

## Teaching Awareness of Strategic Behavior in Combination with Strategy Training: Effects on Children's Memory Performance

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The present study examined the effectiveness of two components (rehearsal training and strategy awareness) of an instructional package designed to train the developmentally young in the use of mature information processing techniques. Two groups of children of equivalent developmental age ( $MA = 8$ ), one mildly retarded and the other of average intelligence, participated. Rehearsal training was effective in improving recall scores on the training task; however, neither rehearsal training, memory awareness, nor their combination significantly altered memory performance on the generalization tasks. There was evidence, however, that the combination of rehearsal training and strategy awareness did increase the likelihood of strategy transfer on the generalization task (recognition) which most closely resembled the training task. Post-task questioning revealed that instructions concerning memory awareness did improve subjects ability to verbalize appropriate strategic behavior; however, these improvements were not consistently translated into either actual use of a rehearsal strategy or improved performance. Discussion centered on the implications of these results and on the need for increased research on the metamnemonic skills involved in strategy generalization.

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Over the course of the last two decades the memory training literature has repeatedly documented the fact that although the developmentally young do not spontaneously use mnemonic strategies they can be trained to do so. Much of this research has been completed with retarded children and these examinations reveal that retarded individuals are capable of retaining a trained strategy for periods of 2 weeks (e.g., Reichhart, Cody, & Borkowski, 1975) to 6 months (e.g., Engle & Nagle, 1979) to one year (e.g., Brown, Campione, & Barclay, 1979). The overwhelming success of training studies had caused researchers to look beyond simple instructional effects and to begin to examine the ability of the developmentally immature to generalize trained strategies to novel tasks.

Preliminary investigations of strategy generalization reveal that if training and transfer tasks are similar some individuals will generalize the use of the trained mnemonic (Kendall, Borkowski, & Cavanaugh, 1980); however, as the task becomes more distinct, generalization becomes a more elusive phenomenon (Burger, Blackman, & Tan, 1980; Campione & Brown, 1977). This evidence also indicates that even with appropriate instruction developmental level may influence the generalizability of training. The developmentally young seldom transfer trained mnemonic skills; however, generalization appears to be most likely with individuals who have obtained a developmental age of at least 8 years (e.g., Brown et al., 1979; Ringel & Springer, 1980). One suggestion for increasing the likelihood of sophisticated strategy utilization (i.e., strategy generalization) has been to train individuals to use a mnemonic strategy and, in addition, to provide them with information regarding the nature and potential uses of that strategy (Borkowski & Cavanaugh, 1979). Pressley (in press) argues that individuals who know that a strategy has multiple uses are more likely to use that strategy and metamemory theory has postulated a direct link between memory awareness and memory performance (Brown, 1978).

The research in this area has documented, at best, a tenuous meta-memory-memory connection (e.g., Salatas & Flavell, 1976) although it has been suggested that the inability to uncover a consistent relationship is primarily a function of deficiencies in assessment technology (Cavanaugh & Borkowski, 1979). Not only are there uncertainties regarding the "natural" relationship between memory awareness and memory performance, but we are only beginning to investigate methods of teaching metacognitive understanding and the effects of this type of training on memory performance (Kramer, Nagle, & Engle, 1980). While some investigators have manipulated aspects of awareness related to performance on specific tasks (e.g., Brown, Campione, & Murphy, 1974), research has not systematically addressed itself to the effects of pointing out to subjects the diverse application of a strategy nor the benefits of strategy transfer. There is, however, reliable evidence that children's

knowledge of their memory systems does begin to develop and expand as they move through elementary school (Cavanaugh & Borowski, 1980; Kreutzer, Leonard, & Flavell, 1975). This coupled with the limited amount of data and the impact of finding a means of inculcating sophisticated memory performance in children necessitates further investigation of mnemonic awareness.

The purpose of the present study was to examine the effects of combining strategy training and increased awareness on the ability to generalize the trained mnemonic. Awareness was manipulated by providing a description of the form of the strategy, information regarding the general utility of the strategy, and examples of the use of the strategy in the presence and absence of rehearsal training. "Direct measures" (Belmont & Butterfield, 1977) were obtained by allowing subjects to control the interitem presentation rate, a method used in previous rehearsal training studies (e.g., Reichhart et al., 1975). Finally, at two points during the course of the experiment individuals were administered a brief series of questions in order to determine the effects of training on metamnemonic awareness.

## METHOD

### *Subjects*

The subjects were 80 children attending public school in South Carolina. Parental permission was obtained for all children before allowing them to participate in the experiment. The children were divided into two groups (normal or retarded) of equivalent mental age ( $MA = 8$ ) on the basis of their scores (normal 90–110, retarded 50–75) on the Peabody Picture Vocabulary Test (PPVT). Children were matched on the basis of their MA scores for inclusion in the four treatment groups. Separate analyses of variance with MA, IQ, and CA as dependent measures revealed no bias in the assignment of subjects to groups.

### *Apparatus*

A stimulus pool of 196 pictures, eight single digit numbers (0–8), and eight letters (H J K L N P Q R) was compiled. In addition, an "awareness package" of two 7-digit telephone numbers, a list of eight grocery items, a series of eight colors, and a 10-digit number was collected. The pictures were of common objects and were taken from children's books and magazines. They were divided into one 8-item, seven 20-item, and two 24-item lists (a total of 216 items due to the fact that 20 of the items were selected for reuse on the metamemory test). The 8-item and two 20-item lists were used as training lists. All other lists of pictures (except for items in the metamemory test) were used for tests of strategy maintenance and generalization. The numbers were randomly ordered into two 8-item lists for use in the serial probe task. Lists (both picture and

letter) presented more than once during an experimental session were random orderings of the same stimuli. The selection of items for the picture lists was conducted in such a way as to minimize the possibility of categorization.

A Besseler Cue/See projector was used to present the stimuli. A response button was programmed to the projector such that subjects could control the duration of item presentation. The interresponse time was recorded automatically.

### *Procedure*

A brief schemata of the experimental procedure is provided on Table 1.

Prior to the experiment each subject was given the PPVT. During the course of the experiment each subject was seen individually over a total of 4 days/sessions. An initial day of orientation and training was followed immediately by another day of training. Two days of post-tests followed, the first within 2 days of the completion of training and the second one week (7–13 days) after training. All subjects were trained on a free recall task.

(a) *Session 1.* Each subject received six training trials: four on the 8-item list and two on the 20-item training list. On the first two training trials (8-item list) the experimenter operated the response button, controlled the rate of item presentation, and modeled perfect recall. During subsequent trials the subject operated the response button, proceeded at his/her own rate, and participated in unpaced free recall. Instructions to the individual groups were as follows:

1. Rehearsal training/No strategy awareness—this group was trained to rehearse the lists in 4-item chunks by means of an “overt-shadowing” technique (Kellas, Ashcraft, & Johnson, 1973). This technique involved the experimenter modeling the rehearsal strategy and the subjects repeated (shadowing) everything that was said. Specifically, the experimenter rehearsed the list by naming the items as they appeared on the screen and after the fourth item (and each subsequent group of four items), the experimenter again labeled each item in the chunk, three times in sequence. This procedure was followed on the first two training lists. On subsequent trials the subjects were told to continue overtly practicing the rehearsal strategy and the experimenter prompted correct usage.

2. Rehearsal training/Strategy awareness—this group was trained to use the rehearsal strategy described above. In addition, prior to the presentation of the first practice list the subjects were told that they were going to learn how to remember long lists by (1) breaking the list into smaller pieces and (2) practicing saying the names of the items over and over until they knew them. Following the shadowing trials and on subsequent training trials the experimenter prompted overt use of the grouping strategy and asked, “What two things are you going to do to help remember the list?” The experimenter corrected any inappropriate answers.

3. No rehearsal training/Strategy awareness—this group received no training in the use of the grouping strategy (that is, no “overt-shadowing” or modeling

TRAINING INSTRUCTIONS AND TEST SEQUENCE FOR EACH EXPERIMENTAL GROUP

	Training/test material	Rehearsal training/ No awareness	Rehearsal training/ Awareness	No training/ Awareness	No training/ No awareness
Day 1	Four trials, 8-item training list	"Overt-shadowing" of chunking strategy	"Overt-shadowing" of chunking strategy and description of <i>two-part</i> memory strategy	Description of <i>two-part</i> memory strategy	Labeling of stimuli
	Two trials, 20-item training list	Prompt use of chunking strategy	Prompt use of chunking and <i>two-part</i> strategy	Prompt use of <i>two-part</i> strategy	Prompts to label
	Two trials, 20-item free recall list	Instructions to remember as much material as possible	Instructions to remember as much material as possible	(no reference to previous training)	
Day 2	Two trials, 20-item training list	Prompt use of chunking strategy	Prompt use of chunking and <i>two-part</i> strategy	Prompt use of <i>two-part</i> strategy	Prompts to label
	Two trials, 20-item free recall list	Instructions to remember as much material as possible	Instructions to remember as much material as possible		
	Awareness package	Presentation of items and memory questions, no feedback	Presentation of items and memory questions, feedback on use of strategy	Presentation of items and memory questions, feedback on use of strategy	Presentation of items and memory questions, no feedback
Day 3	Two trials, 20-item free recall list	Instructions to remember as much material as possible	Instructions to remember as much material as possible		
	Eight trials, 8-item serial probe lists	Descriptions/explanation of task requirements and instructions to do the best job possible	Descriptions/explanation of task requirements and instructions to do the best job possible		
	One trial, 24-item yes/no recognition list	Descriptions/explanation of task requirements and instructions to do the best job possible	Descriptions/explanation of task requirements and instructions to do the best job possible		
Day 4		Presentation of material, sequencing of tests, and instructions identical to that of Day 3	PLUS		
	Metamemory questions	Presentation of questions in metamemory test			

trials). They were, however, given instructions concerning the usefulness of the two steps important in remembering long lists (as in group 2). The experimenter repeated these instructions before presentation of the first two training lists and prior to all future training trials asked, "What two things are you going to do to help remember the list?" Inappropriate answers were corrected.

4. No rehearsal training/No strategy awareness—during the presentation of the training lists the experimenter labeled each picture as it appeared on the screen and instructed each subject to repeat the item name.

Following the completion of the final training list each subject received two unprompted trials on a 20-item list. Subjects were instructed only to remember as many words as possible.

(b) *Session 2.* Each group first received two training trials on a 20-item list. They were to continue (through prompts) using the memory strategy taught during Session 1. Following the completion of the training trials each subject received two unprompted free recall trials on a 20-item list. Subjects were instructed only to remember as many items as possible. The experimenter then advanced the projector and showed each subject a series of four frames: the awareness package. The frames were presented individually and contained two 7-digit telephone numbers; a list of eight grocery items; a series of eight colors; and a 10-digit number. As each frame was presented the experimenter explained the nature of the material (e.g., this is a telephone number, here is a list of colors). The experimenter then laid before the subject a series of file cards containing the pictured items. All subjects were asked how they would go about remembering the material and the experimenter's response to each group was as follows:

1. Rehearsal training/No strategy awareness—Regardless of the subject's response to the memory questions indicated above the experimenter briefly modeled a rehearsal strategy; however, no feedback was provided to the subject concerning the effects of this strategy on performance. This sequence was continued until all frames of the awareness package had been presented.

2. Rehearsal training/Strategy awareness—Correct responses to the memory questions were verbally reinforced and the experimenter briefly modeled an appropriate rehearsal strategy. This sequence was completed for each frame with the experimenter continuously emphasizing the importance of breaking the list into smaller pieces and rehearsing as a memory aid. Following presentation of the fourth frame the training session concluded with the experimenter pointing out that chunking and rehearsal were effective any time a long list was to be remembered and each example was briefly repeated.

3. No rehearsal training/Strategy awareness—Correct responses were reinforced and the experimenter continuously emphasized the importance of breaking the list into smaller pieces and rehearsing as a memory aid. Following the presentation of the fourth frame the training session concluded with the experimenter pointing out that chunking and rehearsal were effective any time a long list was to be remembered and each example was briefly repeated.

4. No rehearsal training/No strategy awareness—Following the subject's response the experimenter advanced the projector to the next frame. No feedback

was provided to the subject concerning appropriate strategy usage. The sequence was continued until all frames of the awareness package had been presented.

(c) *Session 3.* During this session the sequence of events was identical for all subjects. No reference was made to any previous training and subjects were told only to do their best.

Each subject was first given a free recall test on two different orderings of a 20-item list. Following this task the experimenter explained the nature and requirements of the first generalization task, a serial position probe test. Subjects were presented with two practice lists of eight randomly ordered digits. On the first list the experimenter explained the task requirements, demonstrating exactly how the items were to be presented and responded to. On the second list the subject was asked to perform the entire task. If necessary, instructions were repeated and test trials began only after it was evident that the subject understood the task. During test trials each subject was presented a series of eight 8-item lists which consisted of random orderings of the letters in the stimulus pool. Trials were self-paced and letters were presented sequentially. Following the last letter the subject advanced the projector to the next frame which revealed a probe item at the top of the screen and the subject was required to point to the space where the letter had previously appeared. There were two probes for each list.

Next, each subject participated in a yes/no recognition task. They were informed that they would again see a list of pictures; however, on this list they would not have to recall all the pictures they remembered. Following this list each subject would work for 5 min on a series of simple arithmetic problems. Then the experimenter would show them a list of pictures and they would have to mark each picture as old (yes) or new (no) depending on whether it was on the list they had just seen. The trials began as soon as it was clear that the subject understood the task requirements. Each subject received one test trial on a 24-item list. The recognition test consisted of 20 target and 20 distractor items. The distractor items had not appeared on any previous list.

(d) *Session 4.* This delayed post-test took place one week (7–13 days) after training was completed. Post-tests were again given in the order of free recall, serial probe, and yes/no recognition. All instructions and procedures were identical to those of Session 3. New stimuli were used in the free recall tests while the items in the serial probe test were random orderings of the same stimuli during Session 3. Stimuli used in the recognition tests were the identical items used during Session 3 with target and distractor items being reversed. Following the last tasks all subjects were given a brief metamemory post-test. Questions were modeled after the Kreutzer et al. (1975) battery and dealt with study time ("Which would be a better way to remember this list, studying 5 min or 1 min?"),

response justification ("Why would you do it that way?"), and study plan ("How would you go about learning the names of these objects, these cities?"). Questions chosen were those that appeared to require the same type of mnemonic performance as the experimental tasks.

## RESULTS

The two dependent measures of primary interest on each of the experimental tasks were memory performance (items recalled, recognition performance) and duration of item presentation. Analysis of the results from the metamemory tests are discussed as presented.

### Training

*Recall scores.* The recall scores on the two 20-item training lists were considered first and were analyzed by means of a 2 (IQ Level)  $\times$  2 (Rehearsal)  $\times$  2 (Strategy Awareness)  $\times$  2 (Trials) mixed analysis of variance. Table 2 reveals the facilitative effect that rehearsal training has on performance. In addition, performance consistently improved across trials. These findings were confirmed by the existence of reliable main effects of Rehearsal Training,  $F(1, 72) = 21.94, p < .001$ , and Trials,  $F(1, 72) = 188.73, p < .001$ . While performance did improve across trials for all groups, the increase was greater for individuals who had not received rehearsal training. This resulted in a reliable Rehearsal Training  $\times$  Trials interaction,  $F(1, 72) = 8.48, p < .01$ . Neither Strategy Awareness nor Session had any significant impact on performance,  $FS(1, 72) = 0.94$  and  $0.62$ , respectively,  $p > .30$  in both cases.

*Exposure durations.* The analysis of the pause time data on the training lists is not reported because subjects who received rehearsal training were being continually prompted during these trials to use the rehearsal

TABLE 2  
MEMORY PERFORMANCE SCORES

	Rehearsal training/ No awareness	Rehearsal training/ Awareness	No training/ Awareness	No training/ No awareness
Training/Free recall				
Normal	9.45	9.48	8.13	8.08
Retarded	9.75	10.08	8.83	8.05
Maintenance/Free recall				
Normal	9.85	10.04	7.79	7.91
Retarded	10.11	10.58	8.51	8.16
Generalization/Recognition				
Normal	36.95	38.40	36.80	36.40
Retarded	36.85	37.60	37.10	36.95



strategy. Thus their pause times reflect these interruptions rather than the use of the rehearsal strategy which precludes meaningful analysis.

### Maintenance Tests

*Recall scores.* The recall scores on the maintenance lists were analyzed by means of a 2 (IQ Level)  $\times$  2 (Rehearsal Training)  $\times$  2 (Strategy Awareness)  $\times$  4 (Session)  $\times$  2 (Trial) mixed analysis of variance. The recall scores for each of the groups (see Table 2) reveals that rehearsal training improved performance just as it did on the training lists. In addition, performance improved from Trial 1 to Trial 2 and, in general, individuals recalled more items during Sessions 3 and 4. These patterns were confirmed by the existence of significant main effects of Rehearsal Training,  $F(1, 72) = 105.44$ ,  $p < .001$ , Trials,  $F(1, 72) = 78.86$ ,  $p < .001$ , and Session,  $F(3, 216) = 14.28$ ,  $p < .001$ . There was a general improvement in performance over trials; however, the rehearsal-trained group improved more from Trial 1 to Trial 2 during Session 3 than did the untrained group. This resulted in a reliable three-way interaction of Rehearsal Training  $\times$  Session  $\times$  Trials,  $F(3, 216) = 4.80$ ,  $p < .005$ .

*Exposure durations.* The pause time data from the maintenance lists was analyzed by means of a 2 (IQ Level)  $\times$  2 (Rehearsal Training)  $\times$  2 (Strategy Awareness)  $\times$  4 (Session)  $\times$  20 (Serial Position) mixed analysis of variance. Due to the size of the analyses the data were collapsed over trials; however, this was done only after separate analyses of the data at each trial yielded similar results. Comparison of the mean pause times for each subject at each trial did indicate a significant decrease from Trial 1 of Trial 2 ( $t(217) = 2.77$ ,  $p < .01$ ).

This analysis revealed that both rehearsal-trained and normal subjects paused for longer periods of time than did untrained or retarded subjects. In addition to IQ Level,  $F(1, 72) = 6.14$ ,  $p < .05$ , and Rehearsal Training,  $F(1, 72) = 324.05$ ,  $p < .001$ , the main effects of Session,  $F(3, 216) = 10.84$ ,  $p < .001$ , and Serial Position,  $F(19, 1368) = 132.80$ ,  $p < .001$ , were also significant. Subjects paused longer at every fourth serial position and pause times decreased across session. Although normal subjects did pause for longer periods than did retarded individuals this discrepancy decreased substantially during Sessions 3 and 4 resulting in a reliable IQ Level  $\times$  Session interaction,  $F(3, 216) = 3.30$ ,  $p < .05$ .

Inspection of the data reveals that rehearsal training was responsible for increasing the length of pauses at every fourth serial position. However, in Fig. 1 it is apparent that it was subjects who received only rehearsal training (and no awareness training) who paused for the longest periods at these positions. Confirmation of these effects is provided by the reliable Rehearsal Training  $\times$  Serial Position,  $F(19, 1368) = 132.80$ ,  $p < .001$ , and Rehearsal Training  $\times$  Strategy Awareness  $\times$  Serial Position,  $F(19, 1368) = 3.14$ ,  $p < .001$ , interactions.

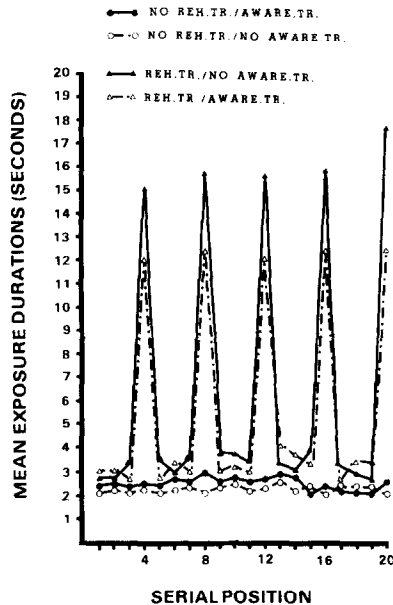


FIG. 1. Mean exposure durations on the maintenance tests as a function of Rehearsal Training, Strategy Awareness, and Serial Position.

Much of the decrease in the duration of interitem pause times over sessions is attributable to the rehearsal-trained subjects steadily reducing the amount of time spent at serial positions 4, 8, 12, 16, and 20. However, even during Session 4 rehearsal-trained subjects were pausing for significantly longer durations at every fourth serial position. These findings were reflected in significant Rehearsal Training  $\times$  Session,  $F(3, 216) = 9.95$ ,  $p < .001$ , Serial Position  $\times$  Session,  $F(57, 4104) = 1.83$ ,  $p < .001$ , and Rehearsal Training  $\times$  Session  $\times$  Serial Position,  $F(57, 4104) = 2.04$ ,  $p < .001$ , interactions.

### Generalization Tests

#### *Serial Probe*

*Number correct.* Prior to analyzing the data, the scores (number correct) were corrected for guessing (number of times a position was chosen and was correct/number of times a position was chosen) and were subjected to an arc sine transformation (Siegel, Allik, & Herman, 1976).

The transformed scores were then subjected to a 2 (IQ Level)  $\times$  2 (Rehearsal Training)  $\times$  2 (Strategy Awareness)  $\times$  2 (Session)  $\times$  8 (Serial Position) mixed analysis of variance. Results indicated the main effect of Serial Position to be significant,  $F(7, 504) = 72.38$ ,  $p < .001$ . Tukey's HSD test for comparing means demonstrated the superiority of subjects' performance at the extreme serial positions. There were no significant

differences between any of the interior (3–6) positions. Rehearsal training had no significant impact on performance,  $F(1, 72) = 0.79, p > .30$  (see Fig. 2). This was also true of Strategy Awareness,  $F(1, 72) = 0.23, p > .60$ , and the Rehearsal Training  $\times$  Strategy Awareness interaction,  $F(1, 72) = 2.46, p > 0.10$ .

*Exposure durations.* Pause times on the serial probe test were analyzed by means of a 2 (IQ Level)  $\times$  2 (Rehearsal Training)  $\times$  2 (Strategy Awareness)  $\times$  2 (Session)  $\times$  8 (Serial Position)  $\times$  8 (List) mixed analysis of variance. Normal subjects averaged longer pause times than did retarded subjects and there was a tendency for all subjects to spend more time studying items which appeared in the middle of a list (see Fig. 2). These findings were supported by the significant main effect of IQ Level,  $F(1, 72) = 4.34, p < .05$ , and Serial Position,  $F(7, 504) = 5.22, p < .001$ . Tukey's HSD test for comparing means demonstrated that the main effect due to Serial Position is the result of pauses at position 4 being significantly longer than at positions 1, 2, and 7. None of the other serial positions were significantly different from one another. Neither Rehearsal Training,  $F(1, 72) = 0.40, p > .80$ , Strategy Awareness,  $F(1, 72) = 0.01, p > .90$ , nor their interaction,  $F(1, 72) = 1.17, p > .20$ , obtained significance.

### Recognition

*Number correct.* The dependent measure of number correct used in the analysis was derived by the formula Number Correct = Hits + Correct Rejections. Table 2 presents the number correct for each ex-

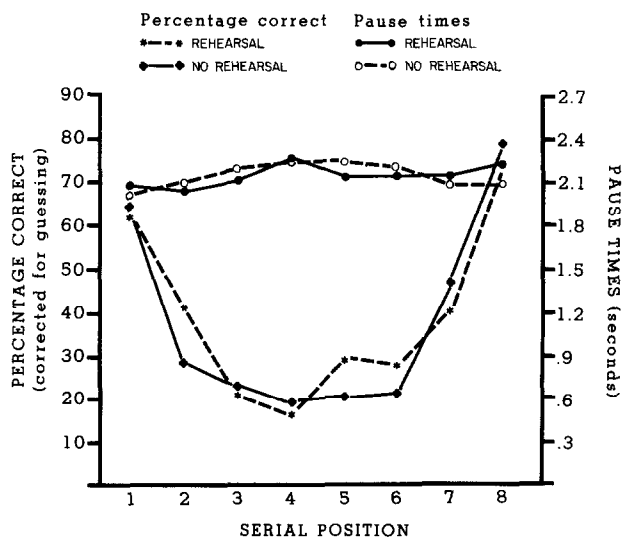


FIG. 2. Percentage correct and pause times as a function of Serial Position and Rehearsal Training.

perimental group and it is apparent that all groups were performing at near perfect levels (maximum = 40). These results were subjected to a 2 (IQ Level)  $\times$  2 (Rehearsal Training)  $\times$  2 (Strategy Awareness)  $\times$  2 (Session) mixed analysis of variance. Only the main effect of session was reliable,  $F(1, 72) = 4.90, p < .05$ . This effect was due to a general improvement in performance from Session 3 to Session 4.

*Exposure durations.* The more interesting findings for the recognition task were obtained from analysis of the duration times. The times were analyzed by means of a 2 (IQ Level)  $\times$  2 (Rehearsal Training)  $\times$  2 (Strategy Awareness)  $\times$  2 (Session)  $\times$  24 (Serial Position) mixed analysis of variance. The main effects of IQ Level,  $F(1, 72) = 5.32, p < .05$ , Rehearsal Training,  $F(1, 72) = 15.62, p < .001$ , and Serial Position,  $F(23, 1656) = 6.86, p < .001$ , were all reliable. Normal subjects paused for longer periods of time, rehearsal training increased the length of pauses and pauses were significantly longer at positions 4, 8, 12, 16, 20, and 24.

It can be clearly seen in Fig. 3 that rehearsal training was primarily responsible for the substantial increases in pause times at every fourth serial position; however, the largest pauses at these positions were by subjects who had received both rehearsal and awareness training. These findings were supported by the existence of significant Rehearsal Training  $\times$  Serial Positions,  $F(23, 1656) = 7.33, p < .001$ , Strategy Awareness  $\times$  Serial Position,  $F(23, 1656) = 2.22, p < .001$ , and Rehearsal Training  $\times$  Strategy Awareness  $\times$  Serial Position,  $F(23, 1656) = 2.04, p < .005$ , interactions.

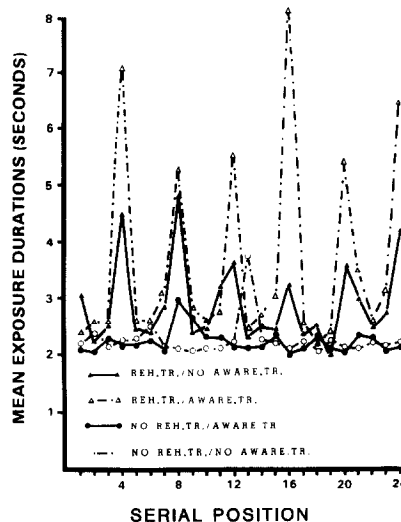


FIG. 3. Mean exposure durations on the recognition tests as a function of Rehearsal Training, Strategy Awareness, and Serial Position.

### Metamemory

Subjects' response to the questions presented during the awareness package (Session 2) and at the conclusion of Session 4 were scored and used as an index of metamnemonic awareness. Responses were scored as appropriate (1) or inappropriate (0) according to the criteria suggested by Kreutzer et al. (1975). The reliability of the scoring procedure was assessed by having two judges independently score each subject's response to each question. Interjudge reliability (percentage of agreement) ranged from 90 to 100%.

Three different types of analyses were undertaken on the metamemory data: the first examined performance on the metamemory tests; the second measured the degree of correspondence between memory awareness and strategy usage; and the last evaluated the relationship between memory awareness and memory performance.

*Metamemory performance.* Subject's scores were summed for each day (range of 0–4) and then analyzed by means of a 2 (IQ Level)  $\times$  2 (Rehearsal Training)  $\times$  2 (Strategy Awareness)  $\times$  2 (Session) mixed analysis of variance. These results indicated that strategy awareness instructions did result in higher scores and that there was a general improvement in scores over sessions. This analysis also revealed that individuals who had not received strategy awareness information improved their scores more over sessions than individuals who had been given this training. The nature of this relationship is qualified by the fact that the awareness group was performing near the ceiling at Session 2 which left little room for improvement. Confirmation of these findings was provided by the significant main effects of Strategy Awareness,  $F(1, 72) = 57.24, p < .001$ , Session,  $F(1, 72) = 16.42, p < .001$ , and by the higher order interaction of Strategy Awareness  $\times$  Session,  $F(1, 72) = 14.23, p < .001$ . Providing individuals with extensive rehearsal training had no impact on their metamemory scores,  $F(1, 72) = 0.68, p > .40$ .

It is also important to note that the awareness package was used as a training vehicle and subjects who received strategy awareness instructions were prompted during the presentation of the package to "break the lists into smaller pieces and say the names over and over." These prompts may have inflated subjects' scores during Session 2; however, the fact that the awareness group also scored higher at Day 4 indicated that even in the absence of prompts they had learned to verbalize an appropriate strategy.

*Memory awareness/Strategy utilization.* In order to determine whether there was any correspondence between individuals' verbalized metamemory and their actual use of a rehearsal strategy a series of correlational analyses were completed. Before this could be done, however, it was necessary to score individuals according to the extent to which they adopted the strategy form taught during training (Borkowski, Ca-

vanaugh, & Reichhart, 1978). Each individual's strategy form was scored on the free recall maintenance tests (MFS) and on the generalization tests (GFS). Session 4 was selected because it was felt that individuals who were using rehearsal one week after training were most likely to be those who had learned the strategy (as opposed to mimicking the training exercises) and because it was believed that the metamemory scores which were obtained on this day were more accurate measures of metamnemonic awareness (since there was no experimental intervention as in Day 2). Due to the similarity in results for the normal and retarded groups the analyses were collapsed across this variable (see Table 3). None of the relationships obtained significance.

*Metamemory awareness/Memory performance.* An attempt was also made to determine whether there was any relationship between subjects memory awareness and their memory performance. Previous authors (Cavanaugh & Borkowski, 1979) have addressed this issue by constructing  $2 \times 2$  contingency tables with the cells of the table composed of those individuals who score high or low (i.e., above or below the mean) on metamemory tests versus high or low on memory tests. The data used in this analysis were from Day 4 for the reasons discussed earlier. The memory measure was scored on the free recall test and these were plotted against subject's metamemory scores. Subjects were evenly distributed throughout the table,  $\chi^2 (1) = 0.952$ ,  $p > .30$ , and thus the present analysis provides no support for the notion that good memory is dependent on a high level of metamnemonic awareness.

## DISCUSSION

The present study evaluated the effectiveness of two components (rehearsal training and strategy awareness) of an instructional package presented to retarded and normal children. As in previous studies, repetitive rehearsal was effective in improving memory performance on immediate and delayed post-tests involving the original training task. Data from the generalization tests were less supportive of the benefits of either rehearsal or awareness training. On the serial probe tests, neither the rehearsal nor the awareness conditions had any impact on performance. In cases of generalization failure one must always consider the possibility of an

TABLE 3  
METAMEMORY SCORES (MMS)/STRATEGY FORM CORRELATIONS (MFS OR GFS)

	Rehearsal training/ No awareness	Rehearsal training/ Awareness	No training/ Awareness	No training/ No awareness
MMS/MFS	0.233	0.205	-0.273	-0.110
MMS/GFS	0.388	0.265	0.133	-0.086

inappropriate strategy-task match. However, in this case not only were there no between group differences in memory performance, pause times were flat across trials and conditions indicating an absence of any systematic attempt to utilize the trained strategy. Results from the recognition test were more encouraging but also more difficult to interpret. There was an obvious ceiling effect on these tests as evidenced by the fact that all groups averaged better than 90% correct. Individuals receiving rehearsal and strategy awareness training did average slightly better recognition scores and it is possible that a more difficult test (more items, longer interpolated task, etc.) would have provided additional information. This speculation receives support from the recognition pause time data which revealed that the rehearsal-trained groups were able to transfer use of the strategy. Furthermore, individuals who obtained both rehearsal training and strategy awareness instructions produced the greatest amount of strategy transfer (i.e., longest interitem pauses). Thus, due at least in part to the ceiling effect, there was the demonstration of strategy transfer without a change in memory performance.

The results from the generalization tests do point out the distinction between near and far generalization (Borkowski & Cavanaugh, 1979). In the present study, the only difference between the training (free recall) and the recognition tasks was in the instructions given to subjects concerning what was expected of them following completion of the list of stimulus materials. Some individuals did generalize use of the strategy in this instance; however, when the transfer task became more distinct (i.e., serial probe test) all evidence of strategy generalization vanished. This indicates that while strategy training and knowledge of a strategy's benefits may result in generalization when training and transfer tasks are similar (near generalization), these factors will not be enough when there is a great deal of difference (structure, content, etc.) between the tasks (far generalization). Furthermore, although awareness did appear to play a role in near generalization, there was a failure to document a firm memory awareness-memory ability relationship on any of the maintenance or generalization tests. These findings are consistent with previous research with the developmentally young (Cavanaugh & Borkowski, 1979; Salatas & Flavell, 1976), although improvements in assessment methodology may lead to a more complete understanding of this relationship (Cavanaugh & Borkowski, 1980).

No consistent differences were found between the performance of normal and retarded children of equivalent MA. The results indicate (pause time data) that the normal and retarded subjects were processing the available information and instructions in a similar manner and suggest that procedures which are effective in producing generalization in one group will also be effective with the other. Prior research in the mnemonic training field has shown this reciprocity (between retarded and normal

individuals of equivalent MA) in ability to learn and maintain a strategy and future research will determine if this is also true of techniques which promote generalization.

Taken collectively the results of the present study suggest alternative directions for future research. Instead of taking the approach of this study which attempted to induce generalization by making individuals aware of the benefits of a particular strategy, it may be more productive to directly train those metamemorial processes involved in generalization. It is reasonable to suppose that generalization becomes more probable when systematically programmed rather than hoped for as a by-product of training. Similar sentiments have been expressed by both Brown (1978) and Borkowski and Cavanaugh (1979) who emphasize the need for extensive task analysis of the component processes involved in strategy generalization and the development of training programs designed to teach these skills to the developmentally young.

One approach which appears to offer much promise is training in the use of self-checking or self-interrogative techniques. The desired goal of this instructional method is a student who is able to perform the teacher's role through self-interrogation (Brown, 1978); however, this is undoubtedly beyond most young or mentally retarded children. Current programs take a more realistic approach, and attempt instead to teach children to ask themselves simple questions in the hope that this process will allow for the forming of associations between the new material and that already stored in memory. This type of higher-order processing (and awareness) involves not only knowledge of a strategy's effectiveness but, in addition, it requires an ability to monitor and manage available cognitive skills. In a review of over 120 cognitive instruction studies, Belmont, Butterfield, and Ferretti (Note 1) found that the only experiments which produced generalization were those which involved instruction in some aspect of self-monitoring.

Other investigators have suggested that the use of more relevant training tasks and more systematic application of behavioral technology might increase the probability of strategy generalization (Kramer et al, 1980; Borkowski & Cavanaugh, 1979). These investigations will be forthcoming and use of these materials and procedures in conjunction with the self-checking techniques described earlier offer the greatest hope for more dramatic improvements in the memory ability of the developmentally young.

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1. Belmont, J. M., Butterfield, E. C., & Ferretti, R. P. *To secure transfer of training, instruct self-management skills*. Presented at the 1980 meeting of the American Educational Research Association, Boston, Mass.

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