Technical Report No. 262

INDUCING STRATEGIC LEARNING FROM TEXTS BY MEANS OF INFORMED, SELF-CONTROL TRAINING

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Abstract

Metacognition is defined emphasizing the distinction between knowledge about cognition and regulation of cognition. The role of metacognition in the identification and categorizing of students with learning problems is then discussed and the suggestion made that further empirical data are required to render such categorization more educationally relevant. Following this discussion, three types of cognitive skills training studies are described and evaluated: blind, informed, and self-control. In addition, the issue of the specificity of the skill trained is discussed and research is cited which illustrates the continuum of such skills. The paper concludes with suggestions regarding desirable features of cognitive skills training programs.

I. What is Metacognition?

There is a burgeoning interest in the metacognitive profile of students experiencing learning problems. The purpose of this paper is to delineate two facets of metacognition and examine their relationship to the identification and categorization of students displaying learning difficulties. Following this, three approaches to cognitive skills training are evaluated with a focus on desirable features of such training programs.

Because the definitions of both metacognition and learning disabilities are by no means clear in the literature, the task of addressing their intersection is problematic. The term metacognition has been used very broadly to refer to many aspects of active cognition (Brown, in press; Brown, Bransford, Ferrara, & Campione, in press; Flavell, 1980, 1981), but two broad categories can be distinguished, namely knowledge about cognition and regulation of cognition. The two forms of metacognition are closely related, each feeding on the other recursively; and attempts to separate them lead to oversimplification. However, they are readily distinguishable, and they do have quite different historical roots. Knowledge about cognition involves conscious access to one's own cognitive operations and reflection about those of others; it is a form of declarative knowledge about the domain "thinking." Of course, this form of declarative knowledge, like any other, is fallible; the child or adult can "know" certain facts about cognition that are not true. Naive psychology is not always empirically supportable. This type of knowledge is usually assumed to be late developing, as it requires that learners step back and consider their own cognitive processes as objects of thought and reflection (Piaget, 1976, 1978).

Regulation of cognition, often referred to as executive control within information-processing models, involves preplanning and planning in action (Rogoff & Gardner, in press), planning and control (Hayes-Roth & Hayes-Roth, 1979), pre-action and trouble-shooting (Norman & Schallice, 1980) and planning and monitoring (Brown, 1978, in press). Prime executive functions include planning activities prior to undertaking a problem (predicting outcomes, scheduling strategies, and various forms of vicarious trial and error, etc.), monitoring activities during learning (monitoring, testing, revising, and re-scheduling one's strategies for learning) and checking outcomes (evaluating the outcome of any strategic actions against criteria of efficiency and effectiveness). Intelligent systems, be they machine or human, are highly dependent on executive orchestration, resource allocation, and monitoring functions. Non-intelligent systems, be they inadequate programs or humans, are assumed to be deficient in these planning and on-line executive control functions.

Poor problem solvers lack spontaneity and flexibility in both preplanning and monitoring. Extreme examples of planning deficits are described in the clinical literature on patients with frontal-lobe syndrome. Such patients typically omit the initial pre-action component

(Luria, 1966); they also experience extraordinary difficulty with error correction (Milner, 1964). Such patients have been described as simultaneously perseverative and distractible; they exhibit a failure in intelligent focusing which is attributed to damage to the supervisory attentional mechanism or executive system (Norman & Schallice, 1980). While pathological cases are extreme, many descriptions of learning disabled children's problem solving are very similar; this similarity deserves attention.

In current developmental psychology, theorists from diverse backgrounds suggest that the twin concepts of reflection and self-regulation are integral to any learning process and are central mechanisms of growth and change (Brown, in press). These theorists include recent Genevan theorists (Karmiloff-Smith, 1979 a,b; Karmiloff-Smith & Inhelder, 1974/1975; Inhelder, Sinclair, & Bovet, 1974; Piaget, 1976, 1978), American developmental theorists (Brown, 1982, in press; Flavell, 1980, 1981) and language acquisition theorists (Bowerman, in press; Clark, in press; Karmiloff-Smith, 1979a). It is important to note, however, that in both Genevan and language acquisition theories a sharp distinction is made between conscious awareness and direction of thought, and self-correction and regulation, which can proceed below this level. This distinction has not been made as clearly in the developmental metacognitive literature.

Piaget distinguishes sharply between active regulation as part of any knowing act and conscious regulation and direction of thought, the keystone of formal operations. The first process is age independent; even the young learner succeeds in action by regulating, correcting, and refining her current theories. Some form of error correction must be part of any active learning attempt; even very young children are capable of regulating their activities via a systematic procedure of error detection and correction (Brown, in press; DeLoache, Sugarman, & Brown, Note 1; Koslowski & Bruner, 1972) and these self-regulatory functions are most informative as they provide us with a window though which to view the child's theories-in-action (Karmiloff-Smith, 1979a). The processes used to correct errors reflect the level of understanding the child has of the problem. Similarly, developmental psycholinguists have argued that production errors are very informative; "the tongue slips into patterns" (Nooteboom, 1969). Such errors reveal a great deal about the organization of the semantic knowledge of the speaker (Bowerman, in press).

These early regulatory actions may be important, but the distinction between self-regulation of action and reflection should not be overlooked. Error correction during language production is integral to the processes of using language and is present no less in young children (Bowerman, in press; Clark, in press) than in adults (Fromkin, 1973; Nooteboom, 1969). Metalinguistic awareness, in contrast, is assumed to be a product of adolescent rather than childhood thinking. The ability to step back and consider one's own thought (or language) as itself an object of thought and, to go further, use the subsequent

conceptualization to direct and redirect one's cognitive theories, is currently believed to be late developing.

Confused in the metacognitive literature, even lost in some versions of the concept, is this essential distinction between self-regulation during learning and knowledge of, or even mental experimentation with, one's own thoughts. Whatever distinctions must be made in order to render metacognition a more malleable concept, this one is a fine candidate for inclusion. It is important to distinguish then between a) declarative knowledge of a domain and b) executive control when operating within that domain, even though the two forms of knowledge have been called metacognition and are closely linked in the sense that adequate conceptualization of a problem will drive on-line executive monitoring, and the products of such monitoring could serve to inform the learner's theory of the task domain, and so on in an essentially recursive manner.

II. What is a Learning Disabled Child

Like the definition of metacognition, the definition of learning disabilities is murky. Conventional stereotypes of poor readers, learning disabled children and mildly retarded children implicate differences in the extent of the learning disability and its degree of severity. Thus the least severely impaired are the poor readers, who are assumed to be children of normal intelligence with difficulties learning to read at the rate set by their average age mates. No other major learning disabilities are assumed. The most severely impaired are retarded children who are commonly supposed to suffer from a general intellectual deficit which results in uniformly poor performance on standardized intelligence tests and on all major forms of academic achievement.

For diagnostic mystique, the most interesting body of children are the "intermediate" group, the learning disabled population. These children are assumed to have normal, or above normal, intelligence; but they suffer from specific clusters of learning problems that are revealed in both their diagnostic pattern of sub-item difficulty on standardized IQ tests (digit span, coding, general information, etc.) and in their relative difficulty in coping with one or all of the main academic pursuits: reading, writing, spelling and calculating. In addition, there is a common assumption that specific identifiable clusters of abilities are involved in the learning impairment. Some authorities prefer many such clusters, e.g., "if one were to evaluate 100 children with this condition (LD), he or she might find 30 or 40 different profiles of strengths and disabilities" (Silver, 1978). Other authorities prefer dichotomous clusters, e.g., dyseidetic dyslexia (visual problems such as visual perception, visual integration, visual memory, fine motor and/or visual motor area impairment) versus dysphonetic dyslexia (auditory problems such as auditory perception, auditory integration, auditory memory and language output disorders). Public Law 94-142 provides a definition generous enough to cover most eventualities when it describes LD as

> a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculation. PL 94-142

Recent reviews of the psychometric, clinical and academic performance literatures have suggested that conventional wisdom distinctions such as the above are far from easy to instantiate in actual differential diagnosis. While poor readers are assumed to be of normal intelligence, they often present low normal IQs (in the 80s) and display other academic slowness. EMR populations also include children with IQs in the low 80s who often have IQ and clinical testing profiles quite similar to LD children. The reason for placement in the EMR category is often a combination of academic and behavior problems, or even considerations of ethnicity rather than a reflection of severity or type of disorder. Learning disabled populations include children with widely differing IQ profiles. In a recent survey of the LD population in a large midwestern city, we found four distinct patterns of scores. A sizable subgroup had both performance and verbal scores at or below 80 (i.e., an essentially EMR sample). An even larger group showed no interesting diagnostic pattern in their IQ performance (i.e., both verbal and performance scores of about 100 and no interesting sub-item problems). The remaining two groups were in the low normal range for composite score but showed at least a 15 point discrepancy between verbal and performance subscores. Interestingly, there were almost as many children with verbal scores that were higher than performance scores than vice versa, although one "conventional wisdom" stereotype of learning disabilities implicates impaired verbal performance only. Similarly, although clinical research has been quite successful at identifying many forms (clusters) of learning disability, it does not provide agreed-upon standards concerning which specific factors at which degree of intensity warrant a diagnosis of learning disability (Lynn, 1979).

The experimental literature that has emerged during the seventies does not clarify the picture greatly. The modal procedure is to compare a "normal group" of children for whom there are usually no descriptive statistics, with a group of impaired learners, for whom the only descriptive statistics available are class placements. The impaired group differs from the normal group in three general classes of cognitive skills: strategic, metacognitive, and processing efficiency. Knowledge base factors have rarely been investigated (Campione, Brown, & Ferrara, in press). These "deficits" are extensively documented for EMR samples; they perform poorly on a wide variety of problems because they fail to employ appropriate strategies such as rehearsal (e.g., Brown, Campione, Bray, & Wilcox, 1973; Butterfield, Wambold, & Belmont, 1973) or organization (e.g., Spitz, 1966) in memory tasks, exhaustive scanning for visual comparison tasks (Vurpillot, 1968) and directed attention in problems involving extraneous materials (Hagen & Huntsman, 1971). They also display a wide variety of metacognitive problems (Brown, 1975, 1978, in press; Flavell, 1971). These include lack of awareness of their own limitations as problem solvers and of compensatory strategies to overcome

such limitations, as well as a general lack of self-management techniques for monitoring and checking their own progress.

In addition to lacking effective learning strategies and inadequate self-management of the limited repertoire of such skills they can be trained to use (Brown & Campione, 1978, 1979), EMR children have learning problems resulting from what has been termed the efficiency of their information processing systems. Such elementary mental operations as identifying incoming information, deploying attention, searching memory, and carrying out logical operations, have been implicated in the EMR child's learning problems (Campione, Brown, & Ferrara, in press).

Also in comparison with their "normal" peers, learning disabled children have been characterized as: lacking in the spontaneous use of various types of attentional and mnemonic strategies (Hallahan, Kauffman, & Ball, 1973; Tarver, Hallahan, Kauffman, & Ball, 1976; Torgesen, 1977 a,b; Torgesen & Goldman, 1977); being deficient in various metacognitive skills such as planning, monitoring and checking (Torgesen, 1977a); and being slower to encode or identify stimulus items (Spring, 1976; Spring & Capps, 1974). The point, of course, is that the descriptions of the two "populations", mentally retarded and learning disabled children, sound remarkably alike.

And, the same is true of poor readers, who compared to normal or good readers display limited use of task specific strategies and metacognitive control of those activities, together with limited declarative knowledge of problem solving domains (cf. Baker & Brown, in press a,b). Basic speed of processing mechanisms have also been implicated as problematic for poor readers (Guthrie, 1973; Jorm, 1979; Perfetti & Lesgold, 1977).

Thus, a consideration of the emergent experimental literature on the cognitive processes of the three diagnostic categories would suggest a great deal of similarity in their performance on laboratory and school-like cognitive tests. This apparent similarity may be misleading however. All of these results have come from the simple procedure of comparing one diagnostic category against a normal comparative group. Comparisons within and between diagnostic groups are rare. The view we espouse is not that the populations do not differ, rather that the research done to this time is not analytic enough to specify the differences between the classes.

A major problem concerns the generalizations permissible from the use of "single-shot independent groups" experimental designs, in conjunction with the inherent heterogeneity of the students comprising both the normal and impaired samples in most studies. Group difference can be produced in many ways and one can obtain group differences when only some proportion of the LD groups are experiencing difficulties. For example, assume that the same subjects are used in a number of studies. Across experimental tasks (and studies), group differences could be due to the same set of subjects being consistently poor, or to different subsets of subjects having problems with different tasks. If the former, we would be led to ask further questions about those specific children;

it could be the case, for example, that those LD children should more accurately be classified as mentally retarded. If different subsets are producing the group differences in different tasks, the strong generalization that all LD students are in general passive, non-strategic learners is not supportable; that is, the inferences from the group results to individual cases are in error.

Because of these difficulties with group designs, the authors have instituted a series of indepth case studies of children with varying disabilities (Campione, Brown, & Ferrara, in press) and have concentrated training efforts on small groups of homogeneous subjects (Palincsar & Brown, Note 2). In this paper, we will concentrate on the latter approach, the intensive training study.

III. Training Cognitive Skills

A. Blind, Informed, and Self-Control Training

Before describing our empirical work, we will situate the attempt in the context of training studies research in developmental psychology. In recent reviews of the literature (Brown, Bransford, Ferrara, & Campione, in press; Brown, Campione, & Day, 1981), we classified training studies into three broad categories: blind, informed, and self-control. The studies differ in terms of when they were conducted historically, the nature of the interaction between the subject and the experimenter, the reasons for undertaking the research, and the criteria used for evaluating the outcomes.

Blind training studies were historically the first. The term "blind" is not intended to be pejorative; the studies were termed blind because they tended to leave the trainees in the dark about the importance of the activities they were being induced to use. The studies were by no means blind from the perspective of the experimenter, however. The choice of activities to be trained was based on a well-articulated and insightful analysis of the demands of a number of memory or problem-solving situations, and the experimenter's main purpose was to evaluate hypotheses regarding the processes involved in efficient performance and the sources of developmental or comparative differences. In this regard the studies were extremely successful; one impressive feature of a number of early blind training studies was that large improvements in performance could be engineered (Belmont & Butterfield, 1971; Borkowski & Wanschura, 1974; Brown, 1974).

The typical procedure in blind training studies is to instruct or induce children to perform particular strategies but not to help them understand the significance of such activities. They are told what to do or are led to do it by the experimenter, but they are not informed why they should act this way, or that it helps performance, or that it is an activity appropriate to a particular class of situations, materials, or goals. Such limited instruction is sufficient for some children who can infer the significance of the strategy for themselves; however, for many children it is not.

To illustrate this point, consider tasks involving free recall of categorizable materials. Children can be induced to categorize through the use of clever incidental orienting instructions (Murphy & Brown, 1975); the material can be blocked into categories (Gerjuoy & Spitz, 1966); or recall can be cued by category names (Green, 1974). None of these procedures guarantees that the child understands why or even if recall is improved; however, all these methods are extremely successful in improving children's performance on a particular set of materials.

Although blind training techniques can and often do help people learn a *particular* set of materials, they do not necessarily help people change their general approach to the problem of learning new sets of materials. In short, blind training procedures fail to result in maintenance (durability) and generalization (transfer) of the learning strategies (Brown & Campione, 1978; Campione, Brown, & Ferrara, in press). Children neither perform these activities subsequently of their own volition nor transfer them to new but similar learning situations. Something other than "blind training" therefore seems to be necessary to help many children learn on their own.

At this point, research aimed at assessing the effects of inducing metacognitive supplements to strategy training became popular. As a rough distinction, we can consider two types of experiments, those involving *informed* training and those involving *self-control* training (Brown *et al.*, 1981). Generally, subjects in informed training studies are given some additional information about the strategy they have been instructed to use; and those in self-control studies are also given explicit instruction about overseeing, monitoring, or regulating the strategies.

Informed training involves instruction in the significance of the trained activity. For example, Kennedy and Miller (1976) were able to show that an instructed rehearsal strategy was more likely to be maintained in the absence of experimenter prompts if it had been made clear to the student that the use of the strategy did result in improved recall. This effect can be obtained with a variety of strategies and subject populations; a similar result with retarded children was obtained by Kendall, Borkowski and Cavanaugh (1980) in work centering on the use of elaborative strategies to hasten paired-associates learning. Somewhat more elaborate instructional packages have been investigated by other authors, including Burger, Blackman, Holmes and Zetlin (1978) with retarded children and Ringel and Springer (1980) with children in regular classes. All resulted in substantial maintenance of the trained behavior in appropriate settings.

A nice example of this approach is a recent study by Paris, Newman and McVey (Note 3). They looked at the process of strategy acquisition in a study that included a number of the features of informed training. After two days of baseline performance on free recall of categorized lists, Paris et al. divided their seven- and eight-year-old subjects into two training groups. In one, the non-elaboration (blind in our terminology) group, the subjects were told how to carry out some mnemonic

activities: grouping, labeling, cumulative rehearsal, and recalling by groups. The second, or elaboration (informed) group, was in addition given a brief rationale for each of the different behaviors; they were also provided feedback about their performance after recall. The elaboration group outperformed the non-elaboration group on both the training session and on subsequent maintenance probes. Paris et al. argue that the provision of information about the rationale underlying each component activity leads students to understand the significance of those activities, i.e., they become aware of the strategies' benefits; and this awareness is in part responsible for continued unprompted use. To evaluate this possibility, they obtained metacognitive judgments throughout the course of the experiment. In fact, the subjects in the elaborated training condition did show increased awareness of the role of sorting activities compared with those in the nonelaborated condition. Also, awareness scores were significantly correlated with both strategy use and recall performance.

The final category of training studies was dubbed self-control by Brown, Campione, and Day (1981). The main feature of this set is the inclusion of explicit training of general executive skills, such as planning, checking, and monitoring. In the informed training approach, instruction of the target activities is supplemented with the provision of information about the activity and its effects. In self-control studies, the instructions include help with overseeing the activity.

Direct instruction of self-control skills is particularly important in the context of transfer. For students participating in blind training, the experimenter does the executive work, telling the learner what to do and frequently how long to do it (cf. Belmont & Butterfield, 1971; Brown, Campione, Bray, & Wilcox, 1973). Self-control training can be regarded as an attempt to emulate more closely the activity of the spontaneous user of the strategy -- the trained student is taught to produce and regulate the activity. Telling students to monitor and regulate their activities should also produce the effects sought in informed training attempts; if a student does monitor her own performance, she can see for herself that performance is improving; she provides her own information about strategy effectiveness.

Although there have been fewer self-control training studies than informed training studies, the initial results are encouraging. For example, in a series of experiments with mildly retarded children, Brown and her colleagues (Brown & Barclay, 1976; Brown, Campione, & Barclay, 1979) adapted the recall readiness paradigm employed by Flavell, Friedrichs and Hoyt (1970). The students were required to study a supraspan set of pictures for as long as they wanted until they were sure they could recall all items. Baseline performance was poor, and instruction was undertaken. In one condition, students were taught a rehearsal strategy to learn the list; in another they were asked to anticipate list items before exposing them; and in both conditions the students were also induced to engage in self-checking activities to

ensure that learning was occurring. The effects of this strategy plus regulation training for a older group of EMR students (MA = 8 years), but not a younger group (MA = 6 years), were: immediate beneficial effects of training; maintenance of the strategy over a one-year period; and evidence for generalization to a quite different task -- studying and recalling prose passages. The younger group showed only immediate effects of training; on maintenance probes, they reverted to baseline levels of performance, although mild prompts were sufficient to elicit the trained activities even one year later.

The authors found similar advantages of self-control training in studies in which more sophisticated students attempted to learn more complex tasks (Brown, Campione, & Day, 1981; Day, 1980). Junior college students were trained to use a variety of rules for summarizing texts. The students differed in ability and in type of instruction afforded them. The "control" treatment was similar to traditional summary writing instructions; the students were told to be economical with words, include all the main ideas, etc., but no further details were provided to help them follow these instructions. Another condition involved demonstration and practice with the set of rules (similar to informed training); yet another included both the rules and explicit instructions regarding the management and overseeing of those rules (self-control training). Students with no diagnosed learning problems improved with informed training, but students with diagnosed reading and writing problems needed direct training in rule application and overseeing, i.e., self-control training, before they showed significant improvement.

Thus evidence is accumulating to suggest that an ideal training package would consist of both practice in the use of task appropriate strategies, instruction concerning the significance of those activities, and instruction concerning the monitoring and control of strategy use.

The need for information concerning the extent of a learning problem and the suitability of various remedial strategies may be particularly acute for children with diagnosed learning problems. These children carry with them a history of academic failure, and repeated failure must cloud their "meta-cognitions" about their own learning potential. Learners have feelings about particular learning tasks and about themselves as learners that can have pervasive effects on their performance (Bransford, 1979; Brown, 1978; Henker, Whalen, & Hinshaw, 1980; Holt, 1964). Some individuals may be convinced of their inability to learn mathematics, for example (Tobias, 1978), or of their incapacity to solve certain types of problems. Some children actively resist learning because of their own diagnosis of personal incompetency (Cole & Traupmann, 1980). A particularly sweeping self-diagnosis was given by Daniel, a learning disabled ten-year-old child who worked with the first author. On encountering his first laboratory task, Daniel volunteered this telling comment: "Is this a memory thing?" (it wasn't) -- "Didn't they tell you I can't do this stuff?" -- "Didn't they tell you I don't have a memory?" Given this devastating estimate of his own ability, it is not surprising that Daniel was diagnosed as passive, even resistant in situations that he classifies as tests of his non-existent faculty. It

would take many sessions of systematically mapping out the specific nature of his memory problem, providing feedback about just where the problem was acute but also where there were no problems at all, before Daniel could derive a more realistic evaluation of his learning problem and, as a consequence, would be willing to attempt active learning strategies to overcome a specific learning problem he recognized and understood.

B. Specific and General Skills

An obvious problem facing those who engage in cognitive skills training is deciding what level of help the student needs. Discussions of this point have centered around the issue of specific and general skills. To illustrate this problem, Newell (1979) introduced the metaphor of an inverted cone of skills. At the bottom of the cone, the broad base, he conceived of a large set of specific powerful routines that are applicable to a limited number of domains; they are powerful in that once they are accessed, problem solution should follow (assuming only that they are executed properly). An example would be a task-specific rehearsal strategy. It is important to note that as we move up the cone, there is a tradeoff between generality and power. At the tip of the cone, there are a few highly general but weak routines -- general in that they are applicable to almost any problem-solving situation but weak in that they alone will not lead to problem solution. Examples here include exhortations to stay on task, or to monitor progress. These are weak in that, for example, merely noticing that progress is not being made or that learning is not occurring cannot rectify the situation unless the student brings to bear more powerful routines that can result in better learning.

Should one teach the general skills from the tip of the cone or the specific skills at the base? The answer is either or both, depending on the specific diagnosis of a particular child's learning problem in a domain. For students who do possess most of the specific procedures needed for mastery, instruction aimed primarily at general self-regulatory skills is indicated. In contrast, there may be students who have had considerable experience with many of the self-regulatory routines in other domains and are highly likely to employ them to guide learning in a novel area. What they may lack in a new problem are the powerful and specific procedures unique to that domain. The relative emphasis on general and specific skills in a particular case will vary as a function of both the ability of the learner and the complexity of the procedures being taught.

A great deal of the existing training research has concentrated on very specific and/or very general skills. This general-specific dimension is related to ease of transfer. Specific skills are powerful enough to enable problem solution _if_ they are accessed; but the problem of access or transfer remains a major one. The executive, self-regulatory skills which are weak evade the transfer problem, as they are appropriate in almost any situation; no subtle evaluation of task demands

is necessary. The result of including both types of skills in training programs is clear; use of the instructed activity is more effective on the original training task (cf. Paris _et al_., Note 3), and there is evidence for increased transfer (cf. Brown _et al_., 1979). Note, however, that the experimental work has involved single strategies and their use, not larger sets of specific skills -- and it is the latter case that is more typical of educational settings. The task of accessing, coordinating, and sequencing subordinate skills is a formidable one.

Rather than teaching a large number of specific routines and some extremely general supervisory ones, an alternative approach is to identify and teach "intermediate level" skills, or packages of skills (Campione & Armbruster, in press). These skills are more general than the extremely specific routines investigated in much of the literature, but more powerful than the weak self-regulatory skills that have attracted so much recent interest. An excellent example of an intermediate level training approach comes from the "self-instruction" work inspired by cognitive behavior modification techniques (Meichenbaum, 1977; Meichenbaum & Goodman, 1971). Initial work in this vein could be characterized as concentrating on the weak general methods. The majority of reseach using self-instruction to investigate school-related problems has concentrated on impulse control. Typically this work has entailed little instruction in task strategies. Rather the student is trained in general coping skills such as "slow down", "look carefully at all your choices", "check your work." The results of this work suggest that students will emulate reflective behavior and increase response latency following fairly brief training sessions in self-instruction (Ridberg, Parke, & Hetherington, 1971; Bornstein & Quevillon, 1976; Palkes, Stewart, & Freedman, 1972). However, response latency has not always been accompanied by an increase in accuracy with the target task (Debus, 1970; Camp, Blom, Hebert, & Van Doornink, 1977) and the findings from research which has investigated maintenance and generalization are equivocal (Meichenbaum & Goodman, 1971; Bornstein & Quevillon, 1976; Kendall & Finch, 1976). In general, however, these programs produce excellent short-term results with children who have at their disposal the necessary task-specific skills, and whose learning problems reside primarily in controlling and overseeing the use of those skills. Hyperactive, impulsive children respond very well to such regimes.

These impulse control programs are, however, insufficient for problem learners who do not already know how to perform the task specific elements of the problem. To deal with this problem, researchers in cognitive behavior modification have added to training programs direct instruction in task specific elements; this is termed <u>response guidance</u>. For example, Leon and Pepe (Note 4; see also Leon, 1979) designed a program of self-instruction on math computation skills for children attending resource rooms. Their program included modelling of task components with gradual fading to covert rehearsal of several problem solving strategies. The students were taught to identify the computation sign, translate the sign to an operation, begin computation with the right hand column and proceed to completion of the problem. The following dialogue illustrates various components of such self-instruction as applied to a math computation problem (126 + 14). "What is it I have to do?" (problem definition); "I have to find the sign and take my time working the problem" (focusing attention); "This sign means add. I start with the 4 and add it to 6. That makes 10. I write 0 at the bottom of the column. Then I write the 1 above the 2..." (response guidance); "Good. I'm doing fine so far" (self-reinforcement); "Now for the next column. No. I skipped a column. Well, that's O.K. -- just erase carefully and try again" (self-evaluation and error correction). Leon and Pepe observed that students so trained improved not only in the targeted problem types but also that improvement generalized from the training setting to the classroom and to an untreated arithmetic operation.

The Leon and Pepe work is an example of a combined package including explicit instruction in task components (Bender, 1976) and general self-management instruction. We will discuss a study from our laboratory where we attempted to train such a "combined package" to enhance reading comprehension.

C. <u>Inducing Comprehension Fostering Via Informed Self-Control Training</u>

Palincsar and Brown (Note 2) devised a training package that shares many of the features of response guidance instructions. The aim was to induce students with reading comprehension problems to become more active in their comprehension fostering activities. The notion that readers should engage in periodic self-interrogation while reading is not new, although it has become an even more common suggestion of late (cf. Baker & Brown, in press a,b; Brown, 1980; Collins & Smith, in press; Flavell, 1981; Markman, 1981). Of more direct interest are specific suggestions about the kinds of questions students should be taught to ask. For example, Collins and Smith (in press) emphasize the continuous process of hypothesis generation, evaluation, and revision while reading. They distinguish between two main types -- interpretations and predictions. Interpretations are hypotheses about what is happening now; predictions are hypotheses about what will happen next. It is clear that good readers engage in these activities while reading, just as they make and test inferences of many kinds (Trabasso, Stein, & Johnson, in press). They also engage in critical evaluation of ambiguous and contradictory segments of texts (Markman, 1981; Stein & Trabasso, in press). Poor readers are much less likely to generate these activities. Novice readers also experience difficulties with "lower-level" functions such as checking that they remain on task (Bommarito & Meichenbaum, cited in Meichenbaum & Asarnow, 1978) and simply paraphrasing sections to see if they understand and remember the gist of sections they have read (Brown & Day, Note 5).

Reading Comprehension Study

The processes selected for training by Palincsar and Brown were based on these findings. They set out to teach students to paraphrase and summarize sections of the texts they were reading, anticipate questions that might be asked, and predict what the author might say next. The instructor worked individually with students for many sessions, modeling the kinds of questions she wished students to produce. Students were continually reminded of why these activities were useful, given feedback concerning their effectiveness, and told that they should engage in such self-questioning any time they studied. Such self-questioning approaches are quite general, being applicable to a wide variety of texts. The transfer problem is in some sense avoided with these approaches, as the occasions for use of the instructed activities are quite clear.

Method

Palincsar and Brown worked intensively with four seventh grade students with homogeneous learning problems. The students were selected from a group of 13 students who were described by their teachers as being "adequate decoders but poor comprehenders" (13 out of a possible 113 seventh graders). Their adequacy at decoding was established by their meeting a criterion of 80 words per minute (with a maximum of 2 words per minute incorrect) reading rate on seventh grade texts. The four students were at the seventh percentile for reading comprehension, compared with other seventh graders. Although the students were not officially labelled as LD, it is not clear why not. Three of the four students were three grades behind on the Metropolitan reading comprehension test and one was two grades delayed. In addition, we administered the WISC intelligence scale and the students had IQ scores of 74, 89, 89 and 108; note that this wide range in IQ scores from a supposedly "normal" sample mimics the range of scores found for all the LD students in our sample from a large midwestern town.

The students were seen individually for many sessions. There were two interventions, corrective feedback and strategy training, preceded and followed by baseline and maintenance periods. Group I received corrective feedback prior to strategy training and for Group II the order was reversed. On each intervention day the student first interacted with the experimenter on a text and then attempted to read and answer questions on another text independently. On baseline and maintenance days they only took part in the independent sessions. All the data reported here relate to texts used in these daily independent sessions, not texts that were the focus of the interactions.

During Corrective Feedback the students were asked to read a passage silently and carefully in order to answer comprehension questions. The students were reminded to ask for assistance with any word he or she could not read or understand. Upon completing the passage the students were asked ten comprehension questions. The investigator praised correct responses. Corrective feedback was provided for incorrect responses by guiding the student back into the passage to the appropriate paragraph

where the answer could be found. If necessary, the line(s) where the answer could be found was given, as well as prompts to help the students find the answer. Having completed the corrective feedback procedure, the students were administered the assessment passage.

During strategy training the experimenter and the student engaged in a interactive learning game that involved taking turns in leading a dialogue concerning each segment of text. Both, the tutor and the child, would read a text segment and then the dialogue leader would 1) paraphrase the main idea; 2) discuss how pieces of information in the paragraph might be grouped or classified; 3) predict the possible questions that might be asked about that segment; 4) hypothesize about the content of the remaining passage segments and 5) comment on any confusions and how they might be resolved. After the dialogue, the dialogue leader asked the other member of the dyad a question concerning that segment. Then the roles were reversed.

The most successful training sequence was that in which the students first received corrective feedback concerning answers to questions by referring back to the text and then received strategy training. These data can be seen in Group I of Figure 1. Although performance was

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INSERT FIGURE 1 ABOUT HERE

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variable, a gradual improvement across days was found. Performance increased from approximately 15% correct during baseline to 50% correct in the corrective feedback session. The Group I students maintained this level of performance well. When the strategy training was introduced, performance soared to an impressive 80-90% correct. Remember that these scores, shown in detail in Figure 1, were obtained on the privately read passages, i.e., different texts that the students read after their interaction with the instructor. What was learned during the interactional sessions was used independently by the learners.

In comparison with the performance of students in Group I, the performance of students in Group II (also shown in Figure 1) was not so impressive. Group II students received the strategy training before corrective feedback and while performance did improve (from 15-50% correct) it never reached the level set by the Group I students. For this reason, at the end of the last maintenance phase, the Group II students were reintroduced to the strategy training. Now their performance also leaped to 85% correct. Apparently, the most appropriate order of these treatments is corrective feedback followed by strategy training.

Throughout the study generalization probes were taken in the classroom, with no notice given to the children that they were in any way related to the study; all seventh graders took the test given to them by their regular teacher. Performance fluctuated wildly, probably due to the use of only one passage per probe. However, the students showed the following mean gains in percentile ranking points over the course of the study; student 1 = 20; student 2 = 46; student 3 = 4 and student 4 = 34.

At least three of our students showed significant improvement by the end of the study and all of them did so at some point. This somewhat erratic generalization performance is not too surprising given the repeated failure to find generalization to classroom settings (Meichenbaum & Asarnow, 1978), and in light of the fact that little was done to ensure generalization to the classroom, e.g., the classroom teacher did not promote the use of strategies and the students received no feedback regarding classroom performance.

Six months after the study had terminated the students were brought back into the lab and tested for long-term maintenance. Unprompted sessions were followed by a reintroduction of the strategy training which was followed in turn by more unprompted sessions. The data are shown in Figure 2. Maintenance at approximately 60% was achieved followed by

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INSERT FIGURE 2 ABOUT HERE

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a leap to 90% during the reintroduction of strategy training. This level was maintained, encouraging evidence of savings.

In addition to these quantitative measures of improvement, Palincsar and Brown gathered qualitative indices of improved comprehension monitoring. Throughout the study, the students were repeatedly encouraged to ask for help with any word(s) they had difficulty reading or understanding. An interesting observation was that until strategy training was introduced, not a single student requested this type of assistance. The finding that students did request this help, when strategy training was instigated, and the finding that students were also observed to re-read, might serve as further testimony that the students were more actively monitoring their comprehension following strategy training.

During the strategy sessions the students took turns to lead the dialogue, trading places with the tutor. Initially, the tutor modelled appropriate activities but the students had great difficulty assuming the role of dialogue leader when their turn came. The tutor was forced to resort to constructing paraphrases and questions for the tutees to mimic. In this initial phase, the tutor was modelling effective comprehension monitoring strategies but the tutees were relatively passive observers. In the intermediate phase, the tutees became much more capable of playing their role as dialogue leader and by the end of ten sessions they were providing paraphrases and questions of some sophistication. For example, in the initial session, 19% of questions produced by the tutees were judged as non-questions and 36% as needing clarification. By the end of the training phase, only 4% of responses were judged as needing clarification. Unclear questions dropped out and were replaced over time with questions that focused on main ideas. A similar improvement was found in the sophistication of the summary statements produced. At the beginning of the sessions, only 11% of summary statements captured main ideas whereas at the end 60% of statements were so classified. The comprehension monitoring activities of the students showed marked

improvement, becoming more and more like those modeled by the tutor. With repeated interactive experiences, with the tutor and child mutually constructing a cohesive representation of the text, the students became able to employ these monitoring functions themselves. This improvement was revealed not only in the interactive sessions but also on privately read passages where the students were required to answer comprehension questions on their own.

IV. Recommended Cognitive Skills Training Program

Although considerable problems are associated with the classification of the skills termed metacognitive and the subjects designated learning disabled, there is also considerable evidence that children with learning problems are in desperate need of interventions aimed at improving their metacognitive skills, both declarative and self-regulatory.

Ideal cognitive skills training programs would include practice in the specific task appropriate strategies (skills training), direct instruction in the orchestration, overseeing and monitoring of these skills (self-regulation training) and information concerning the significance of those activities and their range of utility (awareness training). The level of intervention needed will depend critically on the pre-existing knowledge and experience of the learner and the complexity of the procedures being taught.

The results of training programs such as those used by Brown, Campione, and Barclay (1979), Day (1980), Palincsar and Brown (Note 2) and Paris, Newman, and McVey (Note 3) all suggest that combined packages that include metacognitive supplements to strategy training, either informed or self-control training or both, result in satisfactory maintenance and generalization. Concentration on self-questioning, comprehension inducing strategies that are of general use in a variety of settings is one way of finessing the transfer problem. The success of the Palincsar and Brown intervention suggests that such training packages may have broad educational utility, but they may be particularly appropriate for children with diagnosed learning problems and a concomitant sense of helplessness in an academic milieu.

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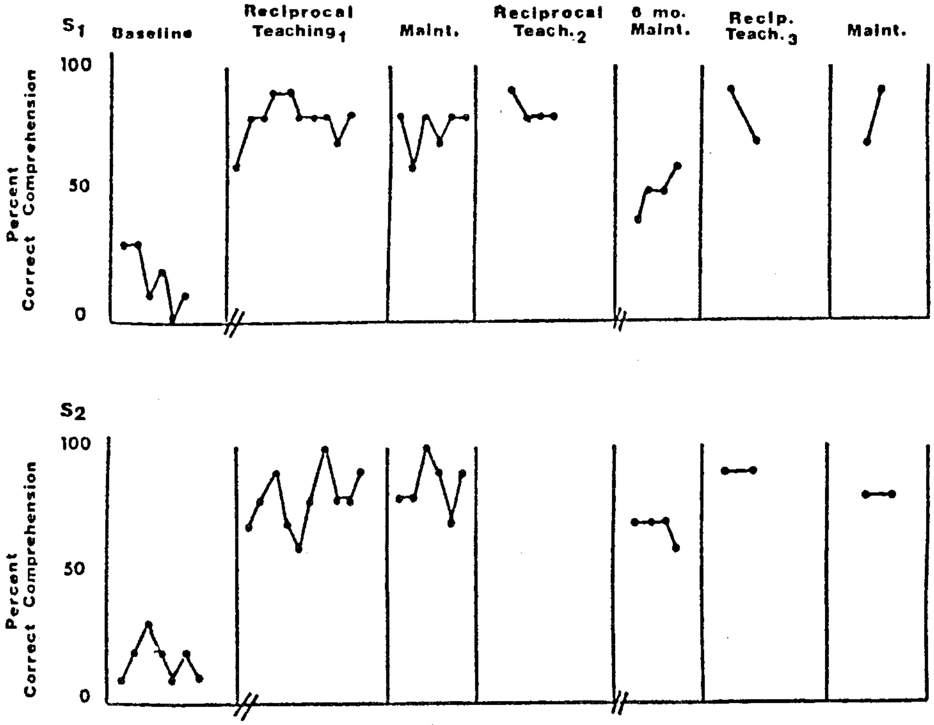
FIGURE CAPTIONS

1. A Comparison of Corrective Feedback and Strategy Training Interventions. From Palincsar and Brown (Note 2).

2. Long-term Maintenance of the Effects of Strategy Training. From Palincsar and Brown (Note 2).



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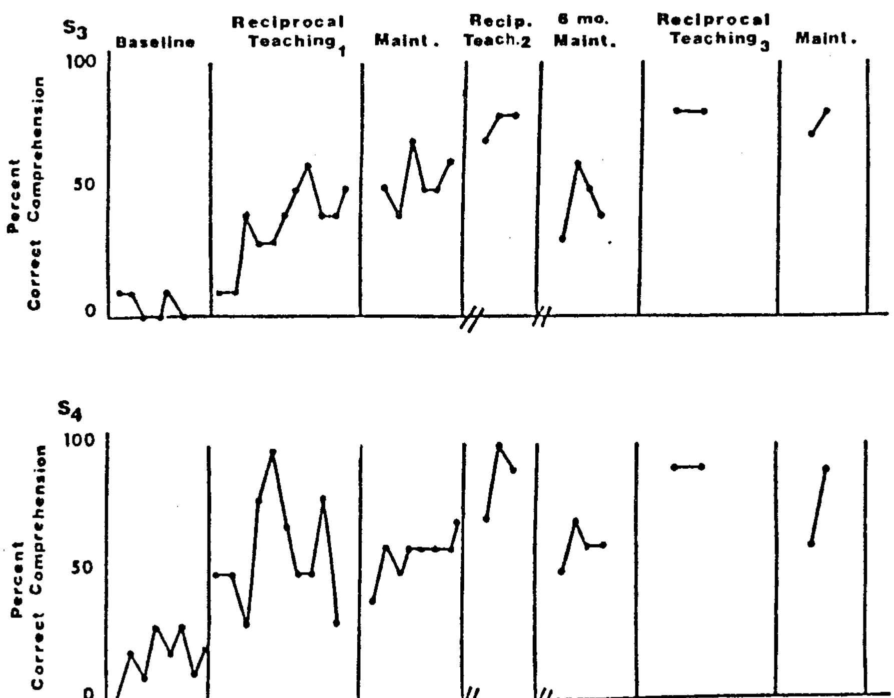

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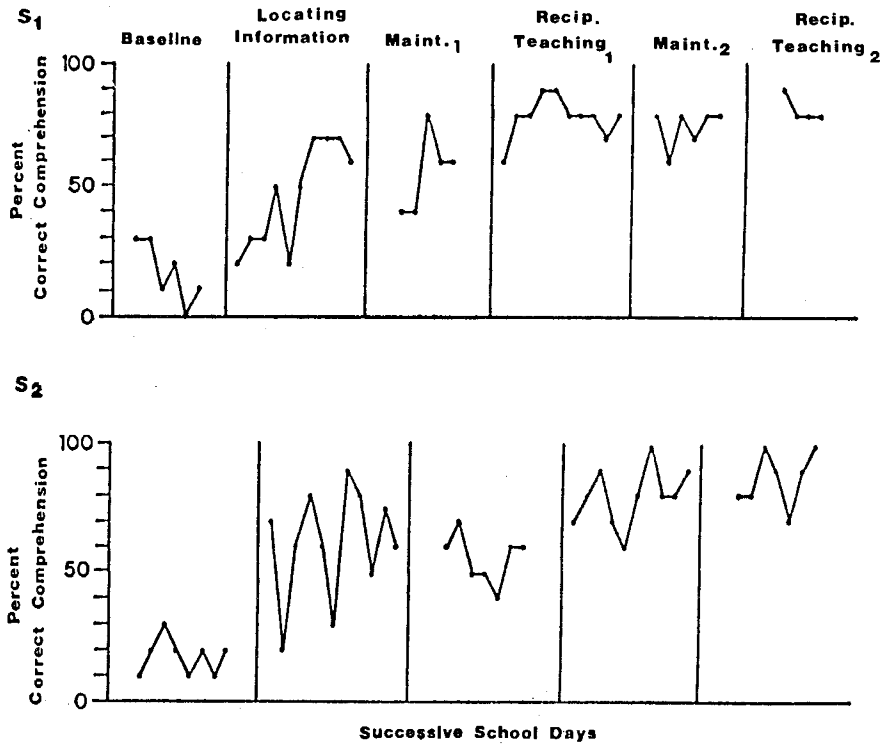
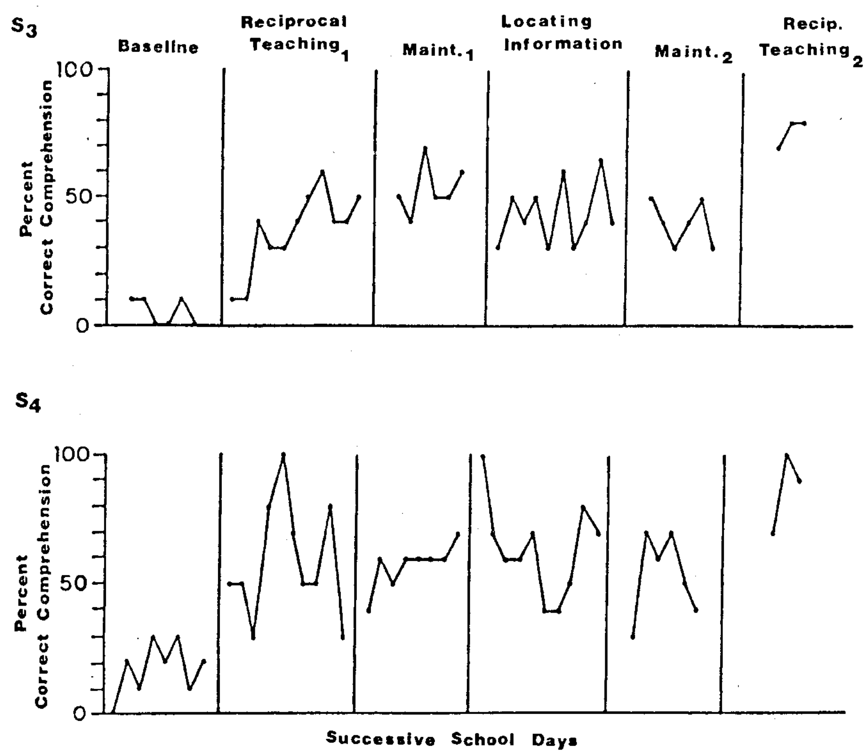


GROUP 1



GROUP 2

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