Maintenance and Generalization of an External Memory Aid by Moderately and Severely Retarded Adolescents

by

Judy Zaparniuk

A thesis
presented to the University of Manitoba
in partial fulfillment of the
requirements for the degree of
Master of Arts
in
Department of Psychology

Winnipeg, Manitoba

MAINTENANCE AND GENERALIZATION OF AN EXTERNAL MEMORY AID BY MODERATELY AND SEVERELY RETARDED ADOLESCENTS

BY

JUDY ZAPARNIUK

A thesis submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfillment of the requirements of the degree of

MASTER OF ARTS

ACKNOWLEDGEMENTS

I wish to express deepest appreciation to my advisor Dr. John Whiteley for his guidance and scholarly advice throughout this research, and for the time and patience he so consistently offered. I would also like to thank the other members of my committee, Dr. Warren Eaton and Dr. Lois Brockman for their comments and criticisms.

I am grateful for the assistance of Jim McArthur, the Principal, for providing a warm and problem free atmosphere in which to work. Danny Mozol, Jim Ealing, and Rick Desautels facilitated this research by accommodating my need for subjects; for this I am greatly appreciative. I would also like to thank the staff at H. L. Softley School for their cooperation and for adding such enjoyment to the time I spent there.

A special thanks is due to Robbie Stewart for the inspiration of this research, and to Dale for the encouragement and confidence.

Abstract

Memory research with mentally retarded children has consistently revealed that these individuals possess memory deficits. Past research has also indicated that mentally retarded children and adolescents can be trained to employ mnemonic strategies, thereby improving memory performance. But maintenance and generalization of these strategies have seldom been demonstrated. Furthermore, little research on memorial training has been conducted with moderately and severely mentally retarded individuals. One purpose of the present study was to train moderately and severely mentally retarded adolescents to use pictures of to-be-remembered items as an external memory aid, and to examine the effects of this aid on memory performance. A second purpose was to examine the effects of metamemory training on maintenance and generalization of the external memory aid. Metamemory training involves increasing the subject's knowledge of his or her memory abilities.

Twenty-four moderately and severely mentally retarded adolescents participated in this study. Their mean chronological age was 17.45 years and their mean mental age, as determined by the Peabody Picture Vocaubulary Test, was 4.98 years. Subjects were initially required to identify 30 pictures of school items and 30 pictures of food items. Subjects then received either two, three, or four baseline sessions. During baseline, the experimenter named lists of

items while simultaneously prompting the subject to find the appropriate pictures and place them in an envelope. Once an entire list had been named, the subject was asked to retrieve the items from a nearby cupboard. In the training phase, subjects were prompted to find and place pictures of the requested items into an envelope. In addition, subjects were trained to use the pictures as an aid in retrieving the requested items. In the next phase of training, one-half of the subjects ($\underline{N}$ = 4) from each baseline group received two training sessions in metamemory skills. These subjects were asked questions regarding their memorial skills, they were instructed about the benefits of picture use, and they received verbal feedback concerning their performance. Following training, all subjects received a posttest, generalization test, and maintenance test. The generalization test involved food item pictures rather than the school item pictures employed in training. One week following the posttest, a maintenance test was administered.

The percentage of items correctly selected was the main dependent variable. Results showed that memory performance increased dramatically following external memory aid training. Moreover, once subjects were taught how to use the pictures as a memory aid, they continued to use the strategy throughout the posttest, generalization test, and maintenance test. Analyses of intrusion errors, which were defined as the number of items selected by the subject that

were not included in the list of to-be-remembered items, revealed that the number of intrusion errors decreased substantially when pictures were used, as compared to when they were not employed. No differences were found in memory performance between the metamemory training and control groups. The present research demonstrated that the use of a picture list as an external memory aid enhanced memory performance considerably. Such aids could be used in applied settings and contribute to mentally retarded individuals' independence.

CONTENTS

MAINTENANCE AND GENERALIZATION OF AN EXTERNAL MEMORY AID BY MODERATELY AND SEVERELY RETARDED ADOLESCENTS

Memory research with mentally retarded people has shown that these individuals possess memory deficits (Ellis, 1970; Detterman, 1979; Kramer, Nagle, & Engle, 1980). Past research has also indicated that mentally retarded children and adolescents may be trained to employ various types of mnemonic strategies (Glidden, 1979). Although strategy training has resulted in improved performance on memory tasks, it has usually resulted in poor generalization and maintenance. Also, little research has been conducted on ways of alleviating the memory deficits in moderately to severely retarded individuals, as opposed to the mildly retarded individuals generally participating in these studies. The present study examined the use of an external memory aid as a means of reducing memory deficits in moderately and severely retarded individuals.

Memory Deficits and Strategy Training

The study of memory processes in mentally retarded individuals has been influenced by information processing models of memory such as Atkinson and Shiffrin's (1968) model of memory, and Craik and Lockhart's (1972) depth of processing theory. One explanation of memory deficits in mentally retarded children attributes this deficit to a production deficiency; that is, these individuals fail to spontaneously use mediators or strategies to aid in retention but can be trained to do so (Ellis, 1970). Research has supported this view (Butterfield, Wambold, & Belmont, 1973; Dash, 1979; Detterman, 1979; Mulcahy, 1979).

Past research has examined a variety of memory strategies with mildly mentally retarded children and adolescents. Labeling and rehearsal are major strategies that have received a great deal of research interest. The labeling technique is aimed at directing the subject's attention toward the appropriate stimuli; whereas, rehearsal provides a means of holding the information in memory for a period of time. Labeling involves the naming of stimuli in their presence (Horowitz, 1969); whereas rehearsal involves the continuous repetition of one or more items (Kellas, Ashcraft, & Johnson, 1973).

A large number of strategies may be classified as being organizational strategies. The underlying assumption of these strategies is that an increased organization of the to-be-remembered material will increase recall. One organizational strategy is known as blocking. Blocking involves presenting categorically related items closely together in time (Evans, 1977). Sorting is a second organizational strategy in which the subject is given a number of stimuli and instructed to sort the stimuli into piles containing categories or relationships of some sort (Reigel & Taylor, 1974). A third organizational strategy is known as categorization. In categorization, lists containing predetermined categories are provided for the subject to memorize and later recall (Reiss, 1968). The category name is often thought to act as a cue that aids recall for the items contained in that category.

Imagery and verbal elaboration are memory strategies which help process information at a deeper level (Craik, 1973). Relational contexts are used to increase understanding of the material, and hence memory performance. In verbal elaboration, subjects are provided with a meaningful, semantically related sentence containing the stimulus words (McMillan, 1972), rather than isolated words. Imagery elaboration is administered by embedding an item in an interactive picture (Ross & Ross, 1978), instead of presenting a solitary item.

Although strategy training research has shown that mildly mentally retarded individuals can successfully employ rehearsal, organizational, and elaborative strategies to improve their memory, there are serious limitations in the applicability of these training methods. To be useful, these newly learned strategies must be maintained and generalized. A strategy is considered to be maintained when the individual continues to use it on tasks identical to the training task. Generalization occurs when the individual employs the newly acquired strategy on a task requiring the same processing skills as the original task, yet the task's specific form differs in some way from the original training task. Brown (1978) states that, "the aim of training is not to get children to perform more like adults on a single task, but to get them to think more like adults in a range of similar situations" (p. 138). Reviews of the literature have concluded that maintenance and generalization of strategies have not usually been demonstrated (Brown, 1978; Campione, & Brown, 1977). Another limitation common to research on strategy training is that the subject population used in these studies has typically been educable mentally retarded children. Most of the strategies employed in these studies would not be appropriate for more seriously mentally retarded individuals because they lack the necessary language skills.

A number of techniques show promise for promoting maintenance and generalization. Feedback given to the subjects regarding their performance during training, and metamemory skills both appear to promote maintenance and generalization (Borkowski & Cavanaugh, 1979). Metamemory refers to the knowledge of one's memory abilities and operations, or more specifically the capabilities and limitations of storing information. Brown (1978) proposed that there is a direct link between memory awareness and memory performance. It has also been suggested (Brown, Campione, & Day, 1981; Moynahan, 1978) that for individuals to maintain a strategy, they must be aware of the value of a strategy for improving their performance.

Research which involved providing six to seven-year-old nonhandicapped children with verbal feedback regarding the usefulness of rehearsal as a memory strategy was found to significantly improve strategy maintenance (Kennedy & Miller, 1976). These children maintained the rehearsal strategy for a greater number of trials than the control group who were not informed about the value of rehearsing. Borkowski, Levers, and Gruenenfelder (1976) found that the observation of a model successfully employing memory strategies led nursery school children to employ the strategies. The purpose of the model was to increase the subjects' awareness of the strategy's utility. Recent research has also indicated that strategy training combined with metamemory skills enhances maintenance (Lodico, Ghatala, Levin, Pressley, & Bell, 1983; Paris, Newman, & McVey, 1982). In the Paris et al. (1982) study, first and second graders were trained to use five different mnemonic strategies. However, one-half of the subjects received feedback, rationale, and justification about the benefits and utility of using the strategies; whereas, the other half were only given demonstrations and practice. Results indicated that the group receiving the additional feedback and explanations employed the strategies more often and recalled more information than the other group. The authors concluded that performance was superior when subjects understood the utility and significance of using the strategies.

External Memory Aids

The memory strategies discussed thus far have all involved internal memory aids. Internal memory aids focus on providing schemes for cognitive encoding and retrieving of information. It has recently been revealed in a survey of non mentally retarded adults (Harris, 1982), that these internal memory aids do not appear to be as frequently employed as external aids. Harris (1982) found that external aids, such as shopping lists and memos, were far more widely relied on than internal aids. The results indicated that the two most frequently used internal aids were mental retracing of events and alphabetical searching. Harris points out that these techniques are retrieval strategies, in contrast with the encoding techniques generally studied. In response to Harris's (1982) survey, Niesser (1982) suggests that "external aids are probably perceived as more dependable than internal ones; for this reason they may be preferred in any situation where the need to avoid forgetting is paramount" (p. 337). The fact that external aids generally appear to be more frequently used

(Harris, 1982), coupled with Niesser's (1982) suggestion that they are more dependable, would lead one to conclude that it would be of considerable benefit to train individuals possessing memory deficits in the use of external memory aids.

The possible effectiveness of external memory aids in reducing memory deficits may be understood in terms of the encoding specificity principle (Tulving & Thompson, 1973). This principle states that if the encoding cues are the same or similar to the retrieval cues, recall will be enhanced. An external memory aid, such as a list, provides a means of ensuring that the encoding and retrieval cues are the same. Hence, it has a high probability of inducing the correct response at recall.

External memory aids may also improve memory performance because they often involve physical manipulation of the stimulus materials. Active processing of strategies, or actual physical manipulation of the stimulus material has been shown to aid in producing maintenance and generalization (Borkowski, Levers, & Gruenenfelder, 1976; Paris, et al., 1982; Wanschura & Borkowski, 1975; Wolff, Levin, & Longovardi, 1974). Active processing refers to the subject's increasing degree of involvement in the training task. In this type of study, the task situation is arranged so that physical involvement and manipulation of the stimulus items are promoted. This is achieved through the use of items such as picture cards and objects, which allow manipulation. A study by Wanschura and Borkowski (1975) exemplifies the use of an active processing strategy. When subjects were instructed to manipulate objects related to paired-associate training on the first trial of each session, strategy maintenance was found. The manipulation of objects included closely observing and handling the items. Another study found similar results when children were prompted to create interactions between pairs of toys (Wolff et al., 1974). More toys were re-paired at maintenance when the interactions were performed by the subjects than when the children merely observed the transactions. Additional research by Paris et al. (1982) reveals that the strategy containing the most physical involvement with the stimuli resulted in the greatest maintenance.

Present Study

One purpose of the present study was to train moderately and severely mentally retarded adolescents to use an external memory aid and to examine the effects of training on memory performance. Subjects were trained to construct lists of to-be-remembered items using pictures of the items. Pictures were employed because subjects could not perform a writing task. When subjects had constructed the lists, they were trained to retrieve the actual items with the aid of the pictures. Then a posttest was given to determine whether they would use the pictures spontaneously without prompting. A generalization test was administered to reveal whether they continued to employ the strategy with pictures and items that were different from the ones used in training, and a maintenance test was given one week following the posttest.

A second purpose of this study was to further explore the effects of combining metamemory training and feedback on maintenance and generalization of memory strategies. In addition to memory strategy training, one-half the subjects were given verbal feedback and metamemory training. These subjects were asked to predict whether they would be able to retrieve all the items contained in lists with varying numbers of items. They were reminded of their prediction at the end of each trial in order to teach them their actual capabilities. Following trials where subjects used the pictures to aid their performance, the metamemory subjects received explanations focusing on the positive aspects of picture use in relation to their performance. On trials where picture use was not permitted, the explanation focused on the subject's relatively poor performance when pictures were not available. At the end of each trial these subjects were questioned about whether they thought the pictures were necessary for retrieving all the items.

It was hypothesized that the number of items retrieved would increase following picture list training. It was also hypothesized that the subjects receiving metamemory training would show superior maintenance and generalization of the memory strategy as compared with the control subjects.

Method

Subjects

A sample of 24 moderately to severely retarded adolescents (10 females and 14 males) from a nonresidential public school for mentally retarded adolescents participated in the study. Their mean chronological age (CA) was 17.45 years (range 9.42 to 22.75). Mental age (MA) as determined by the Peabody Picture Vocabulary Test was 4.98 years (range 3.09 to 9.08), and their mean ratio IQ was 29.67 (range 16.01 to 45.59). Only those subjects for which written parental consent was obtained participated in the study.

Apparatus

The stimuli consisted of 80, 5 x 7-cm colored photographs. A set of 40 pictures of school items (see Table 2, Appendix A), such as a pencil and a paintbrush, were used for the training task. A second set of 40 pictures of food items (see Table 2, Appendix A), such as a loaf of bread and an apple, were used in the generalization test. A 11 x 14- cm brown envelope was provided to hold pictures of the to-be-remembered items, and a 30 x 30 x 10-cm cardboard box was provided to hold the retrieved objects. Plastic chips were employed as tokens, and they were exchanged for back-up reinforcers consisting of a variety of items such as pens, notepads, crayons, and puzzles.

Procedure

Subjects were taken individually from their classrooms to an unused classroom for each session. At the beginning of the session they were seated at a table across from the experimenter.

In the first session, all subjects were shown the array of pictures containing school items, and they were required to identify the item found in at least 30 of the pictures in order to ensure familiarity with the name of each item. The pictures were arranged in a standard position on the table in front of the subject. The experimenter then instructed the subjects by stating

> We are going to play a game with these pictures (pointing to the pictures). First I will name all of the pictures to you, so watch carefully (names and points to each picture). Now I will name a picture and I want you to look carefully at all the pictures and point to the picture that I have named. Show me __________.

The experimenter then named each item following a prearranged random order while the subject pointed to the picture. Subjects had to correctly identify a picture on two out of three trials in order for it to be included in their set of pictures. Hence, if subjects were unable to identify the item on the first two trials, they were given a third trial. This procedure was repeated with the food item pictures. A final set of 30 items was selected for each subject for each set of pictures.

Baseline assessment was administered according to a multiple baseline design, beginning in Session 2. An equal number of subjects ($\underline{N}$ = 8) were assigned to each of three baseline groups (B2, B3, and B4). Subjects in B2 received two baseline sessions, subjects in B3 received three baseline sessions, and subjects in B4 received four baseline sessions. Assignment of subjects to baseline groups was carried out so that the mean MA of the subjects was approximately equal across groups. Multiple baseline sessions were administered to determine whether increased familiarity with the pictures and items would affect the number of items selected correctly.

The school item pictures were arranged on the table in front of the subject. The experimenter initiated the baseline session by stating that they were going to play a game. The experimenter then told the subject:

> I am going to name some of the things in these pictures (pointing to the pictures). When I name each thing, I want you to find the picture of it right away and put the picture in this envelope (holding up the envelope). When I finish naming the things, you go to that cupboard (pointing to

> the cupboard) and get the things I asked for. If you get the things I asked for, you'll get one of these chips (holding a chip) for each thing. If you get enough chips, you can choose a prize at the end of the game.

The experimenter then proceeded by naming the first list of items, while simultaneously prompting the subject to find the appropriate pictures and place them in the envelope. Prompting involved verbally instructing the subject to select the correct picture, and if necessary, physically guiding his or her hand to the picture and then into the envelope. When the list of items had been named, the experimenter then stated "Now go to the cupboard and get the things I asked for." The subject was then escorted to a cupboard where the 30 school items were displayed on a counter, and verbally instructed to, "Try to remember the things I just named, and take them off the counter and put them in the box (pointing to box)." The items chosen by the subject were recorded on each trial. When subjects did not chose an item within 10 s the experimenter said, "Can you remember any more?" A trial would terminate if the subject did not chose an item within 10 s following this prompt. Subjects were not restrained from taking the envelope to the cupboard on the first trial of the first baseline session in order to investigate any spontaneous use of the pictures as a memory aid. If the pictures were removed from the envelope at the cupboard, it was considered an instance of spontaneous use of the pictures. The envelope remained at the table for the remainder of baseline trials.

Subjects were instructed to retrieve different numbers of objects on each trial. During each session, a subject received two trial blocks consisting of five trials each. Each block included one list of 5, 6, 7, 8, and 9 items. The order of list lengths and the items contained in each list within blocks were randomized across subjects and sessions. The cupboard containing the items corresponding to the pictures was concealed by a partition such that its contents were not visible until the subject approached it.

Reinforcement throughout the study involved a token economy system. Subjects received a plastic chip for each item selected correctly. At the end of each session, the accumulated tokens were traded for a back-up reinforcer of the individual's choice. Subjects were required to earn 35 tokens for each back-up reinforcer. Any additional tokens were added to earnings for the next session.

Following baseline sessions, all subjects received picture list training. Picture list training consisted of five training trials during which subjects were instructed and prompted to use the pictures, and five probe trials without prompts. The school item pictures were arranged on the desk in front of the subject. The experimenter explained that they were going to play another game with the pictures. On the training trials, subjects were given the same instructions used during baseline sessions combined with additional instructions to use the pictures to retrieve the items. After the experimenter had instructed the subjects to place the pictures in the envelope, she then stated:

> When I finish naming the things, you take the envelope to the cupboard and get the things in the pictures. When you get to the cupboard, look at the pictures to help you find the right things. This time you have the pictures to help you get all of them right. You will win chips again if you get the things I asked for.

The experimenter proceeded by naming a list of items, while prompting the subject, as in baseline, to find and place the appropriate pictures in the envelope. When an entire list had been named, the experimenter stated "Now bring the pictures to the cupboard and get the things I asked for." The subject was then escorted to the cupboard and instructed to select each item in the list of pictures and place them into the box. Subjects were initially instructed to remove all pictures from the envelope, place the envelope into the box, and then get the items in the pictures. Subjects were trained to hold the pictures in one stack, and to get the item in the top picture. Once an item had been retrieved, they were told to place the picture of the retrieved item at the bottom of the stack. Subjects were taught to stop retrieving items when the items in the pictures were in the box. Physical prompting was included to aid the subject in selecting and placing the correct items into the box. When the items in the pictures had been chosen, the experimenter matched the selected items to the pictures as the subject observed. The experimenter modeled the entire procedure to those subjects who appeared to experience difficulty following the instructions.

The five probe trials were conducted in the same manner as the baseline trials. The probe trials were incorporated to provide a measure of each subject's performance following the five training trials. The training phase terminated when at least 90 percent of the 35 items in the five probe trial lists were correctly chosen. All subjects achieved this level of performance in the first training session.

In the next phase of training, one-half of the subjects ($\underline{N}$ = 4) from each baseline group were given training in metamemory skills. Subjects were divided into list training and list plus metamemory training groups so that the mean MA was approximately equal for the two groups. All subjects received two sessions with ten trials in each session. The ten trials were arranged so that five trials included picture list training, and five trials were given where the subject was prevented from constructing picture lists. These two types of trials were administered in an alternating fashion. Trials again contained lists differing in number of items as described for baseline sessions.

Prior to each trial, the metamemory training subjects were asked, "Do you think you will remember to get all of the things I asked for?" The experimenter recorded their answer as a yes or no response. At the end of each trial, the experimenter reminded the subject of their answer. This information acted as feedback to the subject, making them aware of their actual capabilities as compared to initial conceptions. Following list construction trials, they received an explanation highlighting the notion that their superior performance resulted from the use of the list. The experimenter said, "See how good you did this time using the pictures. You got all the things I asked for and all the chips." Trials performed without the list were followed by the explanation, "See how bad you did this time without the pictures. You didn't get everything I asked for, and you didn't get all the chips." At the end of each trial, metamemory training subjects were also asked, "Do you think you can remember to get the things I asked for better with the pictures or without the pictures?" The order of the "with the pictures" and "without the pictures" phrases was alternated from trial to trial. A with or without response was recorded after each trial. Subjects in the list training condition received the same procedures without the above explanations or questions.

Following training, all subjects were given a posttest, generalization test, and maintenance test. A 10-trial posttest was given on the day immediately following the end of training, and consisted of 10 trials using procedures identical to baseline sessions, with the exception of allowing subjects to use the pictures if they wished. The next session consisted of a generalization test during which the food pictures and corresponding items were employed. A maintenance test was given one week following the posttest, once again employing the school item pictures. Both the generalization and maintenance tests consisted of 10 trials administered according to posttest procedures.

Procedural and Dependent Measure Reliability

Reliability measures were taken in order to measure dependent variable reliability and to ensure that the present study had been undertaken in accordance with the experimental plan, as suggested by Billingsley, White, and Munson (1980). The experimenter was observed at intermittent intervals throughout the study by an observer. Observations were made for four sessions in each phase of the study. Of these four sessions, two sessions involved observing control subjects and two sessions involved observing metamemory subjects. Reliability scores were obtained for: (a) number of items correctly selected, (b) number of intrusion errors, (c) recordings of the with or without metamemory responses, (d) recordings of the yes or no metamemory responses, and (e) correct administration of training techniques and procedures as described in the method. Results revealed a 100 percent interobserver reliability score for each of the dependent measures (a to d above), and a 99.53 percent reliability score for procedural reliability (e).

Results

The number of items correctly selected by the subject on each trial was determined and then summed over blocks of five trials. The percent correct on each block of trials was then calculated. There were two blocks of five trials for the baseline sessions, the posttest, generalization test, and maintenance test. For the training session, there was one block of five probe trials, and for each of the two metamemory training sessions, there was one block of five no-picture trials. The mean percent correct scores for the last baseline session and each subsequent phase of the study are plotted separately for the control group and metamemory group in Figure 1.

Visual inspection of Figure 1 indicates that the training procedure produced a substantial increase in performance, as compared to performance on the last baseline session. The lowered performance on the two blocks of metamemory no-picture trials shows a reversal in performance to baseline levels when subjects were not allowed to employ the pictures. Performance returned to a high level on the posttest, generalization test, and maintenance test, once again demonstrating the positive effects produced by the training procedures. Figure 1 also suggests that the metamemory training technique did not greatly enhance overall performance, as the difference between the control and metamemory training conditions during the posttest, generalization test, and maintenance test is small.

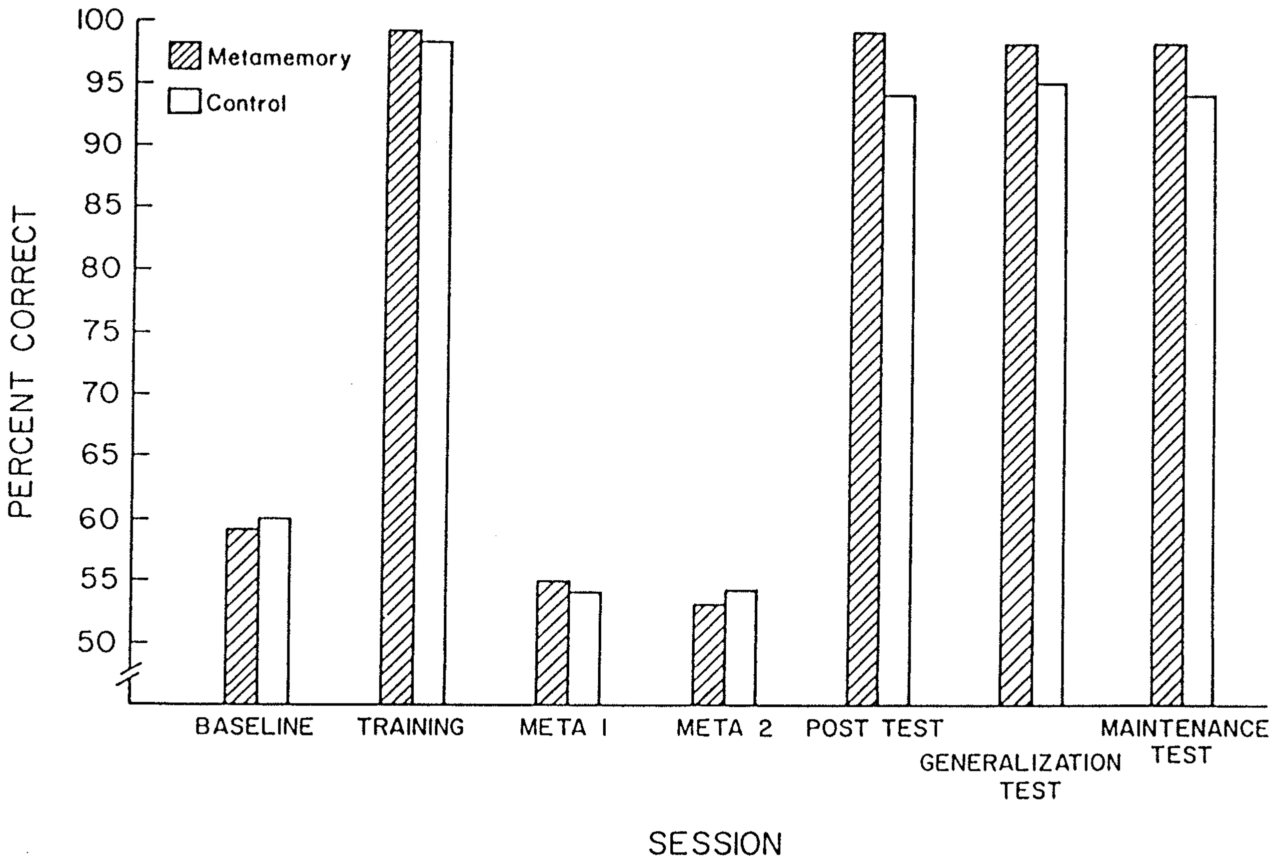


Figure 1. Mean percentage correct by treatment group for the last baseline session, training probe trials, first metamemory session no-picture trials(Meta 1), second metamemory session no-picture trials(Meta 2), posttest, generalization test, and maintenance test.

To confirm these conclusions, statistical analyses were carried out. The first analysis compared performance on the final baseline session with performance on the posttest, generalization test, and maintenance test. A Training Condition (metamemory vs control) x Baseline Condition (2 baseline sessions vs 3 baseline sessions vs 4 baseline session) x Trial Block (Trial Block 1 vs Trial Block 2) x Phase (final baseline session vs posttest vs generalization test vs maintenance test) analysis of variance was performed (see Appendix B, Table 3). Significant effects were obtained for Phase, $F(3,54) = 162.36$, $p < .001$, and Trial Block, $F(1,18) = 38.25$, $p < .001$. Interaction effects existed between Phase and Trial Block, $F(3,54) = 14.08$, $p < .001$, between Trial Block and Baseline Condition, $F(2,18) = 6.09$, $p = .01$, and Trial Block, Baseline Condition and Treatment Condition, $F(2,18) = 3.80$, $p = .04$. Other main effects and interactions were nonsignificant.

The phase main effect indicates that the mean percentage of items correctly selected in the final baseline session for all subjects ($M = 60.00$) was significantly lower than the mean percentage of items correctly selected in the posttest ($M = 96.72$), the generalization test ($M = 97.20$), and the maintenance test ($M = 96.60$).

The Phase x Trial Block interaction revealed that performance on Trial Block 1 of the final baseline session was higher than performance on Trial Block 2 of this session

(M = 65.11 and 54.87, respectively), but there was no difference between Trial Block 1 and Trial Block 2 for the posttest (M = 96.66 and 96.78), generalization test (M = 97.14 and 97.26), or maintenance test (M = 96.90 and 96.30). The Trial Block x Baseline Condition x Treatment Condition interaction means are shown in Table 4, Appendix B. This interaction appeared to result primarily from the lower performance of the 4 subjects in the control, two-baseline condition on Trial Block 1 as compared with the other groups.

Sphericity tests applied to the above analysis revealed significant effects, $p < .001$. Due to these findings of a lack of homogeneity of covariance, Mann-Whitney tests were performed to compare the control and metamemory training conditions at each phase of the study (last baseline session, posttest, generalization test, and maintenance test). Differences between the two groups were nonsignificant for each phase (see Table 5, Appendix B).

Only one subject failed to show the patterns of change in performance illustrated in Figure 1. This subject was in the control group, and he began to perform at levels substantially lower than those of his control group counterparts during the posttest phase (M = 61.42). The subject's performance level decreased to an even greater degree as compared to the other control subjects in the generalization test (M = 65.71) and performance remaind at the lower level for the maintenance test (M = 50.00).

Separate analyses of variance were conducted on data from each of three baseline groups in order to investigate changes in performance over baseline sessions (see Tables 6, 7, and 8; Appendix B). The between-subjects variable was treatment condition (metamemory vs control) and the within-subjects variables were trial block and sessions. Each of the three analyses revealed a significant main effect for trial block. The analyses for the groups who received two, three, and four baseline sessions revealed the following effects for trial block; $F(1,6) = 133.57$, $p < .001$, $F(1,6) = 14.20$, $p < .01$, and $F(1,6) = 7.40$, $p < .03$, respectively. In each case performance on Trial Block 2 was lower than performance on Trial Block 1 (see Table 1). The main effects for treatment and sessions, and the interactions were nonsignificant.

Table 1

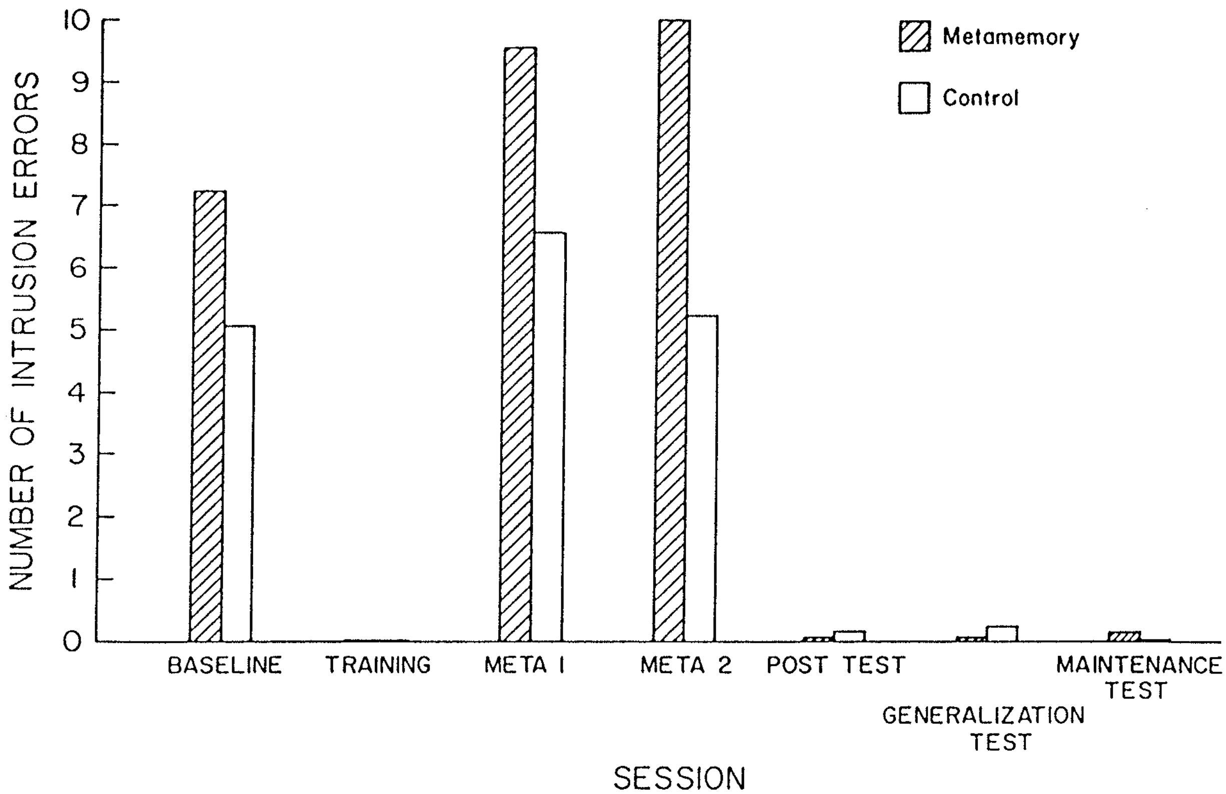
Mean Percentage Correct on Trial Block 1 and Trial Block 2 During Baseline Sessions

Baseline Condition	Block 1	Block 2
2-Baseline Group	68.56	54.63
3-Baseline Group	61.42	54.28
4-Baseline Group	65.35	55.71

Intrusion errors, which were defined as the number of items the subject selected that were not included in the list of to-be-remembered items, were counted for each trial. The first analysis was carried out to compare the number of intrusion errors across groups on the last baseline session. A 2(metamemory vs control) x 2(Trial Block 1 vs Trial Block 2) analysis of variance was performed (see Table 9, Appendix B). A main effect for trial block resulted, $F(1,22) = 9.88$, $p < .004$. The main effect for treatment condition and interactions were nonsignificant. The above analysis was repeated with baseline condition acting as the between-subjects variable, rather than treatment condition. Significant effects were again obtained only for trial block, $F(1,21) = 9.17$, $p < .006$. The mean number of intrusion errors for Trial Block 1 of the final baseline session ($M = 5.37$) was less than the mean for Trial Block 2 ($M = 7.08$).

Visual inspection of Figure 2 reveals that there was a higher mean number of intrusion errors in the last baseline session and the two metamemory trial blocks during which subjects were not permitted to employ the pictures as compared with the posttest, generalization test, and maintenance test when pictures were used by subjects. The Sign test was used to compare performance on the last baseline session with posttest performance. Individual subjects' means for these two sessions were employed. The results indicated that there was a significant decrease in intrusion errors from baseline to posttest, $p < .001$. Figure 2 also suggests that the metamemory subjects made more intrustion errors than the control subjects on the last baseline session and the two metamemory trial blocks. Mann-Whitney tests were carried out to compare performance of the two treatment groups at each phase of training, no significant effects were obtained (see Table 10, Appendix B).

A second set of analyses investigated changes in number of intrusion errors during baseline sessions. The data from each of three baseline groups were entered into separate analyses of variance (see Tables 11, 12, and 13; Appendix B). The between-subjects variable was treatment condition (metamemory vs control) and the within subjects variables were trial block and session. The analysis for the group receiving two baseline sessions revealed a significant Session x Trial Block interaction, $F(1,6) = 10.62$, $p = .017$. Analysis for the group receiving three baseline sessions revealed a significant main effect for sessions, $F(2,12) = 12.72$, $p = .001$. Analysis for the group receiving four baseline sessions revealed a significant main effect for session, $F(3,18) = 11.02$, $p < .001$, and a significant Session x Trial Block interaction, $F(3,18) = 23.87$, $p < .001$. The means for each session and trial block are shown in Figure 3 for each of the three baseline conditions. The



<u>Figure</u> <u>2</u>. Mean number of intrusion errors by treatment group during the last baseline session, training probe trials, first metamemory session no-picture trials(Meta1), second metamemory session no-picture trials(Meta 2), posttest, generalization test, and maintenance test.

Session x Trial Block interactions for the two- and four-baseline conditions resulted from the fact that the intrusion errors decreased from Trial Block 1 to Trial Block 2 in Session 1, but showed a slight increase from Trial Block 1 to Trial Block 2 in subsequent baseline sessions. The same trend is evident in the three baseline condition.

Subjects in the metamemory group were asked two questions pertaining to their metamemory skills during the two metamemory sessions. The first question was, "Do you think you'll remember to get everything I asked for?" A yes or no response was recorded. The second question, "Do you think you can remember to get the things I asked for better with the pictures, or without pictures?" was asked at the end of the trial. A with or without response was recorded. The number of correct answers to these questions were counted for each subject for each of the two sessions. The answers to the two types of questions were combined for each session into one score. A Sign test compared performance on the two metamemory sessions. Results revealed that there was a significant difference between sessions, $p = .003$, indicating that subjects answered a significantly greater number of questions correctly in the second metamemory session ($M = 9.29$) than in the first session ($M = 8.08$).

The frequency with which the subjects employed the pictures was also recorded for the training session probe trials, and the posttest, generalization test, and

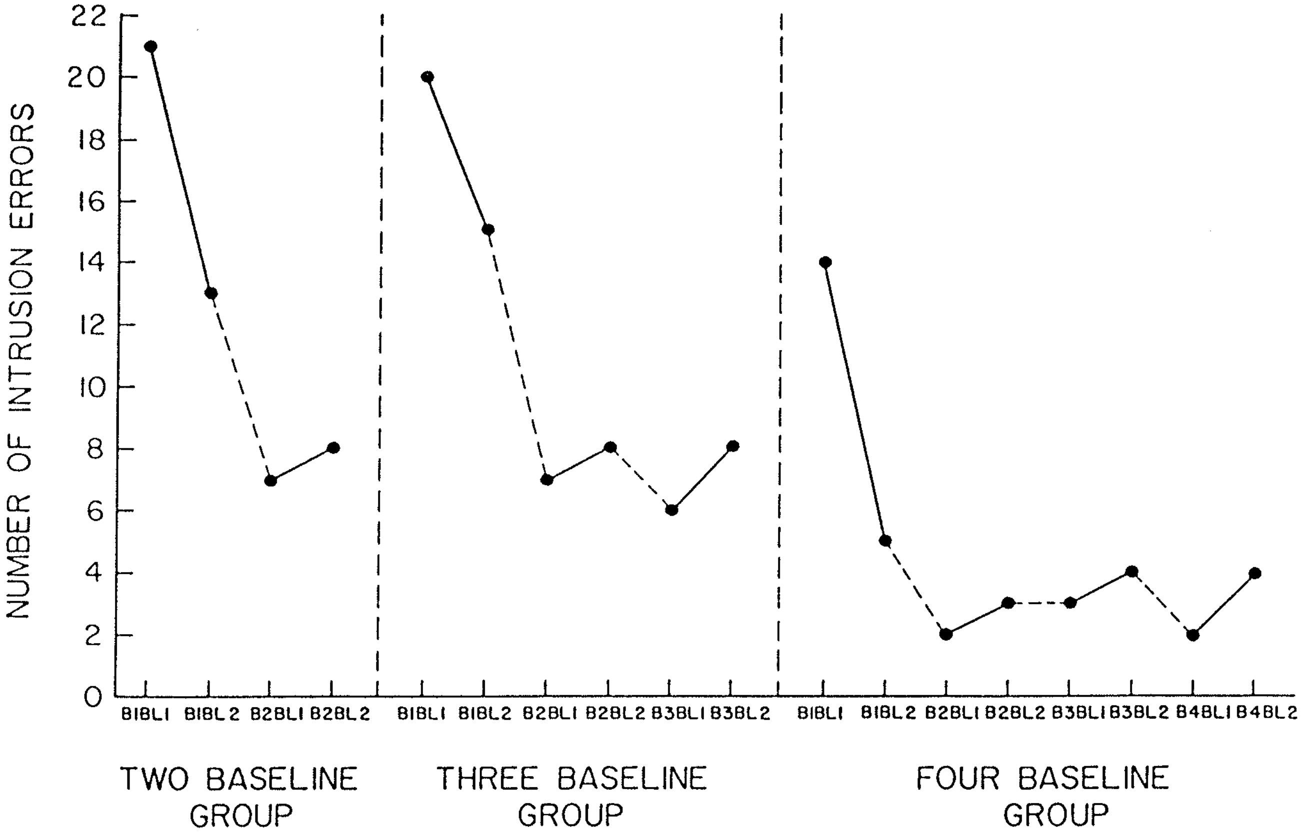


Figure 3. Mean number of intrusion errors by baseline group during each block of each baseline session given to that corresponding baseline group (B=baseline session, BL=block).

maintenance test. Recordings of picture use revealed that 100 percent of the metamemory subjects employed the pictures on each trial of the phases mentioned above; whereas, 100 percent of the control subjects employed the pictures on each trial of the training probe trials, 75 percent of them used the pictures on each trial of the posttest, and 92 percent of them used the pictures on each trial of the generalization and maintenance test.

Of the remaining 25 percent ($\underline{N}$ = 3) of the control subjects not using the picture on each trial of the posttest, the first subject used them on 30 percent of the trials, the second subject used them on 50 percent of the trials, and the third subject used them on 90 percent of the trials. The only subject who was not employing the pictures on the generalization and maintenance test was the first subject mentioned above. This subject did not use the pictures during the generalization test, and used them on 1 percent of the trials in the maintenance test.

Discussion

Past research has shown that mentally retarded individuals can be trained to employ mnemonic strategies in order to improve their memory performances (Glidden, 1979). Although strategy training research has been successful, serious limitations are found in the applicality of mnemonic strategies. Maintenance and generalization of these strategies have seldom been demonstrated (Brown, 1978; Campione & Brown, 1977). Also, little research has been conducted on strategy training with moderately to severely retarded persons; the research has generally been carried out with children and mildly retarded persons. The purpose of the present study was to train moderately to severely retarded adolescents to employ an external memory aid in order to improve their performance on a memory task. The external memory aid was thought to represent a practical memory strategy as suggested by Neisser (1982). Results of the present study revealed that the percentage of items correctly chosen increased dramatically following strategy training. Moreover, once the subjects were taught how to use the pictures as a memory aid for retrieving items, they continued to employ this strategy throughout the posttest, generalization test, and maintenance test, and their performance was maintained at the level found immediately following training. The fact that these mentally retarded adolescents acquired the strategy in only five training trials indicates that this strategy can be easily learned.

One control group subject failed to perform at the high levels attained by his counterparts during the posttest, generalization test, and maintenance test; although, he had reached equally high performance levels during training. Observations of this subject suggest that his lower performance levels may have been due to a general disinterest in the task. This subject received the highest score on the Peabody Picture Vocabulary Test (MA = 9.08). The performance of this individual suggests that the testing procedures would need modification in order to create a more interesting task for some mentally retarded subjects. The use of metamemory training might have made the testing procedures more meaningful for this subject, as it may have increased the subject's understanding of the value of the strategy.

Results also revealed that the mean percentage correct on Trial Block 1 in each baseline session was higher than on Trial Block 2, but no difference was found between Trial Blocks 1 and 2 for the posttest, generalization test, or maintenance test. The trial block effect in baseline is consistent with an interference effect of Block 1 lists on the recall of Block 2 lists. Memorization of a list of items would have become increasingly difficult as a baseline session progressed because of previous lists interfering with the incoming information of new lists, creating proactive interference (Kail, 1984, p.95). During the posttest, generalization test, and maintenance test, picture use was permitted, thereby eliminating proactive interference.

The 4 subjects in the control, two-baseline session condition had percentage correct scores that were lower than the other groups during baseline. Considering the fact that baseline sessions were administered in a standard fashion to all subjects, this difference was probably due to sampling bias.

Inspection of the intrusion error data revealed that the mean number of intrusion errors was higher when pictures were not used as compared to when they were employed. These results again demonstrate the value of the pictures for enhancing performance and eliminating errors. During baseline sessions, the intrusion errors decreased significantly from the initial baseline session to the final baseline session. In addition, the two- and four-session baseline conditions revealed a decrease in intrusion errors from Trial Block 1 to Trial Block 2 in the first baseline session, but a slight increase was found from Trial Block 1, to Trial Block 2 in subsequent baseline sessions. The same trend was evident in the three-baseline session condition. The sessional decrease in errors seems to have resulted from the subjects' increased understanding of the task demands. During Block 1 of the first baseline session, subjects appeared somewhat confused as to the requirements of the task. Errors decreased substantially following the first trial block probably because the subjects learned that only selecting items in the list would be rewarded with a token. The increase in intrusion errors from Trial Block 1 to Trial Block 2 in subsequent baseline sessions may have been caused by proactive interference.

A second purpose of the present study was to examine the effects of combining metamemory training and feedback with strategy training on maintenance and generalization of the memory strategy. In addition to picture use training, one-half of the subjects received feedback and metamemory skill training. Subjects receiving the metamemory training were expected to show superior maintenance and generalization of the memory strategy. All subjects performed at high levels; however, a significant difference between the metamemory and control group was not found. Both groups appeared to perform at equivalent levels throughout each phase of the study. Similarly, no differences were found between the metamemory and control groups for number of intrusion errors. Although the metamemory group obtained slightly higher scores on percentage of items correct than the control group for the posttest, generalization test, and maintenance test, this was primarily due to the deviant control subject mentioned earlier. A more difficult task that would not result in a ceiling effect would be needed to explore the possible benefits of metamemory training.

Only one subject brought the envelope to the cupboard and removed the pictures from the envelope on the first trial of the first baseline session. The remainder of the subjects either brought the envelope to the cupboard and placed it on the counter, or they left it at the table before proceeding to the cupboard.

During the metamemory sessions, the metamemory training subjects were asked two questions related to their metamemorial knowledge. Their responses to these questions revealed superior performance in the second metamemory session than in the first session. These results indicate that metamemory training improved their understanding of their memorial skills and the importance of using the pictures.

Although the present study did not find that significant improvements in performance were related to increased metamemory skills, the importance of metamemory training should continue to be investigated. It is necessary to incorporate a number of measures aimed at increasing metamemory skills when dealing with low functioning subjects, such as those who participated in the present study. For example, the inclusion of a model successfully incorporating the strategy is an additional means of improving metamemory skills (Borkowski et al., 1976).

Future research might include more stringent tests of maintenance and generalization. A maintenance test given after a longer delay following training than the one given in the present study would result in a stronger test for maintenance. A stronger test of generalization could involve carrying out the test in a food store. This new environment would not only demonstrate a greater ability to generalize the strategy, but also provide a more applied setting.

Training in the use of pictures as external memory aids could reduce the memory deficits shown by severely mentally retarded persons on several types of tasks. Moderately to severely mentally retarded adolescents could be trained to employ this memory strategy for classroom tasks involving memory skills. The school could incorporate the external memory aids into routine situations where the student's performance may improve with increased memory skills, such as following cooking instructions, or remembering to perform a task at a specified time. The strategy could also provide practical assistance when employed in the home. Subjects could use external memory aids in situations where several tasks must be completed throughout the day, possibly in a specified sequence, such as performing various house cleaning duties.

External memory aids could also be used in conjunction with other training aids to provide retarded individuals with greater independence. A study by Nietupski, Welch, and Wacker (1983) revealed that moderately to severely retarded young adults successfully learned how to use a pocket calculator in the purchasing of items in a supermarket. A study focusing on request-making in the moderately to severely retarded, designed the training environment to approximate that of a store (Bray, Biasini, & Thrasher, 1983). By combining the external memory aid with the training procedures used by Nietupski et al. (1983) and Bray et al. (1983), retarded individuals could be trained to prepare a shopping list and purchase the items in a store.

The present research demonstrated that the use of a picture list as an external memory aid was rapidly learned and increased memory performance considerably. The ability to maintain and generalize a strategy is considered an invaluable and necessary factor if the strategy is to provide any practical assistance to the individual. The present study was able to show maintenance and generalization of this external memory aid strategy. It would be worthwhile to continue investigating the applicability of external memory aids to assist mentally retarded individuals in tasks requiring memorial skills.

REFERENCES

Atkinson, R. C., & Shiffrin, R. M. (1968). Human memory: A proposed system and its control processes. In K. W. Spence & J. T. Spence (Eds.), The psychology of learning and motivation (Vol. 2). New York: Academic Press.

Billingsley, F., White, O. R., & Munson, R. (1980). Procedural reliability: A rationale and an example. Behavioral Assessment, 2, 229-241.

Borkowski, J. G., & Cavanaugh, J. C. (1979). Maintenance and generalization of skills and strategies by the retarded. In N. R. Ellis (Ed.), Handbook of mental deficiency, psychological theory and research. Hillsdale, NJ: Lawrence Erlbaum.

Borkowski, J. G., Levers, S. R., & Gruenenfelder, T. M. (1976). Transfer of mediational strategies in children: The role of activity and awareness during strategy acquisition. Child Development, 47, 779-786.

Bray, N. W., Biasini, F. J., & Thrasher, K. A. (1983). The effect of communicative demands on request-making in the moderately and severely mentally retarded. Applied Research in Mental Retardation, 4, 13-27.

Brown, A. L. (1978). Knowing when, where, and how to remember: A problem in metacognition. In R. Glaser (Ed.), Advances in instructional psychology (Vol. 1). Hillsdale, NJ: Lawrence Erlbaum.

Brown, A. L., Campione, J. C., & Day, J. D. (1981). Learning to learn: On training students to learn from texts. Educational Researcher, 10, 14-21.

Butterfield, E. C., Wambold, C., & Belmont, J. M. (1973). On the theory and practice of improving short-term memory. American Journal of Mental Deficiency, 77, 654-664.

Campione, J. C., & Brown, A. L. (1977). Memory and metamemory development in educable retarded children. In R. V. Kail & J. W. Hagen (Eds.), Perspectives on the development of memory and cognition. Hillsdale, NJ: Lawrence Erlbaum.

Craik, F. I. M. (1973). A "levels of analysis" view of memory. In P. Pliner, L. Krames, & T. Alloway (Eds.), Communication and affect: Language and thought. New York: Academic Press.

Craik, F. I. M., & Lockhart, R. S. (1972). Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 11, 671-684.

Dash, U. N. (1979). Strategic behavior in the mentally retarded. Mental Retardation Bulletin, 7, 17-30.

Detterman, D. K. (1979). Memory in the mentally retarded. In N. R. Ellis (Ed.), Handbook of mental deficiency, psychological theory and research. Hillsdale, NJ: Lawrence Erlbaum.

Ellis, N. R. (1970). Memory processes in retardates and normals. In N. R. Ellis (Ed.), International review of research in mental retardation. New York: Academic Press.

Evans, R. A. (1977). Transfer of associative clustering tendencies in borderline mentally retarded and nonretarded adolescents. American Journal of Mental Deficiency, 81, 482-485.

Glidden, L. M. (1979). Training of learning and memory in retarded persons: Strategies, techniques, and teaching tools. In N. R. Ellis (Ed.), Handbook of mental deficiency, psychological theory and research. Hillsdale, NJ: Lawrence Erlbaum.

Harris, J. E. (1982). External memory aids. In U. Neisser (Ed.), Memory observed: Remembering in natural contexts. San Francisco: W. H. Freeman.

Horowitz, A. B. (1969). Effect of stimulus presentation modes on children's recall and clustering. Psychonomic Science, 14, 297-298.

Kail, R. (1984). The development of memory in children. (2nd ed.). San Francisco: W. H. Freeman.

Kellas, G., Ashcraft, M. H., & Johnson, N. S. (1973). Rehearsal processes in short-term memory performance in mildly retarded adolescents. American Journal of Mental Deficiency, 77, 670-679.

Kennedy, B. A., & Miller, D. J. (1976). Persistent use of verbal rehearsal as a function of information about its value. Child Development, 47, 566-569.

Kramer, J. J., & Engle, R. W. (1981). Teaching awareness of strategic behavior in combination with strategy training: Effects on children's memory performance. Journal of Experimental Child Psychology, 32, 513-530.

Kramer, J. J., Nagle, R. J., & Engle, R. W. (1980). Recent advances in mnemonic strategy training with mentally retarded persons: Implications for educational practice. American Journal of Mental Deficiency, 85, 306-314.

Lobb, H. (1974). Effects of verbal rehearsal on discrimination learning in moderately retarded and nursery-school children. American Journal of Mental Deficiency, 79, 449-454.

Lodico, M. G., Ghatala, E. S., Levin, J. R., Pressley, M., & Bell, J. A. (1983). The effects of strategy-monitoring training on children's selection of effective memory strategies. Journal of Experimental Child Psychology, 35, 263-277.

MacMillan, D. L. (1972). Paired-associate learning as a function of explicitness of mediational set by EMR and nonretarded children. American Journal of Mental Deficiency, 76, 686-691.

Moynahan, E. (1978). Assessment and selection of paired-associate strategies: A developmental study. Journal of Experimental Child Psychology, 26, 257-266.

Mulcahy, R. (1979). Memory deficits in the mentally retarded: Is this the real problem? Mental Retardation Bulletin, 7, 123-131.

Neisser, U. (1982). Memory observed: Remembering in natural contexts. San Francisco: W. H. Freeman.

Nietupski, J., Welch, J., & Wacker, D. (1983). Acquisition, maintenance, and transfer of grocery item purchasing skills by moderately and severely handicapped students. Education and Training of the Mentally Retarded, 18, 279-286.

Paris, S. G., Newman, R. S., & McVey, K. A. (1982). Learning the functional significance of mnemonic actions: A microgenetic study of strategy acquisition. Journal of Experimental Child Psychology, 34, 490-509.

Riegel, R. H., & Taylor, A. M. (1974). Conceptual strategies for grouping and remembering employed by EMR and nonretarded children. American Journal of Mental Deficiency, 78, 592-598.

Reiss, P. (1968). Rhyming and conceptual relationships in free-recall task with retardates. American Journal of Mental Deficiency, 73, 81-85.

Ross, D. M., & Ross, S. A. (1978). Facilitative effect of mnemonic strategies on multiple-associate learning in EMR children. American Journal of Mental Deficiency, 82, 460-466.

Tulving, E., & Thomson, D. M. (1973). Encoding specificity and retrieval processes in episodic memory. Psychological Review, 80, 352-373.

Turnbull, A. P. (1974). Teaching retarded persons to rehearse through cumulative overt labeling. American Journal of Mental Deficiency, 79, 331-337.

Wanschura, P. B., & Borkowski, J. G. (1975). Long-term transfer of a mediational strategy by moderately retarded children. American Journal of Mental Deficiency, 80, 323-333.

Wolff, P., Levin, J. R., & Longobardi, E. T. (1974). Activity and children's learning. Child Development, 45, 221-223.

Appendix A

Table 2

List of School Items		List of Food Items	
Crayons	Comb	Apple	Potatoe
Kleenex	Tape Recorder	Milk	Cheese
Pen	Paper Towels	Pear	Onion
Eraser	Coat Hanger	Bread	Jam
Paintbrush	Paperclips	Banana	Candy
Cup	Toothbrush	Wieners	Popcorn
Radio	Marker	Corn	Mustard
Pencil	Glue	Orange Juice	Eggs
Chaulk Brush	Masking Tape	Carrot	Chocolate
Scissors	Toilet Paper	Crackers	Marshmallows
Clock	Popsicle Stick	Grapes	Peanuts
Stapler	Calculator	Orange	Spaghetti
Keys	Workbook	Tomatoe	Pickles
Telephone	Light Bulb	Cookies	French Fries
Scotch Tape	Chaulk	Peach	Macaroni
Plastic Dish	Ruler	Lemon	Revels
Yarn	Buttons	Cereal	Coffee
Paint	Notepad	Peanut Butter	Mushrooms
Record	Elastics	Celery	Beans
Thread	Scissor Stand	Butter	Gum

Appendix B

Table 3

Anova Summary Table

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
MEAN	1474439.55	1	1474439.55	3930	0.00
G (Baseline Cond.)	322.23	2	161.12	0.43	0.65
H (Treatment Cond.)	486.9	1	486.9	1.30	0.30
GH	339.5	2	169.74	0.45	0.64
ERROR	6751.44	18	375.1		
R (Phase)	48889.4	3	16296.5	162.4	0.00
RG	587.7	6	97.95	1.0	0.45
RH	204.21	3	68.07	0.68	0.57
RGH	662.98	6	110.50	1.10	0.37
ERROR	5420.04	54	100.37		
S (Block)	336.73	1	336.73	38.25	0.00
SG	107.28	2	53.64	6.09	0.01
SH	35.78	1	35.78	4.06	0.06
SGH	66.94	2	33.47	3.80	0.04
ERROR	158.46	18	8.80		
RS	925.84	3	308.61	14.08	0.00
RSG	58.40	6	9.73	0.44	0.84
RSH	11.02	3	3.67	0.17	0.92
RSGH	157.30	6	26.22	1.20	0.32
ERROR	1183.70	54	21.92		

Table 4

Mean Percentage Correct for the Trial Block by Baseline Condition by Treatment Condition Interaction

		Treatment Condition	
Baseline Condition	Block	Metamemory	Control
2-Baseline Group	1	90.53	85.53
	2	87.85	79.28
3-Baseline Group	1	89.63	88.38
	2	88.03	88.39
4-Baseline Group	1	90.17	89.46
	2	89.10	85.17

Table 5

Mann-Whitney Percent Correct Comparisons

Phase	Mann-Whitney U	Level of Significance
Baseline	69.5	.89
Posttest	81.5	.49
Generalization Test	87.5	.33
Maintenance Test	86	.39

Table 6

Anova Summary Table of 2-Baseline Group

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
MEAN	117596.72	1	117596.72	212.55	0.00
COND (Treatment Cond.)	20.66	1	20.66	0.04	0.85
Error	3319.66	6	553.28		
SESSION	30.87	1	30.87	0.83	0.4
SC	20.66	1	20.66	0.55	0.48
ERROR	223.96	6	37.33		
BLOCK	1214.38	1	1214.38	133.57	0.00
BC	2.29	1	2.29	0.25	0.63
ERROR	54.55	6	9.09		
SB	20.69	1	20.68	0.26	0.63
SBC	30.91	1	30.91	0.39	0.55
ERROR	477.03	6	79.5		

Table 7

Anova Summary Table of 3-Baseline Group

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
MEAN	156059.16	1	156059.16	500.48	0.00
COND (Treatment Cond.)	33.37	1	33.37	0.11	0.75
ERROR	1870.91	6	311.82		
SESSION	347.24	2	173.62	1.15	0.35
SC	904.50	2	452.25	2.99	0.09
ERROR	1815.4	12	151.28		
BLOCK	653.72	1	653.72	14.20	0.01
BC	0.69	1	0.69	0.01	0.91
ERROR	276.18	6	46.03		
SB	65.74	2	32.87	0.31	0.74
SBC	186.09	2	93.04	0.88	0.44
ERROR	1274.95	12	106.24		

Table 8

Anova Summary Table of 4-Baseline Group

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
MEAN	246405.48	1	246405.48	419.36	0.00
COND (Treatment Cond.)	4.57	1	4.57	0.01	0.93
ERROR	3525.47	6	587.58		
SESSION	159.64	3	53.21	0.30	0.83
SC	114.76	3	38.25	0.21	0.88
ERROR	3215.24	18	178.62		
BLOCK	698.68	1	698.68	7.40	0.03
BC	184.21	1	184.21	1.95	0.21
ERROR	566.28	6	94.38		
SB	137.21	3	45.74	1.59	0.23
SBC	10.71	3	3.57	0.12	0.94
ERROR	517.22	18	28.73		

Table 9

Anova Summary Table of Intrusion Errors

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
MEAN	1862.52	1	1862.52	12.49	0.00
COND (Treatment Cond.)	58.52	1	58.52	0.39	0.54
ERROR	3280.46	22	149.11		
BLOCK	35.02	1	35.02	9.88	0.00
BC	2.52	1	2.52	0.71	0.41
ERROR	77.95	22	3.54		

Table 10

Mann-Whitney Intrusion Error Comparison

Phase	Mann-Whitney U	Level of Significance
Baseline	73	.95
Posttest	71	.92
Generalization Test	59.5	.27
Maintenance Test	60	.15

Table 11

Intrusion Error Anova Summary Table: 2-Baseline Group

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
MEAN	5202	1	5202	7.41	0.03
COND (Treatment Cond.)	684.5	1	684.5	0.98	0.36
ERROR	4210	6	701.67		
SESSION	760.5	1	760.5	5.17	0.06
SC	50	1	50	0.34	0.58
ERROR	883	6	147.17		
BLOCK	84.5	1	84.5	2.40	0.17
BC	2	1	2	0.06	0.82
ERROR	211	6	35.16		
SB	180.5	1	180.5	10.62	0.02
SBC	2	1	2	0.12	0.74
ERROR	102	6	17		

Table 12

Intrusion Error Anova Summary Table: 3-Baseline Group

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
MEAN	5985.33	1	5985.33	8.59	0.03
COND (Treatment Cond.)	2.08	1	2.08	0.00	0.96
ERROR	4179.58	6	696.6		
SESSION	1185.54	2	592.77	12.72	0.01
SC	231.29	2	115.64	2.48	0.12
ERROR	559.16	12	46.6		
BLOCK	6.75	1	6.75	0.42	0.54
BC	40.33	1	40.33	2.52	0.16
ERROR	95.92	6	15.99		
SB	128.62	2	64.31	3.57	0.06
SBC	85.04	2	42.52	2.36	0.14
ERROR	216.33	12	18.03		

Table 13

Intrusion Error Anova Summary Table: 4-Baseline Group

Source	Sum of Squares	Degrees of Freedom	Mean Square	F	Tail Prob.
MEAN	1660.56	1	1660.56	6.62	0.04
COND (Treatment Cond.)	210.25	1	210.25	0.84	0.39
ERROR	1505.69	6	250.95		
SESSION	562.81	3	187.60	11.02	0.00
SC	21.37	3	7.12	0.42	0.74
ERROR	306.31	18	17.02		
BLOCK	25	1	25	5.90	0.05
BC	3.06	1	3.06	0.72	0.42
ERROR	25.44	6	4.24		
SB	302.62	3	100.87	23.87	0.00
SBC	8.81	3	2.94	0.70	0.57
ERROR	76.06	18	4.22		