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ABSTRACT

A review of selected literature and data from specific experiments consistently indicates both the causes of poor memory performance by retarded children and the ways this performance can be improved. When memory tasks requiring the use of any of a number of mnemonic strategies are presented to retarded children, they seem to remain passive and fail to produce active memory routines. These difficulties can be overcome in one of two general ways: (1) teaching the children the necessary strategies, such as rehearsal and categorization; and (2) forcing the subjects to think more deeply about the to-be-remembered material when it is presented, a task that puts the burden on the instructor or experimenter rather than on the subject. In either case, the data from research have indicated that the memory performance of retarded children can be improved, often dramatically, as a result of well-designed training procedures. In addition, more recent work aimed at producing generalization has increased optimism that the memory skills of retarded children can be expanded from merely achieving retention of specific material to the internalization of memorization strategies. (RL)

CENTER FOR THE STUDY OF READING

Technical Report No. 196

IMPROVING MEMORY SKILLS IN MENTALLY RETARDED CHILDREN: EMPIRICAL RESEARCH AND STRATEGIES FOR INTERVENTION

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Improving Memory Skills in Mentally Retarded Children

Empirical Research and Strategies for Intervention

General Background

Introduction

The poor memory skills of mentally retarded children have attracted widespread research and practical interest. Research in this domain can be traced back as far as Galton's (1887) and Binet's (1904) pioneering studies of intellectual performance. Almost from the beginning of the intelligence testing movement, memory items such as digit span have been included on standardized intelligence tests. It became clear, however, that the acknowledgment of memory inefficiency as one potentially definitive characteristic of mental retardation neither explained the source of memory deficits nor implied that the deficits were unmodifiable. Accordingly, during the past 15 years, attention has been directed toward investigating why the memory skills of mentally retarded persons appear to be inefficient and how the deficits might be remediated through training. The current research interest in the remediation of memory defects marks the beginning of a convergence of the concerns of the researcher with the interests of practitioners in education and clinical settings.

In light of this shared interest, the goals of this chapter are two-fold: (a) to present an overview of advances in empirical research and theoretical accounts of the memory performance of retarded school-aged children and (b) to discuss the practical implications of the improvement of memory skills through training. Since there are a number of recent, quite detailed reviews of research areas relevant to this topic (e.g., Borkowski & Cavanaugh, 1979; Brown, 1978; Brown & Campione, 1978a, 1978b; Campione & Brown, 1977; Detterman, 1979; Glidden, 1979), our discussion will present a selective, less technical review of this literature. Instead of striving for completeness, we have selected rese paradigms and investigations of particular relevance to those inte ed in practical applications of this research in educational and clinical settings.

A Statement about Memory Theories

Although a detailed discussion of memory theories would not be appropriate here, it is useful to introduce a few distinctions and indicate the kind of research we will be considering. Many different memory theories have been proposed, but there is agreement that there are at least two components of memory. One has been called long-term memory (LTM) and is presumed to be a store of accumulated knowledge. A person's LTM is conceived of as having enormous capacity, and information stored there is presumed to be fairly permanent. Although information in LTM is regarded as being relatively permanent, the fact that information is available in memory does not guarantee that a person will be able to access that information when it is required. We shall return to this distinction later because one major component of intelligence is the ability to access stored information on the occasions when that information would be relevant. As will be seen, retarded children frequently fail to use relevant knowledge even when we e, a fact that causes them problems in many areas, ir ring deliberate memorization (Brown & Campione Brown, 1978).

In addition to LTM, the c onent of the memory system is working memory (also refer er short-term memory or primary memory). This is a limited cap em from which information is lost rapidly. The loss of informat e due to displacement by incoming information or to simple fading. Retention cannot be ensured unless some overt attempt is made to maintain the information. The capacity limitation reflects the fact that a person can only keep so many things in mind at any given time. One additional complication here is that the effectiveness of working memory is limited by both the amount of information being maintained and the demands imposed by the operations required for that maintenance. The more effortful the operations being carried out, the less room there is for the information being processed. One popular metaphor is that working memory consists of a fixed number of "bins," and each unit of information takes up one of them. Maintenance operations may require one or more bins, depending on the efficiency with which the person can perform the operations.

Much of intentional memorizing, including that which goes on in the school, the laboratory or the clinical testing situation, involves the use of procedures designed to circumvent the bottleneck imposed by the limits of working memory. On a very general level, there are two kinds of situations to consider. In one, the task is to remember a small amount of information, all of which fits into working memory, for a relatively brief time. In the other, the total amount of information to be retained exceeds the capacity of working memory. In such cases, the individual can keep only a portion of the information "alive" at any time. This is more difficult and requires that the information be acted upon in some way (while it is present in working memory) to make it more memorable. To be more specific, types of information which require explicit effort to remember include facts for a test, remembering a person's name after an introduction, remembering a new telephone number and other arbitrary facts. Verbatim recall of facts can usually be accomplished only when a memory strategy (an explicit plan to remember) is used. Examples of simple memory strategies include underlining the main points in a text in order to remember them for a test, associating some distinctive physical features with a person's name when introduced and repeating a telephone number several times until it can be remembered in sequence.

Whenever a memory task requires the recall of a number of pieces of information, an efficient memorizer might have to introduce even more complex or sophisticated mnemonic strategies. For example, he or she might elaborate the material so that it fits into a meaningful context (e.g., make up a story to embed the items to be remembered) or perhaps look for redundancies, repeated elements, or categories of information to help organize the material. Remembering that there were four animals in a list of words will help the memorizer to recall those items later;

noting the repetition in the sequence 349349 will reduce memory load by about half; and noting that 149217761941 is not simply a list of twelve arbitrarily chosen numbers, but rather, three very well-known historical dates, will make this list easily retainable. These strategies help the memorizer make more efficient use of a limited ability for verbatim recall.

As it turns out, "good" memorizers are those who possess a variety of strategies for making meaningless material more memorable. We would like to point out that much of what is learned in school is, at least when originally presented to the student, relatively meaningless. Facts, principles, and rules become meaningful only when some organizational scheme into which they fit is built up. During that building process, the items may be nearly meaningless to the student and thus more difficult to remember. After the organizational scheme is learned, new information relevant to that structure is more readily remembered, frequently without any special effort.

A View of the Retarded Child

Having sketched an overview of memory components, we need to ask where in this system retarded children experience specific problems. Although we cannot review the entire literature here, we would like to indicate what seems to be the major strengths and weaknesses. To do this, we introduce another distinction, that between involuntary and deliberate memorization (cf. Brown, 1975) or automatic and effortful memory (cf. Hasher & Zacks, 1979). The main point is that much of what a person remembers about the world finds its way into LTM with no apparent effort. People and places may be recognized, the details of personally experienced events may be recalled (including when and where they took place), and the essential gist of a conversation or story, etc., may be remembered without any deliberate attempt to remember them at the time these events were experienced. The memory system on these occasions seems to function automatically and requires minimal effort to function. The situations here are ones that tend to involve meaningful information and which require recall of general details. While there is not enough research upon which to base any strong claim, there is at least some reason to believe that in memory situations like these, mildly retarded children tend to perform quite well (Brown, 1974). The suggestion here is that this aspect of the memory system is relatively intact, i.e., it is not necessarily the case that the entire system of the mildly retarded adolescent is in some way defective.

In contrast, there are many situations wherein we are forced to deal with information that is not meaningful or wherein we need to recall events in more detail than would be the case if we were to fall back on automatic memory processing. In such cases, effortful processing is required, and we often run into problems imposed by the properties of working memory. Here there are two potential sources of problems for the retarded child. The first is the capacity of working memory. Although it is clear that there are functional differences in the use of working memory (e.g., the well-known problems retarded children have with many memory span tests, most notably digit span), it is not clear whether the differences are due to the actual number of bins available or to the efficiency with which maintenance operations are carried out. The second potential source of problem is the availability of memory strategies to overcome the capacity limitations of working memory, regardless of their size. The data on this issue are very clear: in general, mildly retarded children fail to produce such strategies spontaneously even when they are obviously necessary (see any of the reviews mentioned earlier). We will review some of this research below.

Implications of this research. The most general and optimistic view which can be proposed is that, while the retarded child's memory system appears to function relatively well in automatic memory situations, problems result when the child is required to employ any of a number of strategies designed to overcome working memory limitations. This view is an optimistic one, as it indicates that the major problem underlying the retarded child's poor performance is in the area of strategy use. If this is the case, then it should be possible to improve his performance by teaching him to use these devices. It is this possibility which has motivated recent research, and a large proportion of memory studies with retarded children in the past decade have included a training component. Before looking at some of that literature in more detail, we would like to place it into its historical context to account for what seems to be a paradoxical limitation in that research. Specifically, while many training studies have been conducted, it is in some sense true that only a small proportion of that research is really relevant to the question of whether memory improvements of any practical significance can be achieved through instruction. To understand why this is so, it is necessary to consider briefly the history of the training study and its use in comparative/developmental research.

The Training Study (and Its Limitations)

The first important point is that in many areas of cognitive development, the training study has served as an important theoretical tool; in fact, its use has been more theoretical than practical. The typical situation in which the training study has been used is as follows: We have a specific task and indications that different groups of subjects (young vs. old children, retarded vs. nonretarded children, etc.) perform differentially on that task. We would like to know why. To deal with this question, we need a theory of what individuals must do to perform well on that task and some hypothesis about the specific source(s) of individual differences. As an example, consider a memory task wherein we assume that effective performance requires, among other things, the use of a rehearsal strategy. We also assume that young children perform more poorly than older ones because of a failure on their part to rehearse. We can test both of these assumptions simultaneously by training the younger children to rehearse. If their performance does improve significantly, we are in a position to conclude that our original analysis of the task was correct (if rehearsal were not an important component of performance on that task, instructing children in its use would not lead to improved performance) and that young children perform poorly, at least in part, because they fail to rehearse without prompting (if they did rehearse spontaneously, training would not have been necessary).

These theoretical questions can be evaluated on the basis of the subjects' immediate response to the training, and it is the case that the majority of the studies stop at this point. If, however, we are concerned with the practical implications of that training, we need to ask further questions. Specifically, we need to know if the effects of the training are durable and generalizable. Will the instructed subjects continue to use the trained strategy on the same task given subsequent unprompted occasions? Will they generalize the use of that strategy to other tasks on which it would be beneficial? If the answer to these questions is negative, then the "positive effects" of the training have limited potential for practical application.

The great majority of the studies with retarded children have looked only at the immediate effects of training, and we are thus better able to answer the theoretical, as opposed to the practical, questions. This is probably not surprising, as the initial motivation for research was primarily the theoretical one of identifying the sources of memory problems in the retarded. It was first necessary to show that retarded children did not tend to use memory strategies appropriately on their own and that instructing them to use strategies would indeed improve performance. The results of these studies have been very encouraging because investigators have been able to design training procedures leading to much improved memory performance in many situations. This was no small step, as it indicated both the type of instruction that might be necessary and that success was possible.

Following these studies, a number of experimenters have begun to consider the evidence for durability and generalizability. While the results here are less encouraging, there are reasons to believe that the picture is more optimistic than the data would lead us to believe. We will elaborate upon this conclusion in a later section of this paper and speculate on the form that more successful instructional routines would take. Before doing that, however, we will review a number of studies that show the effects of training on specific tasks and that demonstrate nicely how large the potential for improvement is.

Studies Investigating the Training of Mnemonic Strategies

Rehearsal

Rehearsal strategy training consists of having the learner continue to repeat the names of items that are no longer available in order to keep them alive in working memory. As indicated earlier, there are several uses for these strategies. One is when the amount of information to be remembered is small enough to "fit" into working memory. In such cases, the learner can attempt to keep all the information available until it is needed. If the amount of information to be retained exceeds the capacity of working memory, more elaborate strategies will be necessary because the learner will be able to maintain and work on only a portion of the material at any time. We will consider two cases here to demonstrate how the two situations can be handled.

The first task to be reviewed is the keeping-track task. This task is similar to everyday situations that require us to keep track of several things at once. The task requires (a) rehearsal of the present instances of the variables and (b) no rehearsal of the previous instances of the variables. For example, in an early study of keeping-track performance with mildly retarded adolescents, Brown (1972) presented sequences of four pictures, each representing a different category (e.g., animals, foods, vehicles, or clothing). On one sequence the participants might be shown pictures of a horse, pie, car, and shirt. Following this sequence, they would be asked to recall the instance presented for one of the four categories (e.g., animals). On the next trial, they might see a cat, then a boat, then a tie, and finally a cake and be asked to indicate which food had occurred. Across trials the order and instances of each category changed so that the person was required to keep track of the changing states (instances) of four different variables (categories). Of interest here is the composition of the set of pictures used in the experiment. A total of 16 pictures consisted of two examples, or states, of one variable (e.g., foods: pie, cake), four examples of each of two variables (e.g., vehicles: train, boat, plane, car), and six states of the final variable. Thus, specific pictures would recur frequently over the series of trials.

The most efficient strategy for this type of task is to rehearse the four items presented in the current set, keeping them available until the test occurs. Yntema and Mueser (1960) found that the keeping-track performance of nonretarded adults was not influenced by the number of states of each variable. The adults apparently used a rehearsal strategy to update the information on each trial and were able to disregard previously presented instances. They would consider only the items presented on the current trial and determine which of those was an example of the category being probed. With retarded adolescent subjects, however, Brown (1972) found that accuracy decreased as the number of states per variable increased. These results suggested that all of the states of the variable were being considered at the time of the test. It appeared, then, that the retarded subjects were not using a rehearsal strategy to keep track of the states of the variables.

This early research on keeping-track performance led to one of the more intensive strategy-training studies with mentally retarded adolescents. Brown, Campione, Bray, and Wilcox (1973) trained one group of mildly retarded adolescents to use a rehearsal strategy in a keeping-track task. This rehearsal group was trained to repeat the first three items in each sequence three times in order and then to look only at the last item. The logic here was that looking only at the last item would be sufficient to lead to good memory, as the lag time between its presentation and the test item would be very short. A second group was given no rehearsal training. Consistent with the findings reported in Brown (1972), the performance of the no-rehearsal training group decreased as the number of states per variable increased. Performance in the rehearsal-training group was higher and not influenced by the number of states per variable. Thus, the pattern of results for the rehearsal-training group was the same as the results obtained with nonretarded adults (Yntema & Mueser, 1960).

The accuracy data were supplemented by some speed-of-responding data. Brown et al. measured the amount of time elapsing between the presentation of the probe question ("What was the animal?") and the beginning of the subject's response. For the nonrehearsing subjects, the amount of time increased as the number of states included increased from two to six. In the rehearsal group, however, the response time was uninfluenced by this variable. Again, the implication is that rehearsing subjects consider only the items presented on the current trial; thus, it does not matter how many states the requested variable has. In the absence of rehearsal, however, the most recently presented items will not be available in working memory, and the subject will have to check through all the possible states and determine which had been seen most recently. This task should be more difficult and more time consuming as the number of alternatives increases from two to six.

The data from the experiment indicated that the retarded subjects did not use the rehearsal strategy when left to their own devices but that they were able to use it successfully when they were instructed to do so. Recall that they were instructed to rehearse just the first three items. Students given no rehearsal training were correct approximately 58% of the time when tested on these items, whereas the students trained to rehearse averaged around 85% correct in the same conditions.

In a second experiment, Brown et al. (1973) tested nonretarded adolescents in two conditions. A "rehearsal prevention" group was tested as well as a "no rehearsal prevention" or free strategy group. In the rehearsal prevention group the participants repeated the name of the pictures aloud for the duration of picture presentation. This prevented the cumulative repetition (rehearsal) of the item names. There were no constraints on the study activities of the free-strategy group. Recall in the rehearsal prevention condition was dependent on the number of states per variable, whereas recall was not influenced by the number of states per variable in the free-strategy condition. The same pattern of results was obtained with the response time measure. When prevented from rehearsing, nonretarded adolescents performed like untrained mentally retarded adolescents.

The results from these two experiments seemed to provide good evidence that effective keeping-track performance is dependent on the use of a rehearsal strategy. Of most importance, however, the results indicated that mentally retarded adolescents could use a rehearsal strategy following relatively simple and brief training.

One other important point illustrated by these two experiments is that, in some situations, not every aspect of a memory strategy needs to receive explicit training. The keeping-track task has two strategic components: rehearsing the sequence presented and "retrieving" the correct response from the inspection set. Mentally retarded subjects who were not trained to rehearse apparently "searched" the states of the relevant variables (as indicated by longer response latencies and lower recall accuracy). Nonretarded subjects who were prevented from rehearsing were apparently forced to use the same strategy. This strategy seems to be the only alternative when the picture names included in the most recently presented inspection set are not readily available due to lack of rehearsal. When mentally retarded individuals were trained to use a rehearsal strategy, however, there was no need to train them to retrieve items from the inspection set rather than by category.

Rehearsal and Retrieval

In some situations it may be necessary to teach both an acquisition strategy (e.g., rehearsal) and a systematic way of retrieving the information to be remembered. A training study by Butterfield, Wambold, and Belmont (1973) provides an excellent illustration of this point. Mildly retarded adolescents were given sequences of six letters, each appearing on separate projection screens arranged in a horizontal array. Note that six items are more than these children could hold simultaneously in working memory. A subject-paced procedure was used in which the participant pressed a button to view each item for a fixed exposure before it terminated, but the subject was allowed to pause as long as he or she wished before pressing the button to expose the next item. At the end of each sequence, one of the letters was exposed in a "probe window." The subject was to indicate the location of the probe letter in the sequence.

Belmont and Butterfield (1971) had previously found that mentally retarded adolescents paused very briefly, if at all, between presses, whereas nonretarded adults exhibited a systematic pause pattern. Adults rehearsed the early items in the sequence and then quickly exposed the last few items. The adult strategy is well-adapted to the task requirements, since for a short time after presentation, the last few items are easily recalled without rehearsal. Rehearsal of the first few items in that list helps maintain these items until the recall test.

Butterfield et al. (1973) first trained their subjects to use a "3-3" rehearsal strategy similar to that used by adults. The subjects were trained to repeat the first three letters cumulatively, pausing to do so following the third letter and then to expose the last three letters quickly before an immediate test. This strategy raised the level of performance, especially for the first three letters in the sequence, but recall of the last items was still poor. Butterfield et al. hypothesized that although the subjects were using the trained <u>rehearsal</u> strategy, they were not using an appropriate retrieval strategy. The most effective retrieval strategy would have two parts. First, when the probe item was presented the last three items would be "searched," taking advantage of the fact that these items would not yet have "faded" from the memory. Second, if the letter were not in the last three, the first three rehearsed items would be searched.

The training procedure used by Butterfield et al. (1973) required several steps. The subjects were initially trained to rehearse a sequence of three letters cumulatively and to count to 10 before recalling the position of the probe item in that set. This gave the subject practice in searching a set of three rehearsed items following a delay between the rehearsal and the test. Next, the participant was given six letters and was instructed to use the 3-3 rehearsal strategy, rehearsing the first three and exposing the last three letters with very short pauses between each of the last three letters and between the last letter and the probe. During this phase the subject was told that the test item would always come from the last three items. To aid performance, the subject was instructed to point to screen numbers 4 through 6, in sequence, trying to identify the position of the probe letter by saying the names of the letters to him/herself. After practice at this the subject was told that a probe letter might be taken from any of the six positions. To deal with this, the person was instructed to recall the letters, saying them to him/herself beginning with letters 4 through 6 and then 1 through 3.

The combined rehearsal and retrieval strategy training resulted in a substantial increase in recall for all six items, where the rehearsal training alone facilitated recall only on the first three items.

The Butterfield et al. experiments illustrate that the effective use of an acquisition strategy, while relatively easy to train, cannot always be expected to be coordinated with an effective retrieval strategy. Although subjects in the Brown et al. (1973) study required instruction on the acquisition strategy, they did not require retrieval strategy training. In contrast, the retrieval strategy necessary for the Butterfield et al. task did require special training. Also, it is interesting to note that with the type of training used by Butterfield et al., the mentally retarded subjects were able to perform at the same level as persons with average intelligence. In fact, recall following training was 114% of that obtained with nonretarded subjects of comparable chronological age who were not given training.

Categorization

In the rehearsal training studies, such as those by Brown et al. (1973) and Butterfield et al. (1973), cumulative repetition (rehearsal) was taught as a method for remembering a small set of ordered items. In other types of tasks, rehearsal strategies may not be as effective because the number of items to be remembered is relatively large. In one such task, the free-recall paradigm, the number of items presented can easily exceed a nonretarded adult's ability to repeat a sequence cumulatively. In this situation, a relatively large set of words (usually 10 or more) is presented, and after studying the set, the person is free to recall the items in any order. Nonretarded adults usually try to use some inherent relatedness of the stimuli as a basis for remembering the words. For instance, presented with a 16-item list containing four items from each of four different taxonomic categories (e.g., food, clothing, flowers, and occupations), adults will tend to use the categorical structure of the list as a means of organizing recall. Words from each category will tend to be recalled together, even though they were presented in a random order. The analysis of this "clustering" of recall by categories has been the predominant method for studying organizational strategies in free recall.

Research has consistently indicated that mentally retarded subjects (and young nonretarded children) do not spontaneously adopt strategies utilizing the categorical structure of a list. Several studies have attempted to induce the use of an organizational strategy by presenting the items by category during stimulus presentation ("blocking") rather than using a random order of presentation (e.g., Bilsky, Evans, & Gilbert, 1972; Gerjuoy & Spitz, 1966). Other investigators have tried to induce organizational strategies by cueing the subject at the time of testing to recall the items by category (e.g., Green, 1974). Although these procedures increased the amount of category clustering, they resulted in only small improvements in recall. In most cases, there was no transfer of the organizational strategy to new lists of words. The weakness of these approaches to strategy training seems to be that, in contrast to the rehearsal training studies, the "training" techniques were indirect. That is, by blocking the stimuli according to category at input or by presenting category cues to the subject at recall, the experimenter hoped to induce an organizational strategy that would facilitate recall. But it is the experimenter who is being strategic in this case and manipulating the subject, who can remain relatively passive. These indirect methods appear to be too subtle a manipulation to affect strategic aspects of study behavior for mentally retarded subjects.

Recently there have been more successful attempts to train mentally retarded children to actively use organizational strategies. Burger, Blackman, Holmes, and Zetlin (1978) devised a direct-training procedure in which mildly retarded adolescents were shown 16 cards, each presenting a picture of a common object. The pictures were from four categories (e.g., clothing, foods, flowers, and tools) with four instances of each category. During the first session (baseline) the 16 cards were presented for approximately two minutes and then covered. The subject then attempted to recall the picture names. The categorization training given to one group of subjects consisted of several components. The subject was first asked to put the pictures that "go together" in a horizontal row. Suggestions were given, if necessary, for arranging the cards by category.

The subject was then asked to label each category represented in the sorting and to name and count the instances within each category. Next, the subject was told that the pictures could be remembered best if he or she would try to recall the pictures by the groupings. The pictures were then covered and the subject was asked to recall the picture names. If all of the picture names were not recalled, the experimenter supplied the appropriate category name as a cue.

This training procedure was repeated three times with a different set of pictures each session. There were two follow-up tests: the first, two or three days following training, and the second, three weeks later. Recall and clustering following training was significantly higher than for the baseline session. Performance was also higher than the recall and clustering of a group of mentally retarded adolescents who had received the same amount of practice on the same stimulus sets but were not trained to use the categorization strategy. Whereas training studies failed when using indirect, passive manipulations such as category blocking and cueing, a substantial improvement in memory performance was obtained in more direct training methods that demanded the subject's active employment of a strategy and provided feedback about the strategy's effectiveness.

Elaboration

In many situations, material is difficult to remember because it is relatively meaningless. One way to deal with such situations is to attempt to search for or invent some meaningful context for the information. Particular types of mnemonic techniques designed to bring this about can be used in a variety of tasks ranging from the learning of simple laboratory-type paired-associates lists to more complex academic topics (see Bransford, Stein, Shelton, & Owings, 1980). To illustrate the efficiency of these techniques, we will use some data obtained in the area of paired-associates learning. In experiments of this type, the subjects see a series of pairs of items, e.g., fish and telephone, followed by trials on which one item is presented (e.g., fish), and they are required to indicate the item (telephone) with which it had been paired. One way to facilitate performance on these tasks is to use either verbal or visual mediators to construct a more meaningful context in which to embed the items being paired. For example, in the fish-telephone pair, if learners either produce the sentence, "The fish is talking on the telephone," or form a mental image of a fish talking on a telephone, retention is dramatically improved. It is by now clear from a long series of studies that older and brighter children are more likely than younger or duller ones to use these kinds of elaborative strategies (Rohwer, 1973).

In an experiment by Turnure, Buium, and Thurlow (1976), educable retarded children were given 21 pairs of items to learn. There was one study trial, on which the 21 paired items were presented, one pair at a time. This was followed by a test trial consisting of the first item from each pair presented one item at a time. Separate groups of subjects differed in terms of the activities required of them on the study trial. We will consider only a subset of the groups here. In the labeling condition, subjects simply repeated the names of the items (e.g., soap-jacket) after the tester. This condition served as a type of control treatment and simulated the type of study activity which can be presumed to be typical of the educable retarded child given a paired-associates task. In three other conditions, the subjects were required to answer "what" or "why" questions about the pair, e.g., "What is the soap doing under the jacket?", "Why is the soap hiding in the jacket?", etc. The aim of these procedures was to lead the subjects to think about the meaning of the individual items and to force them to search for possible relations between the members of each pair. Requiring this kind of "deep processing" (Craik & Lockhart, 1972) about items or pairs of items generally leads to good retention, even in cases where subjects do not know they will be given later memory tests (Murphy & Brown, 1975). That is, if materials are presented in such a way as to lead subjects to think in some depth about them, recall of those items will be good, independent of any intention to commit the materials to memory.

In the Turnure et al. (1976) experiment, the differences among the conditions were highly significant. The children in the labeling condition averaged 2.0 items correct (out of 21), whereas those in the "what" and "why" groups were correct on an average of 14.4 items, an increase in recall of over 600%. Turnure et al. also included groups of nonretarded children matched for CA (around $7\frac{1}{2}$) with the retarded groups. Children of this age have not yet begun to use these kinds of elaborative strategies spontaneously, and in fact their performance was not different from that of the retarded sample. They performed poorly unless given the questioning procedures during study, in which case they improved dramatically. Again, the conclusion is that retarded children's memory systems are not generally deficient. When the requisite strategy for the task is not employed by nonretarded children, no performance differences are apparent.

Summary

The data from these experiments (and dozens of others) are clear and quite consistent in indicating both the causes of poor memory performance by retarded children and ways of improving that performance. When memory tasks requiring the use of any of a number of mnemonic strategies are presented to retarded children, they seem to remain passive and fail to produce active memory routines. These difficulties can be overcome in one of two general ways. One is to teach the children the necessary strategies; thiswas the procedure employed in the rehearsal and categorization examples. The other, exemplified in the elaboration example, is to force the subjects to think more deeply about the to-be-remembered material when it is presented. Here the burden is on the instructor or experimenter rather than on the subject. The subject does not have to carry out any plan on his or her own but simply by answering the questions reasonably (In the Turnure et al. example) ends up with a more durable memory representation.

In either case, the data indicate that the memory performance of retarded children can be improved, often dramatically, as a result of well-designed training procedures. It is not the case that the general memory system of these children is defective but rather that they experience major problems when task-appropriate strategies are necessary, problems which can be greatly diminished by instruction. Before claiming that there are significant practical implications of these results, however, we need to consider the effects of the training in more detail.

Beyond the Immediate Effects of Training

In this section we consider the criteria for effective training in more detail. The previous discussion has focused on a single index of successful mnemonic strategy training--initial strategy mastery. Without denying the importance of this criterion as noted previously, we argue for the consideration of additional criteria. Merely demonstrating an initial improvement in performance is not sufficient to establish the practical utility of a training program.[6] The effectiveness of a program should be evaluated against three basic criteria: (a) performance must improve as the result of training, both in terms of accuracy and in terms of the activities (strategies) used to effect this accuracy; (b) the effects of this training must be durable; it is obviously desirable to show that what has been learned through training is still applied after a reasonable time period has lapsed; (c) training must result in generalization to a class of similar situations wherein the trained activity would be appropriate; without evidence of transfer, the practical utility of any training program must be called into question.

Durability or Maintenance of Instructed Strategies

Most of the studies reviewed in the previous sections successfully demonstrated that training improved performance. Among those studies that have explicitly assessed whether trained mnemonic strategies are maintained over time, the results are also encouraging, at least for the more intensive training efforts. For instance, studies of rehearsal training in which multiple practice sessions were used have resulted in clear evidence for strategy maintenance. In a study reported by Turnbull (1974), for example, a series of 14 instructional sessions was followed by a retention test four weeks later. Turnbull reports that all the children in the instructed group were observed to continue with the rehearsal strategy. The subjects in the Brown et al. (1973) experiment referred to previously were also tested for retention of the instructed rehearsal strategy. In this case (Brown, Campione, & Murphy, 1974), the subjects were tested for retention six months after the last of a series of 12 instructional sessions. On the retention test, they were brought back to the laboratory and simply told that they were going to play the game again, i.e., no mention was made of the rehearsal strategy they had been taught to use. After six months, the performance of the instructed children was still significantly better than performance of uninstructed children. Analysis of individual subjects' data showed that eight of the ten instructed children continued to rehearse and were correct on 82% of the trials, compared with 65% correct for the uninstructed control group. Note that 82% correct was almost identical to performance during training, i.e., the subjects who continued to rehearse did so with no appreciable decrease in accuracy, even six months after training.

Studies employing relatively brief periods of instruction, however, frequently demonstrate only temporary improvements in performance. With brief training the mentally retarded memorizer may show a marked tendency to abandon a trained strategy when not explicitly instructed to continue its use. This can be illustrated by situations in which retarded children are taught a strategy for a task and are then given a series of follow-up tests: on Test 1, they are reminded to use the instructed strategy; on Test 2, they are given no such reminders; and on Test 3, they are again reminded. In a series of studies (Brown & Barclay, 1976; Brown, Campione, & Barclay, 1979), children with a mental age of six years performed well on Tests 1 and 3 but poorly on Test 2. Note that there was no additional training during these tests; performance levels were determined simply by the provision of reminders by the experimenter. The strategy was evidently available to the children on Test 2, but they did not use it without prompting. In these cases the task remained the same throughout. The problem of accessing stored information would be expected to be even more problematic when the learner encounters a new task on which the strategy is relevant. The proposal that this ability to access stored information for use in multiple situations is one major component of intelligence, has been outlined in more detail in Campione and Brown (1978) and Brown and Campione (1980).

Overall, it seems to be the case that maintenance of a trained strategy occurs following extended strategy training. In fact, somewhat more fine-grained analyses by Butterfield and Belmont (1972) and Borkowski, Cavanaugh, and Reichhart (1978) suggest that the amount of training necessary may vary with the subject. In their studies, they found that maintenance was a function of the efficiency and precision with which the strategy was carried out during training. Those subjects who executed the strategy well at the time of training were more likely to maintain the strategy subsequently. These results indicate that training for individual children should continue until some criterion of strategy use is achieved, rather than the usual procedure of instructing all subjects for a fixed number of trials or sessions. While some additional "fine-tuning" is necessary to help fill out the overall picture, the current data are encouraging: Maintenance can be achieved with a sufficient amount of training.

Attempts to Assess the Generalization of Training

The third criterion of effectiveness of training in mnemonic strategies, generalization, or transfer to appropriate new situations, presents the most recalcitrant problem for training programs. There is general agreement that evidence for flexible generalization to new situations is sadly lacking. Inflexibility in the use of trained skills in new situations is so pronounced a problem for most retarded children that it has come to be viewed as an almost universal cognitive deficit. Both American and Soviet psychologists, not to mention parents and teachers, have repeatedly observed the difficulty which even mildly retarded children experience with generalization. Successfully training a mentally retarded child to use a simple mnemonic skill in one specified situation seems to be well within our competence as instructors; getting the child to use the information appropriately in other settings appears to be the major hurdle.

In an earlier paper, Campione and Brown (1977) concluded that there was almost no evidence in the literature indicating successful generalization of trained strategies by educable retarded children. This pessimistic note can be offset, however, by a number of considerations. The most important of these is that many of the studies with negative results were not designed specifically to assess generalization and certainly were not done for the purpose of achieving generalized effects of training. As noted previously, initial training studies were conducted to determine if strategy training would facilitate performance. When tests for generalization were included, they were simply "tacked on" at the end of a study. It became apparent from these studies that generalization was not something that would be achieved readily and that if generalization was something to be hoped for, the training procedures would have to be modified to take this into account.

In retrospect, this is not surprising; and, indeed, it now seems unclear why generalization would be expected following the typical training procedures in the literature. In the design of the standard experiment, the subjects are simply given a memory task and are told to employ some strategy. No attempt is made to explain why the strategy was necessary or how it may have affected performance, much less that it may be useful in other situations. Essentially, the students are required to induce all this information on their own. Retarded children do not fill in such gaps readily (Brown, 1978; Butterfield et al., 1973), so the results of such experiments seem as though they should have been predictable.

The minimal instructions and explanations employed might have led us to expect no generalization for yet another reason. Recall that one of the conditions in which strategies are necessary obtains when the amount of material to be retained exceeds the capacity of working memory. There are data available that indicate that retarded children frequently overestimate their memory capacity and capabilities by a large amount. For instance, when shown an array of ten pictures and asked how many of them they will subsequently be able to recall, they frequently indicate that they can recall all ten when in fact they can only recall three or four (Brown, Campione, & Murphy, 1977). Given their overestimation of their own capability, it is not surprising that they fail to employ any strategy to help their recall. It would follow that they would not understand why the trained strategy was necessary, and hence, there would be no reason for them to generalize it.

There is another factor that might be expected to impede generalization, and that concerns the nature of the skills that have been trained. Although the various strategies that have been investigated are important vehicles for the study of strategy training, they are not particularly general. In fact, there are many situations in which the use of the strategy trained would be inappropriate. A rehearsal strategy, for example, is not appropriate for tasks with a large number of items to be remembered. Effective generalization of a rehearsal strategy would, therefore, require that the trainee be able to discriminate situations in which rehearsal would be appropriate from those in which it would not.

For purposes of training, it seems possible that generalization would be more likely to occur if more general skills were trained, i.e., if the activities being instructed were truly trans-situational. In such cases, the children could apply what they had learned without having to analyze the task to determine whether or not it was appropriate. There are reasons to believe that this might work. Proponents of cognitive behavior modification (e.g., Meichenbaum, 1977) have investigated the effects of training self-regulation behavior, such as having students ask themselves if they understand what they are supposed to be doing, if they are remaining on task, etc., and it appears that instructing such general routines results in more generalization than training more specific behaviors.

Recently, theorists have taken the approach that attempts to bring about generalized effects of training require a reanalysis of the design of the instructional component of the research; it should be designed with the goal of generalization in mind (Stokes & Baer, 1977). As indicated above, there seem to be two general directions in which to proceed: (a) improvements in the design of training studies (including the type of instructions and explanations given) and (b) a reconsideration of the types of skills that are trained. A detailed discussion of these two avenues can be found in a paper by Brown and Campione (1978), and we will give only the highlights here. To our knowledge, there is no study available that satisfies all the conditions we feel are necessary for a completely adequate training study. Given this, the negative outcomes in the literature may be due to the faulty design of the training rather than to an inability of the subjects to generalize. To document this, we will show that some of the factors we regard as important do influence generalization when manipulated individually. We will then infer that manipulations of several factors simultaneously will produce even greater effects.

First, consider the design of training studies and the hypotheses that the failure to obtain generalization is a result of inappropriate training regimes. Brown and Campione (1978) have listed a series of requirements for an adequate study, if the aim is to produce generalization, and we will review a number of them here. The first set takes place before intervention begins and involves a detailed diagnosis of the original problem. It should be established that the skill being trained is one that is important in a variety of situations and that is lacking in the immature learner. Even when these conditions are met, the specific causes for the lack should be considered. For example, a child may not use a rehearsal strategy for several different reasons. The child could be unaware of the need for any strategy; or the child could appreciate that a strategy was necessary but not realize that rehearsal would be appropriate. This in turn may be true because a rehearsal strategy was not used by the child in the past. Even if the child had rehearsed on some task previously (spontaneously or in response to instruction), the child may lack sufficient mastery over this strategy for a variety of reasons, including a failure to recognize the new task as one demanding rehearsal or an inability to modify the old strategy to fit the precise demands of the new task. While we could continue, the point seems clear. Simply designating a trainee as a nonrehearser is an inadequate diagnosis of the original state of competence. Very different forms of training would be indicated for children in various starting states.

A number of recommendations concerning procedures during the instructional period warrant consideration. (a) Include a statement about why the strategy is needed, ideally with examples of how poor performance would be without it. (b) Include a detailed specification of the various components and their assembly, since students may not develop the strategy in its full detail, i.e., they may not fill in the missing steps themselves (cf. Butterfield et al., 1973). (c) Train to some criterion to ensure that the learner has mastered the skill within the original context before expecting generalization to a new context. (d) Provide feedback about the effectiveness of the strategy by indicating clearly the level of performance achieved with it vs. without it because students are not likely to transfer the use of some procedure unless they are aware that it is helpful. (e) Train in multiple settings since instructed strategies may remain "welded" to the training task unless the child is shown that the strategies are in fact useful in a number of tasks. (f) Provide direct instructions about generalization so that the learner understands that transfer is an important part of learning. All of these recommendations are based on the fact that retarded children do not tend to "go beyond the information given." Without these training procedures there is no reason to believe that they will infer that generalization is possible or desirable.

Ideally, instruction should be tailored to the beginning competence of the learner. However, it may not be possible to describe that competence completely before training, and training may fail. One final feature of a good training study is that it be designed to distinguish between different possible causes of transfer failures. If the reason for failure can be specified, the instructional procedures may be effectively redesigned.

In addition to suggesting design modifications to maximize generalization, Brown and Campione (1978) also advocated a reconsideration of the skills trained. They suggested a concentration on more general skills likely to be trans-situational. The specific suggestions were based on the pervasiveness of young children's problems with self-regulation and control of their goal-directed activities (Brown, 1975, 1978; Brown & DeLoache, 1978; Meichenbaum, 1977; Mischel & Patterson, 1976). Slow-learning children in particular experience major problems when required to orchestrate and regulate the use of strategies (Campione & Brown, 1977, 1978). An alternative or supplement to training specific skills would be to train general "metacognitive" skills notably absent in the academic problem solving of these children (Brown, 1975, 1978). General metacognitive skills such as checking, planning, asking questions, self-testing, and monitoring current activities rarely appear in the protocols of slow-learning children, but they are very general skills applicable in a wide variety of situations. In addition, it is the failure of learners to employ these general "overseeing" functions that seems to be a major reason for their failure to transfer learned information (Brown, 1974, 1978; Campione & Brown, 1977, 1978). Given this analysis, the logic for directing training at these skills seems strong.

There is another reason why training attempts directed at general skills might be more likely to result in transfer. One problem with specific skills is that they are just that--specific to a very small class of situations. For learners to generalize the effects of instruction in the use of specific routines, they would have to be able to discriminate the situations in which the routine would be appropriate from those in which it would not. Adequate generalization of specific strategies would require both extended use in novel situations and decisions not to use the trained routines in other situations in which it would not be beneficial (Brown, 1978; Campione & Brown, 1974, 1978). In the case of general skills, this discrimination should not be necessary, as the skill or routine could simply be used in a whole battery of problem-solving situations without regard to any subtle analysis of the task being attempted. In this sense, "general metacognitive skills" might be the most likely to lead to transfer across task boundaries.

As a final comment here, these two suggestions regarding design of training studies and choice of skills are not mutually exclusive. In fact, we believe that the best programs will be those that include both the well-designed training of skills together with the training of procedures for overseeing those skills. We would argue that instructing specific skills without explicit instruction in their use and management is unlikely to lead to generalization. Also, we do not see how management of skills can be taught in the absence of specific skills to be overseen. Again, the implication is that both should be considered when instructional routines are being developed.

While no studies have incorporated all the features outlined above, studies taking some of them into account have begun to appear. The result has been an increase in the likelihood of obtaining transfer, allowing much more optimistic forecasts about our ability to engender practically important improvements in memory performance.

Recent Research on Generalization

In this section, we will indicate some of the factors that have been shown to influence the likelihood of obtaining strategy transfer. In a number of studies with nonretarded children (e.g., Borkowski, Levers, & Gruenenfelder, 1976; Kennedy & Miller, 1976), an instructed strategy was more likely to be maintained in the absence of experimenter prompts if it had been made clear that the use of the strategy did result in improved performance. Apparently, for these subjects, the utility of the strategy was not appreciated without explicit feedback, and simply providing that information resulted in increased transfer. In a pair of studies with nonretarded (Kestner & Borkowski, 1979) and retarded (Kendall, Borkowski, & Cavanaugh, Note 1) children, training centered on the use of elaborative strategies to facilitate paired-associates learning. The training extended over four days and involved a number of features, including explicit feedback about the strategy's effectiveness. A generalization task was also employed; the difference here was that the children were required to learn triads, rather than pairs, of words. In both experiments, children given the elaboration training outperformed control children on both the training and generalization tasks.

We turn now to a study by Belmont, Butterfield, and Borkowski (1978), investigating the role of training in multiple, rather than single, contexts. They were concerned with the use of a variety of rehearsal strategies to be used on some similar short-term memory tasks. In each case, the subjects, 12- to 15-year-old retarded children, saw a series of seven letters, one in each of a row of windows. They were allowed to go through the list at their own rate. This study trial was then followed by one of the memory tasks. In three of them, they were required to recall all seven items, but in different orders. The three conditions were 3/4, 4/3, and 2/5. In the 3/4 condition, for example, the subjects were to recall the last three items of the set, followed by the first four items. In a probed recall task, the set of seven items was followed by a test letter, and they were told to indicate the window in which that letter had appeared. The point is that rehearsal processes were necessary on each of these tasks, although the specific form of the strategy had to be modified to take into consideration the specific demands of each. For example, in the 3/4 case, the optimal strategy would be to view the first four items and then pause and rehearse them as a group until they are learned. Following this, the last three items should be viewed more rapidly, and the subjects should attempt recall of the set immediately. Going from a 3/4 recall to a 4/3 recall required the learner both to recognize the continued need for rehearsal and to modify the strategy to conform to the changing response requirement.

In the Belmont et al. study, two groups of retarded children were involved, one that received training on only the 3/4 task and one that was taught to deal with both the 3/4 and 4/3 tasks. While the group trained only on the 3/4 case did not show evidence of generalization, the twice-trained group did continue to rehearse on the 2/5 and probed recall tasks. In these tasks, they showed study patterns consistent with rehearsal usage, and their recall scores were about 170% of those of the singly-trained group. While the variations in the tasks employed here are small and thus the amount of generalization demonstrated somewhat limited, the results are impressive and indicate the potential gains to be achieved through training in multiple contexts.

The final study to be described assessed the effects of instructing mildly retarded children in the use of a general "stop, test, and study" routine (Brown, Campione, & Barclay, 1979). The initial task on which instruction was given was one in which subjects were required to study a supraspan list of pictures until they felt they were ready to recall all the pictures in order. The pictures were presented in a series of windows, and the subjects could view any picture by pressing its window. Only one picture was visible at a time, but the subjects could investigate the windows in any order and as frequently as they wished. They were also told to ring a bell when they felt they were ready to be tested for recall. In a series of preliminary sessions, the maximum number of pictures each child could recall in this situation was determined individually for each child. From this point on, each child was given a series of trials on which he or she was required to recall 1½ times the maximum number; thus, if a child could recall five items without aid, eight items would be presented on each experimental trial.

Performance was initially poor on this more difficult task, even though the children were free to study for as long as they liked. During the training portion of the study, children were taught strategies that could be used to facilitate their learning of the lists along with the overseeing or monitoring of those strategies. The latter aspect of training was accomplished by employing strategies that included a self-testing component and by telling the children to monitor their state of learning. For example, in a rehearsal condition, the subjects were told to break the list down into manageable subsets (three items) and rehearse those subsets separately. They were also instructed to continue rehearsing the group of subsets until they were sure they could recall all the items. Note that one can only continue to rehearse all the items if he or she can remember them well enough to produce them for rehearsal. Thus, in this situation, rehearsal serves both to facilitate learning and to provide a check on the state of that learning. Another strategy, anticipation, which included similar self-testing features, was included. Children in a final condition, labeling, served as a control group. Children in this condition were told to go through the list repeatedly, labeling each item as they exposed it, and to continue that activity until they were sure they were ready to recall.

We will present here the data for only an older group of educable retarded children (mean IQ = 70, mean MA = 8). Children taught the strategies involving a self-testing component improved their performance significantly, whereas those in the control condition did not. These effects were extremely durable, lasting over a series of post-tests, the last one year after the training had ended. Shortly after the one-year follow-up test, the children were tested for generalization to a more typical school task, studying and recalling prose materials. Those students given either rehearsal or anticipation training outperformed a pair of control groups. They showed both better comprehension and recall of the texts. Thus, the effects of instruction given in the context of learning to recall a series of pictures generalized to the very different situation of studying texts.

Practical Implications of Strategy Training Research

Given this body of research, what can we say about the modifiability of the memory capabilities of the retarded child? We think quite a lot. It is by now abundantly clear that whereas retarded children perform poorly in a wide variety of memory tasks, these tasks tend to be ones in which particular strategies must be used to effect efficient performance. Fortunately, if they are induced to carry out the right operations during study and retrieval, their performance improves. This can be achieved in either of two ways, the choice of which depends upon exactly what the aim of intervention is.

The first case is one in which retarded children must learn and remember some specified set of facts or items. We by now have a relatively good understanding of the processes necessary to bring about durable memories. Individuals who engage in deep processing (Craik & Lockhart, 1972) or broad elaborative processing (Anderson & Reder, 1979) of material to be retained show good retention. It is important that this outcome does not depend upon the individual's intention to remember, i.e., good retention is an automatic result of such processing. For example, Murphy and Brown (1975) showed 4-year-old children a set of 16 items, four from each of four categories. In one condition, the children were instructed to remember the items and were given 2 minutes to study them. In two other conditions, the children were given 2 minutes to sort the items into categories, i.e., forced to think about the meaning of the items and note some similarities and differences between them. In one of these two conditions, they were told that they would later be tested for their memory of the pictures; in the other, no warning about the impending memory test was given. The main outcomes were that (a) the latter two conditions led to better recall (50%) than the simple instructions-to-remember condition (34%), and (b) the two categorization groups did not differ, i.e., the children who did not know they would be tested for memory recalled as many items as those who were forewarned.

The conclusion from these data is that the way in which the learner interacts with the material determines the accuracy of recall. It does not seem to matter whether the learner engages those activities in an attempt to remember or is "tricked" into doing so. Thus, in the Turnure et al. (1976) experiment, leading the subjects to think in some depth about the pairs of items resulted in superior performance. If the goal is to produce good memory of some specified set of material, we do not need to rely on the student's producing the necessary mnemonic pyrotechnics. If, during instruction, we force them to carry out the appropriate operation, good memory should result.

The second goal we might aim for is to teach retarded children how to spontaneously employ some of the strategies and operations necessary for good retention, rather than having them rely on external agents. To do this, we must provide them with the skills and strategies upon which memory relies and teach them how to go about recognizing situations in which the skills, or simple variants of them, are appropriate, i.e., teach them to generalize. While we have a long way to go in this area, we are making a beginning. Recent work has begun to show that generalization is achievable and to indicate some of the factors that should be included in any training program. Our own feeling is that we know enough about both memory and the retarded child's cognitive profile that we can devise a "memory curriculum" aimed at achieving this goal, and we have in fact begun doing this. We do not have any data yet, nor do we have space here to describe the overall program, but we can indicate the form the instruction will take.

In describing this "curriculum," we also summarize the paper, for the design of such a program depends upon our knowing what the source of the retarded child's memory problems are and upon our hypotheses about which aspects can be improved and how we might go about improving them. Our beginning point is that retarded children experience memory problems because: (a) they do not produce the mnemonic strategies necessary on a number of tasks, possibly because (b) they do not have a good understanding of the strengths and weaknesses of their memory system or how it works. Finally, (c) they do not systematically regulate their own activity, either as general problem-solvers or, more specifically, as intentional memorizers.

The first step is to teach the children that, for anyone, remembering is very difficult and limited in some situations, whereas in other cases, good retention is relatively easy to achieve (e.g., recalling the names of a set of 25 pictures is very hard, but simply recognizing that you have seen the pictures before is extremely easy; recalling a series of two digits is easy, but of ten digits hard; etc.). They can also be taught how to recognize the areas in which they will have problems, i.e., some of the factors that make remembering difficult--kind of memory test to be employed, amount of material, meaningfulness of the material, etc. After this, we will outline a number of strategies for dealing with these situations. Each strategy will be illustrated on a variety of problems (to minimize welding effects), and there will also be examples of problems in which that strategy would be inappropriate. This can be achieved by giving explicit feedback about recall when the child does, or does not, use the strategy. This component of the program consists of comparing and contrasting the kinds of tasks in which one or another strategy would be appropriate. The aim is to indicate to the trainees that generalization is something they should aim for and to teach them something about how they should go about it.

The preceding steps have been concerned with identifying the need for some strategy and selecting one that matches the task at hand. We then turn to the management and monitoring of the chosen strategy. For example, children will be told to stop and test themselves regularly to check on how well they are learning. On the basis of this checking, they can decide whether to cease studying, if learning is adequate, continue studying with the same strategy, or find that they are not improving and abandon that strategy to search for a better approach. While these various steps seem to be acquired naturally by children of average or greater intelligence, there is evidence that each one causes problems for the retarded child, hence the need for the kind of explicit instruction included here. (For a more detailed description of the issues involved in the selection of generalizing strategies, see Campione & Brown, 1977.)

Finally, in addition to providing instruction on each of these component skills, we will include the kind of self-management procedures used with considerable success by the proponents of cognitive behavior modification techniques (Meichenbaum, 1977). These procedures are designed to maximize the likelihood that the products of our instruction will be accessed when needed to deal with memory requirements of new problems, i.e., to lead the children to think systematically about what they need to do in their current situation. In our application, instead of instructing very general self-management skills ("Do I understand the task?", "Am I attending?", etc.); we will introduce more memory-specific questions. When confronted with a memory situation, children will be taught to ask themselves (a) "Can I remember easily?" and to self-test if not sure. (b) "If not, what do I need to do?" (c) "Is this task like any others I have worked on?" (d) "What did I do there, and can I do something like that here?" If some approach is taken, (e) "Am I making acceptable progress?", etc. The aim here is to introduce a plan for managing the child's memory resources and to make explicit the way in which the various instructed activities should be considered and sequenced to deal with some novel or even old tasks.

Summary

In this chapter, we have considered some of the research aimed at understanding and remediating the memory performance of mildly retarded children. We found areas in which their retention seemed quite good and concluded that the overall memory system was not just generally deficient. When, however, mnemonic strategies were required, retarded children did perform poorly. Teaching them the relevant strategies or leading them to engage in appropriate activities did result in much enhanced recall, thus indicating the potential for improving memory. While the results are sufficient if the goal is to achieve retention of some specified material, we argued that they are not sufficient if we want more widespread effects. In this case, practically important benefits would accrue only if we could also provide evidence for the maintenance and generalization of training effects. While early data were not encouraging in this regard, more recent work aimed at producing generalization has been more successful and has served as the basis for increased optimism.

As a final comment, we try to practice what we teach and have engaged in some checking and monitoring activities ourselves with regard to the current state of our memory and instructional theories. We feel that theories are developed so sufficiently that we are willing to try to develop a memory package which we can take into the classroom with some hope of success. While we may turn out to be wrong, this willingness is at least a measure of our evaluation of the current state of knowledge. A few years ago, we would not have been nearly as willing, and the inference is that the field as a whole is making progress toward some practically significant applications. Further, we would expect more rapid advances in the future, as many workers in the field have come to view such practical success as an important yardstick against which to evaluate theories, resulting in a convergence of "basic" and "applied" research goals; we anticipate that this distinction will become even more blurred with time.

Reference Note

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