, the italicized instructions were omitted. The model overtly rehearsed during the delay period for each trial.

In the MNR,NI condition, subjects were not instructed to rehearse and the model performed silently, without rehearsing.

Following the training phase all children received the same generalization task and following directions: "Now we are going to play the game with new pictures. I am going to point to some pictures and I want you to remember the pictures that I point to in the same order that I point to them. Let's try this one. Here is a ... (pictures named)." Again, nine trials were given with new pictures and different orders of presentation and recall. No cues relating to the model's performance or using a rehearsal strategy were given. When the subject finished, he was thanked and accompanied back to class by the experimenter.

Two dependent variables were observed for each subject. On the first variable, a trial was scored correct if all the pictures were recalled in the proper sequence presented by the experimenter, otherwise, the trial was scored as incorrect. The second variable indicated whether the subject overtly rehearsed during the 15 second retention interval. Rehearsals were independently rated by the experimenter and model as belonging to one of three categories. Responses were rated as definite

rehearsals if the words could be heard or lip movement could be positively identified. No distinction was made as to the amount, accuracy, or extent of rehearsal. The second category consisted of trials in which no rehearsal was detected. A third category was found necessary to record trials where one or both judges were unable to observe the lips of the subject. Only 5 percent of all responses were assigned to the third category. In cases where both judges were able to observe lip movement, agreement was 96 percent. Therefore, it was decided that in the few trials in which only one judge was able to observe the subject, his rating would be used as the measure of rehearsal for the trial. Rehearsals were recorded for all trials during baseline and generalization, but for the training phase, rehearsals were rated only for the two groups not receiving instructions to rehearse.

Responses for each phase on the serial learning task were summed across trials according to the number of correct picture sequences properly recalled. In addition, the total frequency of rehearsals was recorded for baseline and generalization phases which indicated the number of trials on which overt rehearsal was observed. A 2 (model rehearsing, model not rehearsing) X 2(instructions, no instructions) X 3(kindergarten, second, fourth grades)X 3(baseline, training, generalization) analysis of variance model for repeated measures was used to test the main effects and interactions. Tukey HSD (Kirk, 1968) tests were computed as post hoc analyses.

RESULTS

Initial analysis revealed no significant effects for sex, therefore, subsequent analyses were conducted with males and females combined within treatment groups.

Analysis of Recall Scores

The means by phase for each grade and treatment group on the recall task are presented in Table 1. Analysis of variance indicated a main

Table 1

Mean Recall Scores by Phase, Grade, and Treatment Variations

Group	Phase		
	Baseline	Training	Generalization
Separate Cells:			
Model Rehearsing and Instructions	17.5	22.1	22.6
Model Not Rehearsing and Instructions	19.8	22.3	21.8
Model Rehearsing and No Instructions	20.0	23.3	22.7
Model Not Rehearsing and No Instructions	20.5	22.6	19.5
Combined Cells:			
Model Rehearsing	18.7	22.6	22.6
Model Not Rehearsing	20.2	22.4	20.7
Instructions	18.7	22.2	22.2
No Instructions	20.2	22.9	21.1
Grade:			
Kindergarten	11.3	13.3	11.7
Second	20.0	23.7	23.2
Fourth	27.0	30.6	29.8

effect for experimental phases ($F(2,263) = 24.73$, $p<.001$). Recall was higher during training and generalization than during baseline (both ps $<.01$). No difference was found between training and generalization.

A main effect for grade was detected ($p<.001$). Fourth graders recalled more than second graders, who, in turn, scored higher than kindergarteners (all ps $<.01$).

A modeling by treatment phase interaction was found ($F(2,263) = 6.92$, $p<.01$). The modeling groups recalled more during training and generalization than during baseline (both $ps<.01$). For groups observing the model perform without rehearsing, recall did not improve from baseline levels. During generalization, the groups observing the model overtly rehearse recalled more than groups observing a silent model ($p = <.05$).

Similarly, verbal instructions interacted with experimental phases ($F(2,263) = 4.40, p<.05$). The experimental group receiving instructions to rehearse recalled more in both training and generalization than during baseline (both $ps<.01$). Groups that did not receive instructions to rehearse failed to improve our baseline.

A three way interaction between instructions, grade and phase attained significance ($F(4,263) = 2.83, p<.05$). While fourth and second graders performed better than kindergarteners on all treatment combinations (all ps $<.01$), fourth graders did not always recall more than second graders. In baseline and training, fourth graders who received instructions to rehearse recalled more than second graders exposed to the same treatment (both ps $<.01$); however the recall scores of these groups did not differ in generalization.

Rehearsal Analysis

Table 2 presents the mean number of rehearsals observed in baseline and generalization for each grade and treatment combination. Analysis of variance indicated that groups observing a model rehearse

Table 2

Mean Rehearsals Observed by Phase, Grade, and Treatment Variation

Group	Phase	
	Baseline	Generalization
Separate Cells:		
Model Rehearsing and Instructions	1.7	6.4
Model Not Rehearsing and Instructions	1.5	4.1
Model Rehearsing and No Instructions	1.6	2.7
Model Not Rehearsing and No Instructions	1.8	1.2
Combined Cells:		
Model Rehearsing	1.6	4.6
Model Not Rehearsing	1.6	2.7
Instructions	1.6	5.3
No Instructions	1.7	2.0
Grade:		
Kindergarten	.4	2.7
Second	2.4	3.8
Fourth	2.1	4.3

rehearsed more than groups observing a silent model ($F(1,132)=8.55, p<.01$). Groups that were instructed to rehearse during the delay interval

rehearsed more than groups not given instructions ($F(1,132)=24.61$, $p<.001$). A grade main effect was found ($F(2,132)= 11.68$, $p<.001$) in that fourth graders and second graders overtly rehearsed more than kindergartners. A trend analysis (Kirk, 1968) showed a quadratic relationship ($p<.05$) between grade and spontaneous overt rehearsal during baseline. The inverted U-shaped curve indicates kindergarten and fourth grade children produced fewer rehearsals than second grade children. A significant phase effect ($F(1,131)=$ 50.32, $p<.001$) indicated that rehearsals were more frequent during generalization than baseline.

An interaction between modeling and phases was significant ($F(1,131)= 11.97$, $p<.001$). The group observing the model rehearse displayed more overt rehearsals in generalization than the group observing the model perform without rehearsing ($p<.01$). Both groups rehearsed more in generalization than in baseline (both $ps<.01$).

There was a significant interaction between instructions and treatment phases ($F(1,131)= 37.19$, $p<.001$). Groups receiving instructions to rehearse during the treatment phase rehearsed more during generalization than groups not receiving instructions. An increase in rehearsing from baseline to generalization was noted for groups that received instructions ($p<.01$), but no such improvement was found for groups that did not receive instructions to rehearse.

Special Analyses

In order to compare the present results with a similar study by Flavell et. al. (1966), second grade children were divided into two groups, rehearsers and non-rehearsers, based upon whether they rehearsed at least three or fewer than three times during baseline.

The two groups contained 21 rehearsers and 22 non-rehearsers with approximately equal proportions of the experimental treatments distributed in each group. An analysis of variance design for unequal groups (Winer, 1962) was used to analyze the means in Table 3.

Table 3

Mean Recall Scores for Second Grade Rehearsers and Non-rehearsers

Grade	Phase		
	Baseline	Training	Generalization
Rehearsers	22.9	24.1	22.8
Nonrehearsers	17.7	23.5	23.4

An interaction between groups and phases was noted ($F(1,46) = 18.99$, $p < .01$). The rehearser group recalled more than nonrehearsers during baseline ($p < .05$). No significant differences in recall were found during the training or generalization phases. The analysis revealed that nonrehearsers improved over baseline ($p < .05$) while the performance of rehearsers remained unchanged.

A similar analysis for kindergarten children was computed to test the hypothesis that young children who increased in the production of overt rehearsals from baseline to generalization recalled more in generalization than children who displayed no increase in rehearsals. Analysis of variance was used to analyze the means in Table 4.

Table 4

Mean Recall Scores for Kindergartners Increasing Overt Rehearsals and Kindergartners Not Increasing Overt Rehearsals

Group	Phase	
	Baseline	Generalization
Overt Rehearsals Increased	11.3	14.2
Overt Rehearsals Not Increased	11.4	9.2

A significant interaction between groups and phases was detected ($F(1,46) = 9.94$, $p < .01$). In the generalization phase, subjects who increased in the number of overt rehearsals recalled more ($p < .01$) than the no-improvement subjects. Baseline recall scores were not significantly different.

Discussion

These results provide evidence that a mnemonic strategy in the form of verbal rehearsal can be vicariously acquired and generalized to a new stimulus situation. Children exposed to a model who used overt rehearsal as a memory strategy, rehearsed and recalled more during generalization than their counterparts who observed a silent model. Further, the results were obtained without explicit directions to the children to observe or imitate the model. Contrary to the explanations of observational learning by most traditional learning theories, the modeling effects were demonstrated without reinforcement to the model or children.

Although the modeling treatment resulted in higher recall during generalization than the no-model treatment, similar findings were not produced by instructions. No differences in recall during generalization were noted for the instructions and no-instructions groups; however, both the modeling and instruction treatments resulted in greater rehearsal during generalization. Thus, while modeling increased recall and rehearsal, instructions only served to increase overt rehearsal and did not produce differences in recall. One can only speculate about the cause of this anomaly. Perhaps the functional value of the rehearsal strategy for improving recall was more evident in the modeling condition where the rehearsal was being actively applied as a strategy on a problem solving task. The emphasis of the directions to rehearse might have diverted the children from the requirements of the task -- namely recalling the serial order of stimuli. There is evidence available (Zimmerman and Bell, 1972) that directions to respond overtly,

even in the form of verbal coding , can interfere with concept acquisition. Further research should determine whether emphasis on verbal instructions may distract attention from a more basic task requirement.

Additional findings suggest that the modeling of a specific behavior (rehearsal) may effect other behavior (recall) even when primary attention is not focused on this behavior. The model was used to modify rehearsal processes which functioned to augment the abilities of children to remember pictures and sequences different from those exhibited by the model. From a theoretical and practical standpoint, it would be important to investigate the multiple effects of modeling a specific response.

Contrary to the findings of Keeney et al. (1967), overt rehearsal appeared to persist for all grades on the generalization task. When presented with a new task without being cued to employ a mnemonic strategy, the children did not abandon the training strategy of overt rehearsal. One of the reasons offered by Keeney et al. for the failure of the children in their study to maintain the rehearsal strategy was the fact that no feedback was presented concerning the accuracy of the child's recall performance. However, the lack of feedback in the present study did not hinder the use of the rehearsal strategy during generalization. In addition, the Keeney et al. study used only three trials for the generalization results. Three trials may not have produced a reliable measure of the ability to generalize. It is clear from the present study

that the children can transfer vicariously acquired mnemonic strategies to new tasks without explicit instructions to do so.

The results are consistent with the developmental findings of Flavell's research (1970) and the production deficiency hypothesis. Kindergarten children were found to spontaneously emit fewer overt rehearsals during baseline than were either second or fourth grade children. Flavell et al. (1966) predicted a curvilinear relationship between overt rehearsal and age; however, their results revealed a positive linear trend. The present study supports their original hypothesis in that second graders rehearsed more than kindergarten and fourth graders during baseline. These results support Flavell's (1970) hypothesis that kindergartenrs tend not to spontaneously employ either covert or overt rehearsal as a memory strategy and that as children grow older, they tend to rehearse covertly.

The production deficiency hypothesis was supported in that kindergarten children who increased in the number of overt rehearsals from baseline to generalization recalled more in generalization than kindergartenrs who did not improve in their levels of rehearsals. An analysis similar to that reported by Flavell et al. (1966) was conducted on second graders divided into rehearsers and nonrehearsers on the basis of the number of rehearsals emitted during baseline. Recall for rehearsers was found to be higher than recall for non-rehearsers during baseline; however, after the treatment conditions, the recall scores for the two groups were not significantly different.

If the initial differences in recall were due to differences in mediational ability, then the rehearsers would have recalled more than the nonrehearsers in generalization. These results provide additional support for the production deficiency hypothesis and indicate that rehearsal functions as a mediational strategy which enhances recall.

An additional observation of the data indicates that prior to the treatment conditions, fourth graders tended to overtly rehearse more on the difficult trials, those requiring more pictures to be recalled, than on the easier trials. These data suggest that maybe the covert rehearsal strategy "broke down" when the demands of the situation increased the amount of information to be recalled. It is suggested that further research be conducted to examine this possibility.

In terms of pedagogical implications, the results suggest that teachers, through demonstration and instructions, can improve the recall of their students. Children are often assigned material to learn, but are usually not taught how to employ mnemonic strategies to facilitate learning. If teachers can be made aware of the cognitive strategies involved in learning, perhaps they could model and instruct their students on the most efficient use of memory strategies. However, teachers are most interested in long-term memory processes, rather than short-term memory as was investigated in the present study. Additional research is therefore required to identify mnemonic strategies that would enhance transfer of information from short-term memory to long-term memory.

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