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VARIATIONS OF SELF-INSTRUCTION TECHNIQUE: EFFECTS ON BOYS' AND GIRLS' SELF-EFFICACY, ACHIEVEMENT AND PERSISTENCE

City University of New York PH.D. 1986

VARIATIONS OF SELF-INSTRUCTION TECHNIQUE: EFFECTS ON BOYS' AND GIRLS' SELF-EFFICACY, ACHIEVEMENT AND PERSISTENCE

by

Elizabeth Shper Mednick

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Abstract

VARIATIONS OF SELF-INSTRUCTION TECHNIQUE: EFFECTS ON BOYS' AND GIRLS' SELF-EFFICACY, ACHIEVEMENT AND PERSISTENCE

by

Elizabeth Shper Mednick

Advisor: Professor Shirley Feldmann

The purpose of the present study was to determine the effects of training in self-instruction on children's self-efficacy, achievement and persistence. It was hypothesized that this kind of intervention would be especially helpful in enhancing self-percepts of efficacy, and in increasing achievement and persistence. Self-instruction training was subdivided into combinations of its cognitive and verbal subcomponents in an attempt to understand what aspects of the technique are most influential in changing percepts of self-efficacy, achievement and persistence. It was hypothesized that when participation involved direct engagement performance would be best. The subject variables of gender, age and ability were hypothesized to interact with

treatment.

The sample consisted of 116 subjects in the fourth, fifth, sixth and seventh grades. One group of subjects received verbal self-instruction training. A second group were observers of those learning verbal self-instruction. A third group verbalized instructions to their cognitive modeling peers. A fourth group performed the cognitive modeling task while listening to instructions from peers. The fifth group received didactic instruction and served as the control.

Pretesting and posttesting were conducted in a small group situation. The testing booklets contained arithmetic problems in division. Half of them were actually worked, and the remaining half were used to obtain self-efficacy judgment information. Training was performed in pairs on the day following pretest, and it lasted for one session.

Multiple regression procedures were used to analyze the data. Results demonstrated that training in self-instructions significantly increased percepts of self-efficacy and achievement on an arithmetic problem solving task but did not differentiate treatment groups.

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I dedicate this dissertation to my husband, Bob, who has been a constant source of joy and happiness, and to my friends, Nancy Gallina and Marjorie Nicol, who have kept me laughing most of the way.

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CHAPTER I

REVIEW OF THE LITERATURE

An important concern of educators today is the understanding of the interrelationship of motivation and cognitive processes and its combined influence on student performance. Equally relevant is the study of what forms of instruction most influence motivation and cognitive processes and consequently result in optimal performance. Attempts are being made (Bandura, 1982; Corno & Mandinach, 1983; Schunk, 1981, 1982a) to unify learning, motivation and instruction into an integrated theoretical perspective. One question for educational research to consider is which instructional intervention best links motivation and learning. By studying the interrelationship from this perspective, the significant role motivation plays in learning can be better understood. Motivation is defined here as attempting and persisting on a problem-solving task.

The present research explores how variations in instructional interventions can influence the interdependent relationship of motivation and achievement. It considers the role that expectations play in task performance. It asks what kinds of interventions can be made and how they

can be manipulated to alter self-perceptions given that these perceptions can enhance or retard performance.

There are several theoretical models that stress the importance of self-appraisals on performance. One of these, the social learning model, postulates that self-appraisals are derived from self-observation of behavior and from external environmental influences.

Social Learning Theory

Social learning theorists, such as Bandura (1977b), stress the influential role of internal reasoning processes in learning and motivation. According to social learning theory, motivation and the acquisition of information are equally important. Bandura describes four major subprocesses which reciprocally influence each other. He suggests that there is an interdependent relationship between the cognitive processes, attention and retention, and the noncognitive processes, motivation and motoric responses. A change in any one of these four subprocesses will influence the others. According to Bandura (1977a), internal (mental) events and external (reinforcement contingencies) events combine to determine motivation. Motivation is determined by cognitive factors and cognitive factors are influenced by motivation.

Social learning theorists suggest that motivation variables are often potential contributors to variance in

student achievement. In order to understand the relationship motivation has with achievement it is important to study the variables that are the precursors to motivational processes. Many researchers (DeCharms, 1976; Deci, 1975; Harter, 1978; Rotter, 1966, Weiner, 1979) have studied the relationship of motivation to achievement in terms of perceived control of events. Perceived control of events can be characterized as one among many motivational variables that influence student achievement. This variable has been studied from such varying theoretical perspectives as social learning theory, attribution theory and intrinsic motivation theory (see Stipek & Weisz, 1981 for review). For the most part, perceived control of events is the belief a person has that an outcome is contingent on his or her own behavior.

Social learning theorists such as Rotter (1966, 1975) use the construct 'locus of control'. Locus of control can be defined as a generalized expectancy that an outcome is either the result of one's own behavior (e.g. ability, effort) or the result of factors beyond one's control (e.g. luck, task difficulty, influence of others). An expectancy is determined both by experiences within the specific situation and by experiences in other situations that a person perceives as similar. Rotter suggests that children's behavior in achievement situations is influenced by their perceptions of control. He hypothesizes that a

child with an internal locus of control will have higher achievement and this in turn will increase attention and persistence.

In contrast to studying motivation and its relationship to acheivement in terms of locus of control, other social learning researchers (Bandura, 1982; Bandura & Schunk, 1981; Schunk, 1981) conduct investigations via the construct of 'self-efficacy' which was originally proposed by Bandura (1977a, 1982). Research from either perspective shares the assumption that self-referent thought, that is, cognitive self-appraisals of performance, is a key ingredient to understanding psychological functioning. One of the aims of the present research is to find out how instructional interventions can affect percepts of self-efficacy. A further elaboration of self-efficacy theory follows.

Self-Efficacy

According to self-efficacy theory (Bandura, 1977a) perceptions of self-efficacy determine what activities people decide to engage in, the environmental setting they choose, how long they will persist on a particular activity and how much effort they will expend. Bandura uses the construct of self-efficacy to describe the important role people's expectations play in their behavioral functioning. The construct assumes that changes in expectations of personal efficacy are brought about by psychological procedures which provide people with corrective learning experiences. Different

treatments change behavior in part by creating and strengthening percepts of self efficacy. One such treatment, for example, would be the mastery of tasks of increasing difficulty. Bandura (1977b) describes two types of expectations: 1. an outcome expectation is " a person's estimate that a given behavior will lead to certain outcomes; 2. an efficacy expectation is the conviction that one can successfully execute the behavior required to produce the outcomes. Outcome and efficacy expectations are differentiated because individuals can come to believe that a particular course of action will produce certain outcomes, but question whether they can perform those actions" (p. 79).

Even when a person knows the demands of a task and has the necessary skill to carry out the task, performance may still be poor because self-referent thought mediates the relationship between knowledge and action (Bandura, 1982). People's judgments of their capabilities affect their motivation and their behavior.

Judgments of self-efficacy are enhanced through four major sources of social learning (Bandura, 1977b). Since judgments cannot be changed through conversation alone, self-efficacy is changed through a hierarchy of influencing factors. First, self-efficacy is most influenced by one's knowledge of prior performance in similar situations. Past successes raise expectations and past failures lower expectations. This view is similar to the view held by goal-setting theorists

(Locke, Saari, Shaw & Latham, 1981). Goal-setting theory proposes that individuals set higher goals after success and lower goals after failure. However, while each theory deals with expectations, goal-setting has to do with general aspirations while self-efficacy has to do with judgments within the current situation.

Second, self-efficacy expectations are also derived from vicarious experiences. Watching similar others perform tasks successfully can raise mastery expectations and watching others fail can lower expectations. Brown & Inouye (1978) investigated the role of perceived competence of the subject to a model in developing helplessness. Modeled helplessness greatly influenced subjects' judgments of self-efficacy. When subjects saw themselves as superior to the model their persistence increased. When they believed they were of similar competence their persistence and self-efficacy went down.

Third, self-efficacy appraisals are also influenced by verbal persuasion. Hearing others persuade a person into believing that he or she can succeed can raise expectations of self-efficacy. However, this particular source of information is assumed to be short lived in its influence.

And fourth, emotional arousal can influence efficacy expectations. When people are tense or aversively affected, performance will not be as good. People will

have higher expectations in situations where they are not highly aroused. In addition to these four major sources of information influencing self-efficacy expectations, situational circumstances can also be influential.

Self-efficacy theory (Bandura, 1982) predicts that active engagement in activities promotes development of skills and of self-efficacy. Yet, even in enactive contexts, judgments of self-efficacy are not based only on information from past performances. For example, Bandura & Schunk (1981) found that judgments of self-efficacy were enhanced when children set attainable subgoals as compared to distant goals or no goals. Schunk (1983a) found that judgments of self-efficacy were enhanced when children were given 'ability feedback' as compared to those given 'effort feedback' or to the no feedback condition. In another study, Schunk (1983b) found children who were given social comparative information about the number of problems solved by other children on the same task along with being given specific proximal goals had enhanced self-efficacy to children receiving only specific proximal goals. In another experiment (Schunk, 1983c) the relationship between tangible, extrinsic rewards and percepts of self-efficacy was examined. Schunk found that rewards offered for performance attainments increased percepts of self-efficacy whereas offering rewards for task participation did not

increase perceived self-efficacy.

Appraisals of self-efficacy by a learner involve an inferential process in which there is a weighting of many contributing components, such as perceptions of ability, task difficulty, amount of effort expended, type of help received, situational circumstances and pattern of previous successes or failures (Bandura, 1981). Self-efficacy expectations vary on three dimensions (Bandura, 1977a), all of which have implications for performance: 1. Magnitude, or the relative difficulty of the task compared to other tasks in a hierarchy. 2. Strength, or how extinguishable expectations are when a person is faced with disconfirming experiences. 3. Generality, or the relative degree of specificity or generalizability of expected mastery.

Recent research has shown that children's judgments of self-efficacy are highly predictive of their overt performance (Bandura & Schunk, 1981; Schunk, 1981, 1982a, 1982b, 1983a, 1983b, 1983c; Salomen, 1984). If a person's judgment is one of feeling highly efficacious, he or she will use more effort to master a task. Increased effort results in higher achievement (Bandura & Schunk, 1981; Brown & Inouye, 1978; Schunk, 1981; Weinberg, Gould & Jackson, 1979). On the other hand, if a person's judgment of efficacy is low, then there is a tendency to dwell on thoughts of being incompetent

and to imagine tasks to be more difficult than they really are (Beck, 1976; Lazarus & Launier, 1978; Meichenbaum, 1977; Sarason, 1975).

Some studies (Zimmerman & Koussa, 1975, 1979) have demonstrated that observing a model influences children's value judgments. Other studies have investigated how providing children with attributional feedback modifies achievement (Andrews & Debus, 1978; Chapin & Dyck, 1976; Dweck, 1975). Attributional feedback refers to giving subjects information about whether their performance is the result of ability, effort, task difficulty or luck. Schunk (1981) studied the change in self-efficacy brought about by the combined social influence of observing a model and of receiving attributional feedback. He looked at the relationship between self-efficacy and achievement within the context of an arithmetic task. One group of children was provided an adult model who verbalized the cognitive operations involved in an arithmetic problem-solving activity. Another group received the same didactic instruction but was not provided with a model. There was also a control. All children who participated in the study had a history of poor math achievement. A practice period followed training during which half the children from each group received effort attribution. These children were told that their successes were the result of high effort and their failures a matter of not enough effort.

The results from the study demonstrated that children who received either modeling or didactic instruction judged themselves more efficacious than those who did not receive either treatment. They also persisted longer and showed improved performance. The modeling group's performance was raised significantly more than the didactic group. The treatments however did not differentially affect self-efficacy. While there was no evidence found that attribution within modeling improved persistence there was a relationship between persistence and self-efficacy. Children who judged themselves more efficacious in the context of arithmetic problems also persisted longer. These results suggest that treatment effects on persistence come about by way of changes in self-efficacy. In addition, the data demonstrated that as self-efficacy increased so did accuracy.

Self-efficacy theory predicts that active engagement in activities can result in enhanced self-efficacy more than other kinds of intervention (Bandura, 1982). Depending on the instructional procedure, self-efficacy can be raised or lowered to varying degrees. One intervention next described, and one used to test self-efficacy theory, has been modeling instruction.

Modeling

Modeling studies that have tested self-efficacy theory consider differences in direct versus observational

performance on tasks. Subjects are assigned to a treatment condition where they observe a model perform a task or to a condition where they actively participate in a modeled task. Chief among these studies is Bandura's work with snake phobics (Bandura, 1982; Bandura, Adams & Beyer, 1977). Bandura, Adams and Beyer (1977) assigned severe snake phobics to either a participant modeling condition, where subjects actually participated in a hierarchy of increasingly more difficult 'snake' experiences; a modeling alone condition, where subjects watched the model go through a hierarchy of experiences; or to no treatment. Subjects in both the enactive group and those in the observing model group did better than those with no treatment, but those in the participant modeling group had higher, more generalized and stronger expectations of self-efficacy than the modeling alone group.

Self-Instruction

One possible way to promote self-efficacy is through training in self-instructions. Self-instructional technique teaches children verbal strategies helpful to self-guidance of their own behavior. Self-instructional intervention requires active participation and may therefore be a particularly good training method to raise percepts of self-efficacy. Self-instruction is often interchangeably named 'cognitive behavior therapy', 'verbal mediation', 'covert self-control' and 'self-verbalization'. The Soviet psychologists Luria (1961) and Vygotsky (1962) were major

contributors to the study of children's self-talk. Vygotsky (1962) described a developmental sequence where audible talking gradually becomes internalized talking. Vygotsky hypothesized that the primary function of 'talking to oneself' was self-guidance. Luria (1961), a student of Vygotsky, studied the effects of self-talk by providing children with verbal self-instructions as they performed tasks in a laboratory setting (See Meichenbaum, 1975; Meichenbaum & Goodman, 1976; and Wozniak, 1972, for a more detailed presentation of the Soviet position).

Self-instruction techniques are typically used to help children control their own behavior. Training in self-instruction is very similar to earlier modeling instruction studies (Bandura, 1965). The difference is that with self-instruction technique, the subject not only carries out the behavior of the model but also verbalizes self-directions. Self-instructional procedures emphasize the functional relationship of language, thought, and behavior.

A prototypic example of studies using techniques like these is Meichenbaum and Goodman's 1971 study. In their research self-instruction training was used on a Matching Familiar Figures Test selected sample. The population included kindergarten and first grade children. Children were assigned to either a cognitive

self-instruction training condition, a modeling condition or to a control. Both training groups displayed significant increases in response latency compared to a control but only the self-instruction training group had obtained a decrease in errors.

Meichenbaum (1975a, 1977) and Meichenbaum and Goodman (1971) offer an outline to the five stages of self-instructions. In the first stage, 'cognitive modeling', the adult models a task associated with successful performance while talking to himself or herself aloud. In the second stage, 'overt external guidance', the child performs the same task as the one just modeled while the adult gives instructions aloud. During stage three, the child performs the task while saying the directions aloud, and in stage four, the child again performs the task while whispering the instructions. Finally, in the last stage, 'covert self-instruction', the child performs the task with, it is assumed, guidance from private speech.

The effectiveness of using a self-instructional approach has primarily been evaluated on children who have been identified as aggressive, impulsive, hyperactive, lacking self-control or having behavior problems (Bender, 1976; Bornstein & Quevillon, 1976; Cohen, Meyers, Schlesser, & Rodick, 1982; Cullinan, Epstein & Silver, 1977; Kendall & Finch, 1978; Meichenbaum & Goodman, 1971). Other populations on which self-instruction training has been successful include socially withdrawn children (Gottman, Gonso &

Rassmussen, cited in Meichenbaum, 1977) and adult schizophrenics (Meichenbaum & Cameron, 1973).

In a study of the role of expectations and its relationship to internal versus external monitoring, Bugenthal, Whalen & Henker (1977) studied 36 hyperactive and impulsive boys between the ages of 7 and 12. Half of the subjects were given methylphenidate (Ritalin). Treatment was conducted twice a week for a total of 16 sessions. Children were assigned to either a self-instruction or a contingent social reinforcement condition. The results demonstrated that when children's attributional styles were congruent with their treatment (high internal control-self instruction training or high external control-social contingency management) they achieved better on the Porteus Maze Test than those in the noncongruent condition. The data further revealed that those who were not medicated did better with self-instruction training while those who were on medication did better with social contingency management.

In addition to attributional style and medication status interacting with treatment approach, other self-instruction studies have found several subject variables interacting with treatment. Copeland (1981) reviews the relationship of subject variable with self-instruction training and concludes that a broad age range of children do benefit from self-instruction training with those who are younger doing better when training is more structured

and concrete. Research conducted by Cohen et al. (1982) indicated that cognitive level as defined by Piagetian stages of cognitive development (preoperational versus concrete operational) interacted with different types of training. Braswell, Kendall, Braith, Carey and Vye (1984) found that child involvement was an important variable. Those perceived as most actively involved were also those whose behavior improved most based on teacher ratings. Sex as a subject variable has rarely been considered in the literature on self-instruction training. This is probably due to the high proportion of males existing in the populations typically chosen for these studies.

Within the self-instruction literature, modeling alone has been compared to modeling with self-instructions. For example, as already described, Meichenbaum and Goodman (1971) found that only the modeling-with-self-instruction group showed a significant decrease in errors as well as an increase in latency. At variance with these results are the findings from a study conducted by Denney (1975). Denney assigned 6, 8 and 10 year old children to one of three treatment conditions or to a control. Conditions included cognitive modeling with self-rehearsal, where the child verbalizes a strategy and participates in the task; cognitive modeling, where the model verbalizes the strategy and the child participates in the task; and exemplary modeling, where the child participates in the task. Using

the game 'twenty questions' an attempt was made to get children to ask more constraint seeking questions ('Is it an animal?') rather than interrogative questions ('Is it a dog?'). The results indicated that cognitive modeling with self-rehearsal was not more effective than exemplary modeling and it was less effective than cognitive modeling.

Summary

Several key ideas are especially relevant to the present research. First, research to date has indicated that enhanced self-efficacy increases persistence and heightens performance. Second, according to self-efficacy theory, direct engagement in a task enhances self-efficacy more than any other psychological procedure. Third, self-instruction technique requires active engagement with the task and therefore may be a particularly helpful tool for influencing self-percepts of efficacy. Fourth, the effectiveness of self-instruction training is influenced by its interaction with subject variables such as age, gender and ability.

Pilot Research

In an unpublished study, Mednick (Note 1) looked at the effects self-instruction technique had on normal children's self-efficacy, achievement and persistence within the context of a problem-solving task. Children in the fourth, fifth and sixth grade of a New York City public school were randomly assigned to one of three

treatment conditions or a control. Testing was done in a group situation within the child's own classroom. Subjects in all groups were first given an arithmetic (division) pretest. Following its completion a self-efficacy judgment task was administered. This task required the child to choose from a graduated scale ranging from 10 to 100 of self-efficacy judgment on increasingly more difficult division problems. These problems corresponded to but were not identical to those on the arithmetic pretest. Subjects were asked to judge privately their ability to solve each problem and to put an 'X' on the box which best showed how sure they were that they could solve the problem. The treatment conditions included a direct self-instruction group where children performed a task while verbalizing, a vicarious self-instruction group where children worked the problem as they listened to the direct group talk through the steps, and didactic instruction group where children were given the same training booklet as those in the other treatment conditions but were only told to study the sample problems and then to continue to solve remaining problems. Following training a self-efficacy posttest was administered. The self-efficacy posttest asked that after each presentation of a division problem, the subject should check the box which best matched how capable he or she would be in finding the solution. Following these judgments a parallel form to the arithmetic pretest was administered.

Overall, the results were consistent with predictions that self-instruction training enhanced self-efficacy and this would in turn increase accuracy and persistence. When comparing subjects from all groups, those in the vicarious self-instruction condition did best. These results were at variance with the hypothesis that it would be those in the direct self-instruction training group who would do best. While this research did not include data on individual ability level, it was found that the group who had the lowest mean achievement also did best with direct self-instruction. In considering age, the oldest children, those in the sixth grade gained the most. Those in the fifth grade were next and those in the fourth grade benefitted least from the training. Among the oldest group of children, those in the vicarious group did better than those in the direct group. From these results it appears that as children progressed in age they also benefitted more from self-instruction training. It also seems that there is a relationship between age and type of self-instruction training.

While the study did not predict sex differences, serendipitous findings did emerge. First, the girls' data strongly supported the original hypotheses, i.e. those girls in the direct self-instruction training group did significantly better on the self-efficacy scores than girls in the other groups. Enhanced scores were related

to increases in accuracy and persistence. Second, when comparing girls to boys, the girls began with higher scores on pretest and ended with higher scores on all measures at posttest. Third, while there was a significant increase in both the boys' and the girls' self-efficacy, the boys' self-efficacy change was almost four times greater than the girls. Still, only the girls had significant increases in accuracy and a tendency to increase persistence. For the boys, even though their self-efficacy sharply increased, their accuracy went down and there was no change in their persistence.

The results from this study again demonstrate the important need to consider individual differences when conducting research in this area. This sample, drawn from a normal population, benefitted from self-instruction training that enhanced self-efficacy. Some children did better with direct self-instructions, here, for example, low achievers and girls (regardless of ability level). Others did better with vicarious self-instructions, in this sample, fifth and sixth graders. Vicarious self-instruction in this study is very similar to what could be called a modeling condition. The difference, however, is that the children are not only watching and listening to an adult model but are also watching and listening to their classmates as they carry out the tasks necessary for successful performance.

It is interesting that while there were no predicted differences between males and females, still differences were significant. A logical way to understand these findings and interpret them is to turn to the literature on gender differences.

Gender Differences

As was stated earlier, people with positive perceptions of their efficacy approach tasks with higher expectations for success and consequently perform better (Bandura, 1977; Battle, 1965; Eccles, 1983). It is also believed that females tend to have lower estimates of their ability, performance and expectations regarding future performance. This is true even when their actual performance is equal to or better than males (Crandall, 1969; Meece, Eccles-Parsons, Kaczala, Goff & Futterman, 1982; Parsons, Ruble, Hodges & Small, 1976). Laboratory studies generally have found females from as young as eight to have lower initial expectancies on novel tasks than males (Crandall, 1969; Dweck & Bush, 1976; Montanelli & Hill, 1969; Parsons & Ruble, 1977). When tasks are familiar or when actual school subjects are used findings have been inconsistent (Parsons & Ruble, 1977; Stein, 1971). When expectancies on specific math tasks are compared to expectancies

for future math performance, findings have also been inconsistent (Fox, 1975; Fox, Brody & Tobin, 1979; Heller, Futterman, Kaczala, Karabenick & Parsons, 1978; Stein, 1971). Frieze, Fisher, Hanusa, McHugh and Valle (1978) suggest that a distinction between specific and generalized expectancies needs to be made. They propose that females have lower generalized expectancies than males. However, females' specific expectancies, like males, are based on their past experiences of success or failure on other similar tasks.

Sex differences in estimations of ability, performance and expectations seem to be task specific. When the sex appropriateness of the task is controlled, females expect to do less well on male-typed tasks but as well as males on 'feminine' or neutral tasks (Gitelson, Peterson & Tobin-Richards, 1982; McHugh, Frieze & Hanusa, 1982; Stein & Smithells, 1969). Males and females have greater expectations when tasks are perceived as more appropriate for their sex. Since it has been found that children tend to sex type math as a male domain (Eccles, 1983; Fennema & Sherman, 1978; Stein & Smithells, 1969) then boys should be more confident in math.

In addition to boys being more confident in math it has also been suggested that males have more mathematics ability (See Maccoby & Jacklin, 1974, for review). However there is increasing evidence that when studies are carefully

controlled little difference in ability is present (Fennema, 1974; Fennema & Sherman, 1978; Sherman, 1979), that biological differences cannot be substantiated (Sherman, 1978) and that the source of variance in sex-related differences can be attributed to differences in training and practice (Angoff, 1971). What differences do exist between males and females on math tasks are not the result of differences in ability but instead are a matter of socialization differences (See Block, 1984).

A recent study by Gold, Crombie, Brender & Mate (1984) is one example of research demonstrating that differences in boys' and girls' socialization lead to differences found in cognitive functioning. These researchers hypothesize that boys are typically encouraged to rely on their own independent efforts. Girls, on the other hand, are given less freedom and are socialized into a world that is more controlled by adults. Therefore, girls tend to rely more on adults than boys do. To test this hypothesis they conducted an experiment to see whether girls would be more adversely affected than boys when an adult model's responses were misleading or when one's own prior experiences were misleading. Children were randomly assigned to either a model learning or a trial and error

learning condition. There was also a control. In the model learning condition, the subject was taken into a room to play a game involving the winning of pennies. The subject observed the model win a penny every time she pressed the response key (clown's nose) while the light was on. In the trial and error condition the task was the same but it did not include modeling. Once the child had made ten successful trials, the experimenter left the room and the contingency was reversed. The results from this study demonstrated that observation of the model's misleading task performance had greater interference on the girl's performance than on the boys. Moreover, when the subject's self-taught prior learning was misleading there were no differences between girls and boys. These results give support to the hypothesis that girls are more reliant upon adults in problem-solving situations. These results are consistent with prior reviews of the literature suggesting girls to be more dependent upon adults than boys (Caplan, 1979; Maccoby & Jacklin, 1974).

The results from Mednick's (Note 1) study give further support to Gold et al, (1984) hypothesis. Girls' self-efficacy and accuracy significantly

increased when they were aided by an adult. This was especially the case when they actively participated in the training. Boys, however, while they thought they would do better, actually showed a decrease in performance when aided by an adult.

Summary of Pilot Research

Overall results from this study demonstrate the important need to consider individual differences and their interaction with treatment conditions. This sample, drawn from a normal population of 4th, 5th and 6th grade children benefitted from self-instruction training. This technique influenced self-efficacy, accuracy and persistence.

Studying the effect of self-instruction training on children's self-efficacy was the primary purpose of Mednick's (Note 1) pilot study. This particular training approach had not heretofore been empirically studied as a vehicle to test self-efficacy theory. It was felt that since the technique requires active participation it would be an especially powerful procedure for enhancing self-percepts of efficacy. Some children did better when the self-instructions involved active vocalization (low-ability children, and girls, regardless of age or ability). Others did better with vicarious self-instructions (older children).

Breaking down self-instruction treatment into vicarious vs. direct training groups was done in an attempt to partial out the verbal component of the self-instruction task into 'active' and 'passive' conditions.

It was predicted, in accordance with self-efficacy theory, that those directly participating in the verbalizations would do better than those in the vicarious group. The results demonstrated that this was true for only certain groups of subjects in the sample. Others did better when listening to but not vocalizing the verbalizations. Perhaps for some children the process of actively working on the problem when combined with the process of actively engaging in the verbalizations interferes with performance. For example, for those who already have an effective strategy for solving division problems, learning an alternate strategy may retard performance.

One question relevant to these results is whether the overt verbalizations are guiding behavior as they are intended. Vocalizing a series of instructions to oneself is not helpful unless these instructions are meaningful. Whether or not these instructions become meaningful may depend too on the complexity of the motoric demands of the task. On the task used in this study, the motoric demands required the writing down of numbers using a long division format. Distinctions between the verbal and behavioral aspects of the task are not easily made because of their strong interdependence.

While this study separated out direct versus vicarious verbalizations in an effort to test Bandura's theory (1977a, 1982), it did not consider differences in direct versus vicarious motoric performance. It is expected that

when participation is direct at both the verbal and motoric levels, self-efficacy will be most enhanced.

CHAPTER II

THE PROPOSED STUDY

Statement of the Problem

The present research was designed to find out whether boys' and girls' self-efficacy, their division performance and their persistence on task were each enhanced through self-instruction training or variations of this technique. Another question was whether the way self-instructional intervention was presented, for example, directly or vicariously, would contribute differentially to subsequent performance. In addition, the subject variables of gender, age and ability were explored for their interaction with treatment levels.

According to Bandura's theory (1977a, 1982), perceived self-efficacy is most influenced by performance accomplishments. These accomplishments are influenced by cognitive appraisal of a number of factors such as level of prior knowledge, task difficulty, perceptions of ability, amount of effort expended, type of help received, situational circumstances and pattern of previous successes or failures (Bandura, 1981). One concern of the present

research was to break down the motor and verbal elements of self-instruction technique to see which elements were more important in influencing cognitive appraisal of performance. This study also investigated the influence of the motoric and verbal aspects of direct or vicarious experience in creating efficacy expectations. This was tested within the context of an arithmetic performance task.

Equally important to this study was an investigation of what components of self-instructional technique most influence task performance and persistence on task. Information on the enactive versus observational elements and on the verbal versus motoric aspects of this instructional intervention were of particular interest.

The present investigation was designed to adjust for some of the assumed weaknesses of the pilot research. For example: 1. The pilot study did not consider the ability level of the subjects. 2. While trends existed in the analysis of children's persistence, no significance was found. The scoring system for the persistence measure marked answers as 'all right' when any attempt at all was made at finding the solution or as 'all wrong' when no attempt was made at finding a solution. In addition, there were a total of only eight division problems on the division tests. Both of these factors may have contributed to a scoring system which was not

sensitive enough. 3. All groups, including the control, had inflated self-efficacy scores. Perhaps an inflated score reflected the imprecision of the test instrument. For instance, on a scale of 10 to 100, most of the scores clustered around the 70 to 80 category. In an item analysis of the self-efficacy measure, individual by individual, it seemed that very few children were consistently honest in how they scored themselves. For example, there were large fluctuations in the accuracy of division problems worked with the corresponding self-efficacy judgments. Some children could answer the problems when they judged they could not. More often, children voted that they were certain they could answer a division problem when in fact, they could not. The experimenters also felt that the measure was somewhat confusing especially for the youngest group of children. Therefore, an objective of the present research included the development of an improved self-efficacy measure that would better reflect an honest self-appraisal from the children.

In the study under investigation presently, it was expected that children in any of the training groups would outperform the didactic instruction group. Among the four self-instructional treatments, a modeling component, be it participant or observational, was present in each case. This was not true for the didactic instruction group. Children receiving self-instruction

training when there was both direct cognitive modeling and direct self-verbalizations were expected to do better than children in all other training groups. In the groups which differed in the type of activity they participated in, it was expected that those who were directly involved at the cognitive modeling task would outperform those directly involved with the self-rehearsing task. Both of these groups were expected to outperform those whose experience was vicarious at both levels. These expectations were based on the findings of previous research (Bandura, 1977b), which has already confirmed that participant modeling is superior to vicarious experience alone.

Bandura (1977b) theorizes that when conceptual skills or verbal skills are underdeveloped, observers benefit more from behavioral modeling, where they actually watch the task being carried out, than from verbal modeling, where they are told what is to be carried out. This research theorized that direct involvement in the cognitive modeling would enhance self-efficacy more, raise division performance more and increase persistence more than direct involvement in the verbalizations for children from the younger age group and those from the low ability group.

The literature is at variance on the importance of verbalizations in self-instructional learning. In Denney's (1975) study, verbalizations got in the way

of learning new tasks when the verbalizations were vocalized but enhanced performance when verbalizations were listened to. In contradiction, Meichenbaum and Goodman (1971) found that overt verbalizations used while working on a task enhanced performance. Hetherington (1971) found that verbal cues worked best for low ability children but that they probably interfered with the mediational processes of high ability children. One of the objectives of the present study was to analyze the affect of verbalizations on cognitive performance.

Objectives

The following objectives were set for the study:

1. To find out if self-instructional training and/or a variation of this technique enhance self-judgments of one's capability to perform an arithmetic activity.

2. To find out if self-instructional training and/or a variation of this technique increase performance on a division task.

3. To find out if self-instruction training and/or a variation of this technique increase persistence on a division task.

4. To find out what components of training, for example, verbal or motoric and participant or observational, are most important to promoting achievement.

5. To find out how the subject variables of age, ability and gender interact with treatments.

6. To find out how self-rehearsing instructions compares to listening to a peer self-rehearse instructions.

7. To find out how participating in task compares to watching a peer participate in the task.

8. To find out what combination of direct and vicarious experience in verbal and motor performance is most likely to enhance self-efficacy and increase achievement.

Experimental Hypotheses

The first set of hypotheses (1-4) test whether self-instructional training or a variation of this technique is an effective vehicle for enhancing self-efficacy, heightening performance and increasing persistence. The second set of hypotheses (5-10) test which treatments are best. The third set of hypotheses (11-19) consider subject variables and how they interact with type of training.

1. Children's perceptions of self-efficacy are enhanced following self-instruction training or a variation of this technique.

2. Children's division performance is increased following self-instruction training or a variation of this technique.

3. Children's persistence is increased following self-instruction training or a variation of this technique.

4. Each treatment group outperforms the didactic instruction group on all three dependent measures.

The next set of hypotheses tested which self-instructional treatment was most effective in enhancing self-efficacy, accuracy and persistence.

5. Children directly engaged in the cognitive and/or verbal aspects of the task outperform those vicariously engaged in the cognitive and verbal aspects of the task on all three dependent measures.

6. Children directly engaged in the cognitive task as they listen to their partner's instructions outperform those children who self-rehearse, that is, talk through the verbal instructions as they observe their peer partner perform the cognitive task on all three dependent measures.

7. Children who self-rehearse while watching their partners work the cognitive task outperform those children who are observing their partner work the task and listening to their partner self-rehearse the instructions on all three dependent measures.

8. Children who are directly engaged in the cognitive task as they listen to their partners's verbal instructions outperform those who are observing their

partner self-rehearse the instructions on all three dependent measures.

9. Children directly engaged in both the cognitive task and the verbal task outperform those directly engaged in only the motor task as they listen on all three dependent measures.

10. Children directly engaged in both the cognitive and verbal tasks outperform those directly engaged in only the verbal task as they watch on all three dependent measures.

The next set of hypotheses tested gender differences and how they interact with treatment.

11. Boys and girls will significantly differ on all three dependent measures with girls benefitting more from self-instructional treatment.

12. Boys who directly participate in both aspects of the task will outperform those in groups where there are combined vicarious and direct elements or where there are only vicarious elements on all three dependent measures.

13. Girls in treatment groups where there is a combined vicarious and direct element will outperform those in groups where the task is direct at both levels or where it is vicarious at both levels.

The next set of hypotheses tested how subjects' ability interact with treatment.

14. Low-ability children will differ significantly from high-ability children on all three dependent measures with low-ability subjects benefitting more from self-instructional treatment.

15. Low-ability subjects in the direct cognitive and/or verbal group will outperform low-ability children in the vicarious group on all three measures.

16. High-ability subjects in the vicarious cognitive and/or verbal groups outperform high-ability subjects in the direct group on all three dependent measures.

The last set of hypotheses tested how age interacts with treatment.

17. Younger and older children will significantly differ on all three dependent measures, with younger children benefitting more from self-instructional treatment.

18. Younger children in the direct cognitive and/or verbal groups will outperform younger children in the vicarious group on all three dependent measures.

19. Older children in the vicarious cognitive and/or verbal groups will outperform older children from the direct group on all three dependent measures.

CHAPTER III

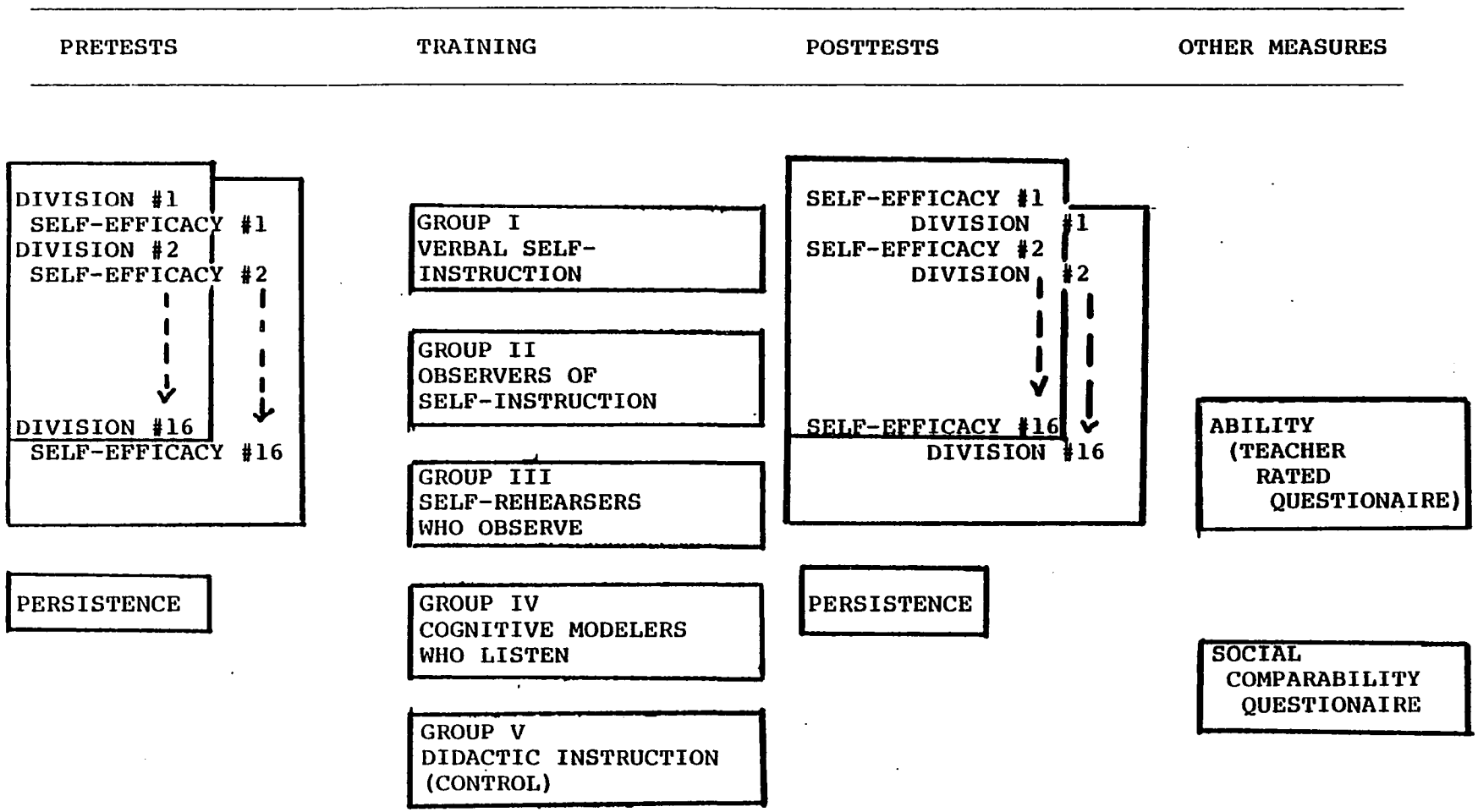
METHOD

The present study was conducted over the summer of 1985. Children were assigned to one of four treatment groups or to a control. There were three phases to the experiment: pretesting, training, and posttesting. In addition, information was gathered from the subject's teachers on their math ability and from the subjects on social comparability, as discussed later in the chapter. Figure 1 outlines the phases of the experiment.

Subjects

The sample consisted of 116 children from a total of ten classrooms in four different public schools in New York City. The subjects were black and Hispanic and came from low socioeconomic families. Children who had just completed the fourth, fifth, sixth or seventh grade were asked to participate and those who had obtained written parental permission were included. Initially 130 children had gone through pretesting and training, however, fourteen children were absent on the day of posttesting and had to be dropped from the study. This resulted in unequal cell sizes in what were initially equal samples within

Figure 1
Phases of the Experiment



within each dyad. The mean chronological age for the final sample was 11.7.

Random assignment to treatment groups was assured by using a variety of colors on the topsheet of the testing booklets. Booklets were presorted so that they were distributed blue, yellow, pink, green, white, blue, yellow, pink, green, white. Those children receiving the blue booklets were assigned to Group I (verbal self-instruction training). Those children receiving yellow booklets were assigned to Group II (observers of self-instruction). Those children receiving pink booklets were assigned to Group III (self-rehearsers who observed their cognitive modeling partners. Children receiving green booklets were assigned to Group IV (cognitive modelers who listened to their self-rehearsing partners). Children receiving white booklets were assigned to Group V (didactic instruction/control).

Pretreatment Measures

Arithmetic Performance Task

The arithmetic task consisted of sixteen division problems with one, two or three digits in the divisor and from two to five digits in the dividend. Each problem was presented on a single page and problems were increasingly more difficult. The subjects were asked to look at each sheet, solve the problem and when

completed or when they decided to try no further, to turn the page and continue with answering the self-efficacy question.

Self-Efficacy Judgment

The self-efficacy task consisted of sixteen self-efficacy questions. A level of efficacy immediately followed every division problem. The subject was presented with a division problem similar to the one he or she had just worked on the preceding page. Subjects were asked to only look at the problem for a couple of seconds and were told not to actually work the problem. A grid was drawn around each self-efficacy division problem to serve as a reminder that those problems were not to be worked. Subjects were asked instead to judge privately their ability to solve a problem like the one they were viewing on that page and after briefly looking at it to check the box which best represented how sure they were that they could solve a problem like that one. Subjects were asked to be honest with their appraisals and to check the box which best illustrated how they felt just at that moment. There were five boxes to choose from. The boxes were scaled by number, with verbal descriptors and with pictures.

In the pilot study, the self-efficacy measure

similarly asked subjects to pick the box which best matched how sure they were that they could answer a problem like the one viewed. However, for the present measure five boxes were used rather than ten. Secondly, instead of a scale from 10 to 100 which is the same scale used by teachers for tests in the classrooms and may sway children toward an inflated score, numbers of one to five were used here. Third, verbal descriptors were now placed under each box rather than under half of the boxes. Fourth, pictorial descriptors were displayed under each box to help assist subjects in understanding the task.

The pretest measures were administered in a small group situation. Subjects were shown sample problems of one digit addition at the chalkboard to assure their understanding of how to carry out each task.

Treatment Conditions

Verbal Self-Instruction (Group I)

Subjects assigned to Group I participated in the arithmetic task while verbalizing the instructions for carrying out the task, as described on page 43.

Observers of Self-Instruction (Group II)

Subjects assigned to Group II observed their peer partners from Group I who were performing the task and

simultaneously self-rehearsing, as described on page 43.

Self-rehearsers who Observe their Cognitive Modeling Peer Partner (Group III)

Subjects assigned to Group III observed their peer partners perform the cognitive modeling task. Subjects in Group III self-rehearsed, as described on page 45.

Cognitive Modelers who Listen to their Self-Rehearsing Peer Partner (Group IV)

Subjects assigned to Group IV listened to the instructions of their self-rehearsing peer partners. Subjects in Group IV participated in the cognitive modeling task. This is described on page 45.

Didactic Instruction (Group V)

Subjects in this group were told to first study the two sample problems in their training packet and then to continue answering the remaining problems.

Experimental Assignments

Following pretests, children were called out of the room, two at a time according to the colors of their topsheets. A girl with a blue topsheet was paired with a girl with a yellow topsheet. A girl with a pink topsheet went out with a girl with a green topsheet. A girl with a white topsheet went with the same. Boys were matched in the same way.

Instructional Material

All subjects received the same arithmetic training packet. The packet included ten division problems. Each one was presented on a single page. The first two problems were samples and all work was shown with the solution. Accompanying each of these samples were written explanations on how to solve the problem.

Experimenters

Two white, female graduate students conducted all phases of the research. Each experimenter alternately trained children in Dyad 1 and children in Dyad 2.

Procedures for Training

The training phase of the experiment was conducted on the day following pretesting. The instructional procedures included five steps for those in Group I, II, III and IV. The steps followed were dependent on the experimental assignment. Figure 2 outlines the procedures for each group. The five-stepped increments match Meichenbaum and Goodman's (1971) original verbal self-instructional delineation only in Group I. Group II, III and IV represent variations of Meichenbaum and Goodman's technique.

Children were trained in pairs. Dyad 1 included a child from Group I and a child from Group II. Dyad 2 included a child from Group III and a child from Group IV. All paired partners were of the same sex and

grade and from the same class.

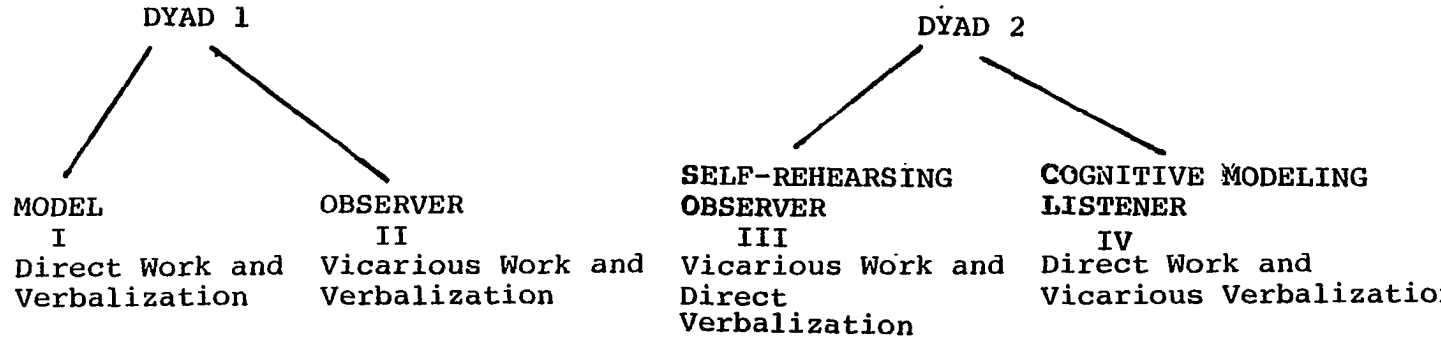
Dyad 1

The experimenter told the paired children that they would be learning a new way to solve arithmetic problems. Each pair shared a training booklet. At step one of the five step procedure outlined in Figure 2, the children were seated on either side of the experimenter who worked sample problems one and two while talking through the steps of the division task. Four task-specific statements were used in solving each problem. The following is an example of the experimenter's modeled verbalizations which the subject used later:

> There are four steps I have to use to solve this problem. I will say them a few times before I begin working the problem.....How many, Multiply, Subtract, Bring down.....How many, Multiply, Subtract, Bring down..... How many, Multiply, Subtract, Bring down. Now I will use these steps when working on the problem. The problem is 3820 divided by 5. First, How many 5's in 38? Second, Multiply 7x5. Third, Subtract 38-35. Fourth, Bring Down the 2. First, How many 5's in 32? Second, Multiply, 6x5. Third, Subtract 32-30. Fourth, Bring down the 0. First, How many 5's in 20? Second, Multiply 4x5. Third, Subtract 20-20. Finished, I did it.

During step two, the child from Group I was asked to sit in the middle seat and to work problems three and four. The experimenter verbalized the steps as the child worked the problems. The child from Group II was asked to watch his or her partner and to listen to the experimenter. In

Figure 2
Procedures for Self-Instructional Learning



Step 1	EXPERIMENTER WORKS PROBLEM WHILE SELF-REHEARSING			
Step 2	Subject Works Experimenter Verbalizes	Subject Observes Experimenter Verbalizes	Subject Observes Experimenter Verbalizes	Subject Works Experimenter Verbalizes
Step 3	Subject Works and Self-Rehearses	Subject Observes and Listens	Subject Observes and Self-Rehearses	Subject Works and Listens
Step 4	Subject Works and Whispers Verbalizations	Subject Observes and Listens	Subject Observes and Whispers Verbalizations	Subject Works and Listens
Step 5	Subject Works	Subject Observes	Subject Observes	Subject Works

step three, the child from Group I was asked to work problems five and six and to say the steps as the experimenter had done in the last four problems. The child from Group II was asked to watch his or her partner and to listen to the partner verbalize the steps. In step four, the child from Group I was asked to work the seventh and eighth problem and this time to whisper the steps of the problem The child from Group II was again asked to watch and to listen. In step five, the child from Group I was asked to work problems nine and ten without saying the steps aloud. The child from Group II was asked to watch.

Dyad 2

Step one was identical to that described for Dyad 1. In step two, the child from Group IV was asked to work problems three and four. The Group III child was asked to watch his or her partner and to listen to the experimenter. During step three, the child from Group IV was asked to work problems five and six while listening to the verbalizations of his or her partner. The child from Group III was asked to say the steps of the problem as the experimenter had already done in the last four problems. Both children were asked to work at the same rate as their partners and were told not to jump ahead of each other. In step four, the child from Group IV was asked to work problems seven and eight and to listen to his or her partner from Group III who was told to this time

whisper the steps of the problem while watching his or her partner work the problem. In step five, the child from Group IV was asked to work the next two problems. The child from Group III was instructed to watch his or her partner but not to verbalize the steps aloud.

Dependent Measures

Self-Efficacy Skill

This was a self-efficacy judgment measure. On each of 16 sheets, subjects answered on a scale from one to five. The scoring system was set up on a continuum from 0 to 100.

Division Skill

This was an accuracy measure. A score for the total number of problems solved correctly was obtained. Partial credit could be earned. A scoring system was worked out based on a continuum from 0 to 100.

Persistence

This measure assessed to what extent children persevered on the division task. For each answer, any attempt at solution was credited even when it was not completed or when the answer was not correct. A perfect score was 16.

Posttreatment Measures

The posttests were administered in a small group situation on the day following the training. This time the self-efficacy judgment preceded each division task. This was done to determine the predictive value of the obtained information. The problems corresponded to but were not

identical to those on the division posttest. After each problem was presented, the child was asked to check the box which best exemplified how capable he or she would be at solving the problem. After each of these self-efficacy judgments, a division problem was presented and children were instructed to solve it.

Social Comparability

Following the completion of the self-efficacy and division skill posttests, children were presented with a rating sheet. They were asked to check the box which best matched how they felt about their performance on the posttest as compared to the performance of their partner during the training phase of the experiment. Three sentences were listed. An attempt was made to ascertain whether each child felt that he or she did better than the partner, that he or she felt performance was the same or that he or she felt the partner did better.

Teacher Rating

Teachers were asked to fill out a questionaire on which they rated each child in their class who was participating in the experiment as being either low, average or high in math ability.

CHAPTER IV

RESULTS

Preliminary ANOVAs were performed, with no statistical significance found among groups. A decision to use gain scores in lieu of posttest scores was made because the central concern was with how much the groups improved as a result of treatment rather than with where they started out or finished.

Multiple regression procedures were used to analyze the data (Pedhazur, 1982). The self-instructional treatment was the predictor variable. The criterion variables included self-efficacy change, accuracy change and persistence change.

Major Hypotheses

Table 1 reports the means and standard deviations by experimental condition. In all four experimental conditions self-efficacy and accuracy increased. On the other hand, the didactic instruction group (control) went down in self-efficacy and remained virtually unchanged in accuracy. Two of the self-instructional treatments, the self-rehearsing observers and the cognitive modeling listeners, went up slightly in persistence. The other two groups, the verbal self-instructors and the observers of self-instruction, went down slightly. The didactic instruction group (control) went down more than any other group on persistence.

In Table 2 the results of the combined self-instructional treatments compared to the didactic instruction group (control) are displayed. The combined self-instructional treatment group included the verbal self-

Table 1
Pretest, Posttest and Gain Score Means and Standard Deviations on Self-Efficacy, Accuracy and Persistence by Experimental Condition

Experimental Condition		Self-Efficacy[a] M	Self-Efficacy[a] SD	Accuracy[b] M	Accuracy[b] SD	Persistence[c] M	Persistence[c] SD
VSI	Pretest	86.74	23.17	78.22	26.06	14.56	3.11
n=25	Posttest	89.42	14.45	88.88	16.89	14.16	2.78
	Gain	2.78	23.27	10.67	12.96	-.40	3.34
OSI	Pretest	80.05	26.23	72.33	32.12	14.14	3.64
n=28	Posttest	84.51	21.45	84.09	22.27	13.86	3.05
	Gain	4.46	11.81	11.76	13.23	-.36	1.83
SRO	Pretest	70.58	28.53	61.31	32.80	13.00	3.63
n=20	Posttest	78.62	23.92	74.61	26.16	13.35	3.51
	Gain	8.04	11.11	13.55	18.80	.35	1.90
CML	Pretest	83.91	21.77	72.94	28.09	13.96	3.56
n=23	Posttest	91.57	11.69	87.09	17.79	14.57	2.54
	Gain	7.66	14.84	14.15	16.39	.61	1.75
DI	Pretest	89.04	20.82	77.31	28.84	13.90	3.88
n=20	Posttest	84.70	22.41	78.08	26.25	12.60	4.37
	Gain	-4.35	15.66	.71	10.68	-1.00	2.70

a. percent of efficacious judgments
b. percent of accurate problems
c. number of problems attempted

Note. VSI=Verbal Self-Instruction
OSI=Observers of Self-Instruction
SRO=Self-Rehearsing Observers
CML=Cognitive Modeling Listeners
DI=Didactic Instruction

Table 2
Multiple Correlations and ANOVAs for Combined Treatments (VSI, OSI, SRO & CML) Versus Didactic Instruction (DI)

Criterion Variable	Predictor	r	ANOVA	DF	SS	MS	F
Self-Efficacy Change	Combined Treatments	.229	Regression	1	1614.46	1614.46	6.33**
			Residual	114	29056.57	254.88	
Accuracy Change	Combined Treatments	.295	Regression	1	2269.96	2269.96	10.90***
			Residual	114	23733.75	208.19	
Persistence Change	Combined Treatments	.159	Regression	1	16.90	16.90	2.96[a]
			Residual	114	650.99	5.7	

**p < .01
***p < .001
[a] approached significance p < .10

instructors, the observers of self-instruction, the self-rehearsing observers and the cognitve modeling listeners. These four experimental treatments were combined and entered as dummy variable one so that they could be compared to the didactic instruction group. Separate regression analyses were performed on each of the three criterion variables. Self-efficacy change was significant, $F(1,114)=6.33, p<.01$ giving support to the first hypothesis that percepts of self-efficacy would increase following self-instruction treatment. Another statistically significant finding was for accuracy change, $F(1,114)=10.9, p<.001$. Hypothesis 2, which proposed that accuracy would improve following self-instruction treatment was supported. Persistence change only approached significance, $F(1,114)=2.96, p<.10$ so that these findings do not, therefore, support the third hypothesis that persistence would increase following self-instruction training.

Hypothesis 4 proposed that each of the four self-instructional treatment groups would do significantly better than the didactic instruction group on all three dependent measures. A multiple regression analysis was performed on all groups for each criterion variable. The five levels of treatment were coded in four dummy variables. In this way, comparisons between each treatment group with the control could be made. Dummy variable one

was the verbal self-instruction (VSI) treatment (n=25). Dummy variable two was the observers of self-instruction (OSI) treatment (n=28). Dummy variable three was the self-rehearsing observers (SRO) treatment (n=20). Dummy variable four was the cognitive modelers who listened (CML) treatment (n=23). The didactic instruction (DI) treatment, or control, (n=20) was the constant. Table 3 reports the results of the analyses. The self-rehearsers who observed, $F(1,111)=5.95, p<.05$ and the cognitive modelers who listened, $F(1,111)=5.98, p<.05$ were better predictors of self-efficacy change than the other treatments.

All four treatments were good predictors of accuracy change. The cognitive modelers who listened, $F(1,111)=9.10$, $p<.01$ and the self-rehearsers who observed, $F(1,111)=7.77$, $p<.01$ were better predictors than the observers of self-instruction, $F(1,111)=6.72, p<.05$ and the verbal self-instructors, $F(1,111)=5.19, p<.05$.

Only one of the four treatments was significant in regard to persistence change. The cognitive modelers who listened were the best predictors, $F(1,111)=4.86, p<.05$ followed by the self-rehearsing observers, $F(1,111)=3.20, p<.10$.

In each separate regression equation, the predictive order of the treatments on self-efficacy change, accuracy change and persistence change was the same. The order from the best predictor to the worst was: 1. cognitive modeling listeners (CML) 2. self-rehearsing observers (SRO) 3. observers of self-instruction (OSI) and 4. verbal self-

Table 3
Multiple Regression Analyses on All Groups

Criterion Variable	Predictors	r	Beta	F	ANOVA	DF	SS	MS	F
Self-Efficacy Change	VSI	.117	.294	2.19	Regression	4	2065.81	516.45	2.00
	OSI	.132	.180	3.51					
	SRO	.260	.232	5.95*	Residual	111	28605.22	257.70	
	CML	.117	.288	5.98*					
Accuracy Change	VSI	.132	.273	5.19*	Regression	4	2453.07	613.27	2.89*
	OSI	.176	.316	6.72*					
	SRO	.307	.324	7.77**	Residual	111	23550.64	212.17	
	CML	.124	.358	9.10**					
Persistence Change	VSI	.160	.103	.70	Regression	4	35.43	8.86	1.55
	OSI	.161	.115	.85					
	SRO	.230	.213	3.20	Residual	111	632.46	5.70	
	CML	.160	.267	4.86*					

Note. VSI=Verbal Self-Instruction
OSI=Observers of Self-Instruction
SRO=Self-Rehearsing Observers
CML=Cognitive Modeling Listeners
*$p < .05$
**$p < .01$

instructors.

In summary, the results pertaining to the first set of hypotheses (1-4) indicate that self-instructional treatment significantly enhanced self-efficacy and significantly increased accuracy. Persistence change approached significance. Hypothesis 4 predicted that each self-instructional treatment would outperform the didactic instruction treatment on all three dependent measures. This hypothesis was partially supported. First, in terms of the cognitive modeling listeners, they did significantly better than the didactic instruction treatment on all three dependent measures. Second, in terms of the self-rehearsing observers, they did significantly better than the didactic instruction treatment on self-efficacy change and on accuracy change. Third, in terms of the observers of self-instruction, they did significantly better than the didactic instruction treatment on accuracy change and their self-efficacy change approached significance. Fourth, in terms of the verbal self-instructors, they did significantly better than the didactic instruction treatment on accuracy change.

Treatment Group Differences

To test the next set of hypotheses (5-10) which proposed that certain self-instructional treatments would be better than others, comparisons were made among the

four levels of treatment. Subjects in the didactic instruction treatment were not included in these comparisons. To test hypothesis 5, the verbal self-instructors were compared to the observers of self-instruction. To test hypothesis 6, the cognitive modeling listeners were compared to the self-rehearsing observers. To test hypothesis 7, the self-rehearsing observers were compared to the observers of self-instruction. To test hypothesis 8, the cognitive modeling listeners were compared to the observers of self-instruction. To test hypothesis 9, the verbal self-instructors were compared to the cognitive modeling listeners. To test hypothesis 10, the verbal self-instructors were compared to the self-rehearsing listeners. No statistical significance was found on any of the above contrasts.

Gender Differences

The next three hypotheses (11-13) postulated differences between boys and girls in their response to treatment. Table 4 reports the means and standard deviations of boys and girls by experimental condition. Girls started out with higher scores on all three measures and ended with higher scores on all three measures.

Hypothesis 11 predicted significant differences between boys and girls on all three measures with girls

Table 4

Pretest, Posttest and Gain Score Means and Standard Deviations of Boys and Girls on Self-Efficacy, Accuracy and Persistence by Experimental Condition

Experimental Condition		Self-Efficacy				Accuracy				Persistence			
		Boys		Girls		Boys		Girls		Boys		Girls	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
VSI	Pretest	70.17	39.09	91.84	13.12	59.65	36.67	84.08	19.51	11.67	5.39	15.47	1.07
male n=6	Posttest	92.05	8.84	88.58	15.93	81.68	20.38	91.16	15.56	13.33	3.20	14.42	2.67
female n=19	Gain	21.88	40.86	-3.26	9.89	22.03	20.83	7.08	6.84	1.67	5.27	-1.05	2.30
OSI	Pretest	73.46	32.44	82.69	23.75	58.15	32.80	78.01	30.83	12.63	4.66	14.75	3.08
male n=8	Posttest	83.46	23.54	84.93	21.18	79.01	24.63	86.13	21.59	13.00	4.24	14.20	2.48
female n=20	Gain	10.00	10.45	2.24	11.83	20.86	14.41	8.12	11.11	.13	.83	-.55	2.09
SRO	Pretest	66.61	33.63	75.43	21.72	55.21	35.75	68.74	29.06	11.91	4.23	14.33	2.29
male n=11	Posttest	74.26	28.17	83.93	17.58	72.11	33.14	77.66	15.29	13.09	4.18	13.67	2.74
female n=9	Gain	7.65	8.10	8.50	14.51	17.35	16.93	8.91	20.90	.18	1.47	-.67	1.94
CML	Pretest	72.89	32.07	89.78	11.12	61.73	30.79	78.92	25.60	12.38	5.07	14.80	2.21
male n=8	Posttest	90.20	14.82	92.29	10.17	79.75	21.42	91.00	14.86	13.88	3.23	14.93	2.12
female n=15	Gain	17.31	21.22	2.50	6.27	18.03	15.71	12.08	16.90	.50	2.73	.13	.64
DI	Pretest	88.94	20.22	89.09	21.96	81.41	30.44	75.19	28.96	14.14	4.10	13.77	3.92
male n=7	Posttest	91.43	17.85	81.07	24.40	82.81	28.14	75.53	25.99	14.29	4.54	11.69	4.17
female n=13	Gain	2.49	5.20	-8.02	18.24	1.40	4.51	.33	13.04	.14	.90	-1.62	3.15

Note. VSI=Verbal Self-Instruction
OSI=Observers of Self-Instruction
SRO=Self-Rehearsing Observers
CML=Cognitive Modeling Listeners
DI=Didactic Instruction

expected to make more gains following treatment. In order to test this hypothesis, boys from all four self-instructiontal treatment levels were combined, entered as a dummy variable and compared to the girls from all four self-instructional treatments. The subjects from the the didactic instruction treatment were not included in the analysis. Table 5 reports the findings. As predicted, significant differences were found on self-efficacy change, $F(1,94) = 12.78, p < .001$, division change, $F(1,94) = 11.34, p < .01$ and persistence change, $F(1,94) = 12.15, p < .001$ however these were all in the opposite direction from the one predicted. It was the boys who did significantly better than the girls following self-instructional treatment.

Hypothesis 12 predicted significant differences for boys among the four self-instruction treatment levels with those in the verbal self-instruction group expected to do better than all other groups. Comparisons were made between the verbal self-instructors and each of the three other treatment levels. No statistical significance was found.

Hypothesis 13 predicted signifcant differences for girls among the four self-instruction treatment conditions with those in the cognitive modeler listening condition or those in the self-rehearser observing condition expected to do better than the verbal self-instruction and the

Table 5
Multiple Correlations and ANOVAs Comparing Boys Treatment to Girls

Criterion Variable	r	ANOVA	DF	SS	MS	F
Self-Efficacy Change	.346	Regression	1	2920.01	2920.01	12.78***
		Residual	94	21477.85	288.49	
Accuracy Change	.328	Regression	1	2321.33	2321.33	11.34**
		Residual	94	19243.33	204.72	
Persistence Change	.338	Regression	1	58.71	58.71	12.15***
		Residual	94	454.28	4.83	

**p < .01
***p < .001

observers of self-instruction treatments. A series of comparisons to test this hypothesis yielded significance in two cases. First, girls in the self-rehearsing observer group did significantly better than those in the verbal self-instruction group on self-efficacy change, $F(1,26)=6.37, p<.025$. Second, when the cognitive modeling listeners and the self-rehearsing observers were combined and compared to the verbal self-instructors, again self-efficacy was signifcant, $F(1,41)=6.65, p<.025$.

Ability Differences

Another set of hypotheses (14-16) proposed significant differences on dependent measures between high-ability and low-ability subjects. Children were grouped by ability based on the information gathered from a teacher-rated questionaire. Teachers were asked to rate the children as low, average or high in their math ability. Table 6 gives the means and standard deviations of low, average and high-ability subjects by experimental condition. Many of the subjects in the high-ability group scored near the ceiling even at pretest.

Hypothesis 14 predicted significant differences between high and low-ability subjects on all three dependent measures with low-ability subjects expected to make significantly more gains. In order to test this hypothesis all children from the four self-instructional treatments who were

Table 6

Pretest, Posttest and Gain Score Means and Standard Deviations of Ability on Self-Efficacy, Accuracy and Persistence by Experimental Condition

Experimental Condition		Self-Efficacy						Accuracy						Persistence					
		Low		Average		High		Low		Average		High		Low		Average		High	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
VSI																			
Low n=12	Pretest	79.93	28.54	96.97	5.29	100.00	0.00	58.08	24.80	95.83	4.05	97.95	3.45	13.00	4.00	16.00	0.00	16.00	0.00
Aver n=7	Posttest	83.95	13.41	100.00	0.00	100.00	0.00	76.84	17.83	100.00	0.00	100.00	0.00	12.17	2.92	16.00	0.00	16.00	0.00
High n=6	Gain	4.02	34.06	3.03	5.29	0.00	0.00	18.77	14.60	4.17	4.05	2.05	3.45	-.83	4.90	0.00	0.00	0.00	0.00
OSI																			
Low n=13	Pretest	58.85	24.65	99.38	1.51	97.78	6.67	46.33	29.85	90.75	9.43	97.63	4.08	12.08	4.59	16.00	0.00	15.89	.33
Aver n=6	Posttest	68.52	22.02	99.23	1.88	97.78	6.67	66.38	21.82	98.62	3.39	100.00	0.00	11.54	3.13	16.00	0.00	15.78	.67
High n=9	Gain	9.67	16.03	-.15	2.63	0.00	0.00	20.04	13.42	7.90	11.45	2.37	4.08	-.69	2.63	0.00	0.00	-.11	.78
SRO																			
Low n=13	Pretest	59.92	29.81	83.15	5.82	100.00	0.00	46.61	30.86	81.27	12.80	98.37	1.46	11.62	3.82	15.25	.96	16.00	0.00
Aver n=4	Posttest	70.65	25.39	88.45	13.57	100.00	0.00	64.52	26.53	88.33	13.55	100.00	0.00	12.46	3.93	14.25	2.36	16.00	0.00
High n=3	Gain	10.73	12.12	5.30	9.39	0.00	0.00	18.30	18.67	7.05	23.38	1.63	1.46	.84	1.63	-1.00	2.94	0.00	0.00
CML																			
Low n=12	Pretest	71.76	24.24	98.55	3.55	95.52	6.38	54.29	27.00	95.22	2.86	90.96	11.43	12.25	4.29	16.00	0.00	15.60	.89
Aver n=6	Posttest	85.13	13.17	99.23	1.88	97.84	3.01	76.96	19.78	97.22	3.51	99.24	1.70	13.75	3.22	15.33	1.21	15.60	.89
High n=5	Gain	13.37	18.97	.68	1.67	2.12	3.40	22.67	17.87	2.00	3.89	8.28	9.90	1.50	1.88	-.67	1.21	0.00	2.25
DI																			
Low n=5	Pretest	61.78	27.94	97.45	3.78	100.00	0.00	34.26	23.30	91.02	10.29	93.73	7.24	8.20	4.02	15.73	.65	16.00	0.00
Aver n=11	Posttest	56.94	25.63	91.75	12.57	100.00	0.00	44.26	26.22	86.92	15.63	95.55	8.90	7.80	5.22	14.00	2.83	14.75	2.50
High n=4	Gain	-4.84	29.13	-5.70	10.81	0.00	0.00	10.40	5.50	-4.10	10.70	1.83	7.60	-.40	2.30	-1.18	3.09	-1.25	2.50

Note. VSI=Verbal Self-Instruction
OSI=Observers of Self-Instruction
SRO=Self-Rehearsing Observers
CML=Cognitive Modeling Listeners
DI=Didactic Instruction

scored as high in ability by their teachers were combined, compared to all those who had been scored as low in ability and entered as a dummy variable. The subjects who were scored as average in ability and those who were in the didactic instruction treatment were excluded from the analysis. Table 7 reports the findings. Accuracy change was statistically significant, $F(1,71)=23.11, p<.001$ as was self-efficacy change, $F(1,71)=4.06, p<.05$. In support of hypothesis 14, low ability subjects made significantly more gains following treatment.

Hypothesis 15 predicted low-ability subjects in the verbal self-instruction, the cognitive modelers who listened instruction or the self-rehearsers who observed instruction to do better than those in the observers of self-instruction treatment. A series of comparisons tested this hypothesis. No statistical significance was found.

Hypothesis 16 predicted high ability subjects to do better in the observers of self-instruction treatment over any other treatment. Comparisons testing this hypothesis resulted in no statistical significance.

Age Differences

The last set of hypothesis (17-19) predicted differences between younger and older children's response to treatment. Fourth and fifth grade children were

Table 7
Multiple Correlations and ANOVAs Comparing the Treatments of High Ability Versus Low Ability Subjects

Criterion Variable	r	ANOVA	DF	SS	MS	F
Self-Efficacy Change	.233	Regression	1	1268.00	1268.00	4.06*
		Residual	71	22178.92	312.38	
Accuracy Change	.496	Regression	1	4257.78	4257.78	23.11***
		Residual	71	13080.42	184.23	
Persistence Change	.044	Regression	1	.93	.93	.14
		Residual	71	470.96	6.63	

*$p < .05$
***$p < .001$

grouped as the younger children (mean age 10.6). Sixth and seventh graders were grouped as the older children (mean age 12.4). Table 8 reports the means and standard deviations of younger and older children by experimental condition.

Hypothesis 17 predicted significant differences between younger and older children on all three dependent measures. It was expected that younger children would do better. In order to test this hypothesis all children from the self-instructional treatments who were in the fourth and fifth grade were combined, compared to those in the sixth and seventh grade and entered as a dummy variable. Subjects in the didactic instruction treatment were excluded from the analysis. Table 9 displays the findings. Self-efficacy change was statistically significant, $F(1,94)=3.97, p<.05$. Division change was highly significant, $F(1,94)=26.17, p<.001$. Persistence change was not significant.

Hypothesis 18 predicted that, among younger children, those in the verbal self-instruction treatment would outperform those in the other three self-instructional treatments. A series of comparisons yielded no statistical significance.

Hypothesis 19 predicted that older children in the

Table 8

Pretest, Posttest and Gain Score Means and Standard Deviations of Younger and Older Children on Self-Efficacy, Accuracy and Persistence by Experimental Condition

Experimental Condition		Self-Efficacy				Accuracy				Persistence			
		Older		Younger		Older		Younger		Older		Younger	
		M	SD	M	SD	M	SD	M	SD	M	SD	M	SD
VSI	Pretest	94.41	12.71	74.99	30.47	94.84	7.82	53.28	23.26	15.87	.52	12.60	4.27
older n=15	Posttest	96.21	11.16	79.23	13.08	92.63	4.91	74.11	17.85	15.93	.69	11.50	2.72
younger n=10	Gain	1.80	3.98	4.24	37.61	3.89	4.11	20.83	15.18	.07	.26	-1.10	5.36
OSI	Pretest	95.74	9.20	55.80	25.62	92.63	9.57	40.96	29.25	15.71	.69	11.73	4.94
older n=17	Posttest	96.56	8.01	65.88	22.60	98.03	6.31	62.55	20.85	15.76	.66	10.91	2.95
younger n=11	Gain	.82	3.40	10.08	17.34	5.40	8.16	21.59	13.82	-.06	.56	-.82	2.86
SRO	Pretest	87.64	15.80	53.52	28.67	81.51	20.73	41.10	30.57	15.00	.63	11.00	4.03
older n=10	Posttest	93.69	10.40	63.54	24.38	90.30	15.63	58.91	25.56	14.90	1.73	11.80	4.24
younger n=10	Gain	6.05	11.28	10.02	11.16	9.29	16.00	17.81	21.21	-.10	1.97	.80	1.81
CML	Pretest	94.34	9.03	70.36	26.24	89.23	12.39	51.76	29.01	15.38	1.26	12.10	4.70
older n=13	Posttest	98.23	2.87	82.92	13.28	97.53	3.85	73.51	19.79	15.54	.97	13.30	3.37
younger n=10.	Gain	3.89	6.75	12.56	20.75	8.3	11.79	21.75	18.91	.15	1.57	1.20	1.87
DI	Pretest	93.33	19.49	71.90	18.92	86.94	21.23	39.08	23.87	15.06	3.00	9.25	3.77
older n=16	Posttest	89.81	19.83	64.25	22.79	85.03	21.77	50.27	26.58	13.62	3.46	8.50	5.74
younger n=4	Gain	-3.52	9.55	-7.65	32.84	-1.91	10.04	11.20	6.00	-1.06	2.82	-.75	2.50

Note. VSI=Verbal Self-Instruction
OSI=Observers of Self-Instruction
SRO=Self-Rehearsing Observers
CML=Cognitive Modeling Listeners
DI=Didactic Instruction

Table 9
Multiple Correlations and ANOVAs Comparing Younger Children's Treatment Groups to Older Children's Treatment Groups

Criterion Variable	r	ANOVA	DF	SS	MS	F
Self-Efficacy Change	.201	Regression	1	987.71	987.71	3.97*
		Residual	94	23410.15	249.04	
Accuracy Change	.467	Regression	1	4696.59	4696.59	26.17***
		Residual	94	16868.07	179.45	
Persistence Change	.004	Regression	1	.01	.01	0.00
		Residual	94	512.98	5.46	

*p < .05
***p < .001

observers of self-instruction treatment would do better than any other self-instructional treatment. A series of comparisons yielded no significant findings.

Relations Among Variables

In a post hoc analysis, an attempt was made to see if self-efficacy change could be successfully predicted on the basis of the four treatments of self-instruction (VSI, OSI, SRO and CML) and the change scores of persistence and accuracy. Table 10 displays the results. Persistence change, $F(1,109)=76.25, p < .001$ was the best predictor followed by accuracy change, $F(1,109)=5.59, p < .05$. An analysis of variance showed overall self-efficacy change to be significant, $F(6,109)=20.76, p < .001$ as can be seen on the right hand side of Table 10.

A separate multiple-regression equation was developed to see if accuracy change could be successfully predicted on the basis of the four self-instructional treatments and the change scores of self-efficacy and persistence. Self-efficacy was the best predictor of accuracy change, $F(1,109)=5.59, p < .05$. Two of the treatment groups were also significant in predictions of accuracy change, the cognitive modeling listeners (CML), $F(1,109)=4.4, p < .05$ and the observers of self-instruction (OSI), $F(1,109)=4.18$. $p < .05$. An analysis of variance demonstrated overall accuracy change to be significant, $F(6,109)=5.74$, $p < .05$ as can be seen on the right hand side of Table 10.

Table 10
Multiple Regression Analyses on Each Criterion Variable Using Treatment and Change Scores as Predictors

Criterion Variable	Predictor	r	Beta	F	r	ANOVA	DF	SS	MS	F
Self-Efficacy Change	VSI	.725	.068	.59	.730	Regression	6	16358.16	2726.36	20.76***
	OSI	.727	.015	1.34		Residual	109	14312.87	131.31	
	SRO	.730	.098	1.28						
	CML	.438	.065	.53						
	Acc Chg	.433	.173	5.59*						
	Pers Chg	.725	.625	76.25***						
Accuracy Change	VSI	.452	.280	3.45	.490	Regression	6	6241.37	1040.23	5.74***
	OSI	.463	.234	4.18*		Residual	109	19762.34	181.31	
	SRO	.490	.212	3.71						
	CML	.124	.237	4.40*						
	SEff Chg	.440	.282	5.59*						
	Pers Chg	.450	.143	1.46						
Persist Change	VSI	.711	-.041	.20	.713	Regression	6	339.60	56.60	18.87***
	OSI	.713	-.067	.51		Residual	109	328.29	3.01	
	SRO	.713	-.006	.00						
	CML	.711	.040	.19						
	Acc Chg	.378	.093	1.46						
	SEff Chg	.707	.658	76.25***						

Note. VSI=Verbal Self-Instruction
OSI=Observers of Self-Instruction
SRO=Self-Rehearsing Observers
CML=Cognitive Modeling Listeners
Acc Chg=Accuracy Change
Pers Chg=Persistence Change
SEff Chg=Self-Efficacy Change

*$p < .05$
***$p < .001$

Another multiple-regression equation was introduced to see if persistence change could be successfully predicted on the basis of the four self-instructional treatments and the change scores of accuracy and self-efficacy. Self-efficacy was the best predictor, $F(1,109)=76.25, p<.001$. None of the other variables were good predictors. From an analysis of variance displayed on the right hand side of Table 10, overall persistence change was statistically significant, $F(6,109)=18.87$, $p<.001$.

The results from this post hoc analyses indicate that persistence change and self-efficacy change are particularly powerful predictors of each other even when the treatment levels and accuracy change are controlled. In addition, accuracy change and self-efficacy change are statistically significant predictors of each other.

Social Comparability

A post hoc analysis was conducted on the social comparability measure and how it interacted with treatment. No statistically significant findings were present. In addition the social comparability of boys was contrasted to girls in the self-instructional treatments. There was no statistical significance found.

CHAPTER V

DISCUSSION

The results from this investigation indicate that training in self-instruction technique significantly increased achievement on an arithmetic activity. In addition, each of the four self-instructional treatments was compared to the didactic instruction treatment. The findings here revealed the cognitive modeling listeners and the self-rehearsing observers to be the best predictors of change on self-efficacy, accuracy and persistence.

In turning to differences between any two of the treatments of self-instruction, none of the comparisons were statistically significant. However, gain scores did indicate interesting trends. It should be kept in mind that gain scores can be unreliable and necessitate caution in their interpretation (Cohen & Cohen, 1975) but proceeding with this caveat, this chapter includes a discussion of treatment group differences even when statistical significance was not found.

The subject variables of gender, ability and age did yield significant results. Boys gained more from self-instructional treatment than girls, younger children gained more than older children and children who were low in ability did significantly better than those who were high in ability. Still, the statistical significance

found on these three subject variables must be interpreted cautiously because of the influence of ceiling effects among high ability subjects, the older subjects and the female subjects. An analysis of the data, individual by individual, suggested that the task was better suited to children in the fourth and fifth grades. It was too easy for older children and those high in ability. Since there were fifty-one female subjects among the older children and only nineteen male subjects among the older children, and since a predominate number of older children were scored as high in ability, it appears that ceiling effects interfered with the results of the girls' data as well.

Self-EFficacy

Self-efficacy theory predicts that active engagement in a task promotes skill and self-efficacy (Bandura, 1982). Self-instruction technique requires active engagement at both a motoric and verbal level. Therefore, it seemed a particularly useful tool for affecting self-efficacy.

Until now, verbal self-instruction has not been used as a vehicle to raise children's self-efficacy judgments. The results from this study support Bandura's (1977a,1982) theory. Both enactive participation in the task and vicarious engagement significantly increased skill and self-efficacy over didactic instruction.

As predicted, the results from this investigation indicate that perceptions of one's efficacy play an important role in subsequent performance. Participation,

be it direct or vicarious, is helpful in raising self-percepts of efficacy. The findings suggest that the amount or kind of participation most helpful to enhanced self-efficacy is dependent on the task. There appears to be an interaction between the task demands and degree of participation. Manipulating task difficulty and level of participation would probably bring some enlightening results.

The weighting of a variety of factors goes into how one appraises self-efficacy. Perceived characteristics of the task, the material, the setting, the model, ability, effort expended, external support received, are all influential (Bandura, 1981). What may be crucial, and in need of further investigation, is the effect of the partner on performance.

In order for judgments of self-efficacy to have meaning, a measure which got at accurate appraisal needed to be developed. For children, this can be especially difficult. In the pilot research (Mednick,Note 1), children's judgments of self-efficacy were often inflated. In addition, there were wide differences between self-efficacy scores and accuracy scores. Presently, scores were close estimates of actual performance. All children, even the youngest, used the measure correctly.

Accuracy

As predicted, training in verbal self-instruction technique or a variation of this technique, significantly increased student achievement on an arithmetic activity. Children's division skill change following training was statistically significant. Self-instruction technique is speculated to be an important intervention because it helps the

child to focus on the relevant and necessary task variables, it helps the child order the steps of the task in the correct sequence, it helps with self-reinforcement and it helps make manageable what may be perceived as a difficult content area.

Every treatment group did significantly better than the didactic instruction group on accuracy change. The findings do not reveal what attributes were most helpful or which cut through all self-instructional groups, but it is thought that the cognitive modeling element and the verbalization element were both strong subcomponents in the striking outcome. This is based on the findings from the data analysis, which revealed that the cognitive modeling listeners and the self-rehearsing observers were the two best predictors of accuracy change. It appears too that the combined vicarious and direct elements of the task resulted in the favorable outcome. The results indicated that the two groups who had the combined direct and vicarious treatment did better than those who had only the direct treatment and better than those who had only the vicarious treatment.

Most self-instructional research has been conducted on atypical populations. The sample drawn here was composed of normal children from the 4th, 5th, 6th and 7th grades. All had at least some competence in division skill at pretesting. The significant accuracy findings suggest that this intervention technique offers benefits

to normal children as well.

Persistence

The present results found no significant differences between groups on the persistence measure. Bandura (1977a, 1982) postulates that as individuals develop self-efficacy and skill, so persistence on task increases. When looking at gain scores, the groups which showed the biggest increase in self-efficacy were also those who persisted longer. These groups were also those which made the most gain in performance. In addition, the post hoc data analysis revealed that persistence change was the best predictor of self-efficacy change even when the four treatment levels and accuracy change were controlled. Self-efficacy is a powerful predictor of persistence and persistence is a powerful predictor of self-efficacy.

Modeling

Skills can be learned through observation alone (Rosenthal & Bandura, 1978; Rosenthal & Zimmerman, 1978). When a person observes others perform a task, that individual is more likely to believe that he or she can perform the task as well (Bandura, 1981). Few studies have investigated modeling's affect on children's self-efficacy. Among these, adults have been traditionally used as the models (Schunk, 1981; Zimmerman & Ringle, 1981). The modeling literature reveals that similarity to models can increase observational learning (Bandura, 1971, 1981; Perry & Furukawa, 1980) and enhance self-

efficacy (Bandura, 1981; Brown & Inouye, 1978; Schunk, 1984). In a recent study, Schunk & Hanson (1985) exposed children to either a peer model or to a teacher model and found that being exposed to a peer model led to higher self-efficacy and achievement.

Group Differences

The hypothesis regarding group differences predicted the self-instruction treatment groups would significantly differ from each other. Basically, it was assumed that the more participatory involvement in the tasks the better. Therefore, it was expected that the verbal self-instructors would do best. It was also felt that when direct involvement was at either the motoric or verbal level, actually working the task would be better than simply verbalizing the steps. Therefore, the cognitive modelers who listened were expected to outperform those who observed as they self-rehearsed. It was also felt that whereas a vicarious experience with self-instruction would be better than didactic instruction, still it would not be as helpful as being in the three other treatment conditions, all of which included direct experiences.

While differences between groups were not statistically significant, perhaps as a result of the large standard deviations and small cell sizes, studying group means and betas from the regression equations reveal a different

hierarchical order from the one predicted. Predictions regarding the verbal self-instructors were not borne out. In fact, they did least well of all four groups. The other findings are in agreement with the remaining group differences hypotheses. Cognitive modelers did best, self-rehearsers were next and those vicariously experiencing the self-instructional treatment were third.

Those whose treatment was modeled after Meichenbaum and Goodman's (1971) format, that is the verbal self-instructors, did not do as well as their partners who vicariously experienced the verbal self-instructions on all three dependent measures. Perhaps, had just these two conditions been under investigation, it might be concluded that direct involvement in the tasks is not as helpful as vicarious experience. However, when these results are presented within the context of all four treatment groups their meaning changes. Children directly involved in the cognitive modeling group and those directly involved in the self-rehearsing group did better than those vicariously experiencing the treatment.

It might be that the requirement of participating in the task while simultaneously giving oneself instructions was overly demanding and more taxing than the requirements of the other three groups. Performing the

arithmetic task may have prevented the verbalizations from becoming meaningful. Or, the inclusion of verbalizations may have interfered with task performance. The complexity of the combined tasks may have kept subjects from rehearsing or remembering the procedures helpful to subsequent performance. Another difference, and one that warrants continued investigation, is that this group did not have the assumed benefit of an aiding peer partner. Instead, the partners for this group were only observers. Finally, while the demands for this group may have hindered outcome when compared to other self-instructional treatments, still they outperformed those in the didactic instruction groups on all three measures and this was statistically significant with regard to their accuracy change.

In turning to the vicarious (observing) group, these subjects did significantly better than the didactic instruction group on self-efficacy change and accuracy change. Learning skills through observation alone is well documented in the literature (Rosenthal & Bandura, 1978; Rosenthal & Zimmerman, 1978). As discussed earlier, vicarious experiences can raise mastery expectations (Bandura, 1977b). The vicarious experience for this group was at the cognitive modeling level as well as the

verbalization level. When this group was compared to those directly participating at one level, whether it was cognitive modeling or self-verbalizations, the vicarious group did less well on gain scores. This finding supports Bandura's (1977a, 1981) theorized hierarchical ordering of how self-expectations of efficacy are raised. It also supports the present hypotheses. In contrast to expectations, the vicarious group made more changes on all measures than those in the verbal self-instruction group, that is, those participating at both levels. The vicarious experience may have provided an opportunity to symbolically code new information to be used later at posttest.

Subjects from Dyad Two, those who directly participated at one level of the task and vicariously experienced the other, made more changes than any other treatment. It seems that a combined vicarious and direct element present in the self-instructional treatment is the best approach to enhancing percepts of self-efficacy and increasing accuracy and persistence. These two groups were very similar in the gains they made. They repeatedly outperformed other groups on every dependent measure. Whether the vicarious element was motoric or verbal or the direct aspect was motoric or verbal did not seem to matter. Instead, it was that each of these two groups had both a direct and vicarious element present.

Children who self-rehearsed did best, according to gain scores on self-efficacy change. Children who cognitively modeled did best on accuracy and persistence change. The cognitive modeling treatment was the best predictor of self-efficacy change, accuracy change and persistence change according to the statistical analyses. Another study would be necessary to examine existing differences between these two treatments. It may be that the instruction which includes self-rehearsing affects self-efficacy change more than the other groups and that the instruction which includes cognitive modeling affects performance more than any other treatment. It could also be that the effects of one of these techniques is more long lasting or would carry over more easily to other tasks. These two groups were the only ones to show an increase in their persistence change. That these children were mutually supportive of each other in carrying out the task during training may have been the strongest contributing factor to this change.

Lastly, the didactic instruction group (control), had the highest self-efficacy group mean before treatment began. Still, they were the only group at posttesting to go down on this measure. It may be deduced that whereas self-instructional treatment helped children perceive the task as easier, didactic instruction did not. The didactic instruction group showed virtually no

change at posttesting and their persistence went down.

A helpful way to understand the results of the present research may be in recognizing similarities rather than focusing on differences among treatment groups. From this perspective, the common threads running through the self-instructional training groups are: 1. The heavy modeling component be it verbal or motoric. 2. The addition of a peer model to the training procedure. 3. The exposure of all four modeling groups to an adult model who worked two sample problems while verbalizing. The adult model verbalized the procedural steps for the next two problems as well. 4. The pairing of children with a same-sexed partner who was also from the same grade and class. The above intertreatment similarities may have weighed so heavily in the training session that their benefits masked any possible differences.

While the trends among experimental conditions in terms of gain scores and betas in the regression equations suggest differences among treatments, no statistical significance resulted. Therefore, it is difficult to claim that verbal self-instruction technique added anything beyond the effects of direct teaching. All verbal self-instruction treatments contained elements of direct teaching. The didactic instruction group were not taught directly by an adult. It is unknown whether direct teaching only would in itself have significantly enhanced performance when compared to the didactic instruction group.

Whereas verbal self-instruction training involves

direct teaching of strategies and rules, direct teaching alone involves rote presentation of subskills. The use of overt self-instruction techniques assures task strategy rehearsal. Verbalizations were added to the child's task strategies either directly or through observation of a peer. In all of the experimental conditions the experimenter used a modeling procedure which included the verbalization of problem solving steps while teaching math problems. This was different from direct teaching where the experimenter would have simply taught the children how to solve math problems.

Gender Differences

Significant differences were found between boys and girls on all three dependent measures. Contrary to prediction, boys made more gains from self-instructional treatment. Perhaps this can be explained by the unusual features of this particular sample. First, there were twice as many girls in the study as boys. Second, girls started out at pretesting with higher group means on all three dependent measures. Even though the boys did dramatically better on the gain scores as compared to the girls, still the girls made gains from treatment as well. While the results from the analysis suggest that boys are extremely responsive to self-instructional treatment, the girls still ended at posttesting with higher scores than

the boys on all dependent measures. In fact, they may have responded just as well as the boys to treatment had it not been for the influence of the ceiling effects. Third, while standard deviations were large for the entire sample, this was especially true for the boys.

It was predicted that boys would do better when participation required active involvement at both levels. There were, however, no significant differences found between groups on the boys' data. With the original total sample for the boys being only forty, cell sizes for comparisons between treatment groups became very small. There were also very large standard deviations on the scores. When considering gain scores, there is support for the hypothesis. Boys did better when actively participating in both aspects of the task.

It was predicted that girls would do best when the task demands included the help of a partner. They were expected to do less well when they had to carry out all aspects of the task independently or when they carried out none of the direct elements to the task. It was shown by the gain scores to be true. It is suggested that the cooperative nature of the task for the girls from Dyad 2 (CML & SRO) played an important role in the resultant findings. This interpretation supports the already existing literature that girls are more reliant on others in problems solving situations than are males (Caplan, 1979; Gold et al.,1984; Maccoby & Jacklin,1974). The boys responded best to the condition which required more independent

work than others. The boys relied on their own independent efforts and did well. The girls relied on others for help and did well. These findings raise further questions about how children respond to competitive versus cooperative features of a task and whether significant differences exist between how boys and girls learn best.

It appears that boys responded better to the motor elements of the task whereas girls responded best when verbal elements were present. Very often boys expect to do better than girls on mathematics tasks (Deau, 1976; Mednick, Note 1; Parsons, 1983). In this experiment girls expected to do better on the task at pretest and again at posttest. In fact, they did better at both pretest and posttest on all three dependent measures.

Ability

Statistically significant differences were found in the change scores of high versus low-ability subjects with low-ability subjects making more gains. However, the problem of ceiling effects among the high-ability subjects requires consideration in order to accurately interpret these differences. The influence of ceiling effects had been a confounding factor initially in the pilot research. Therefore, an effort was made to eliminate this effect by way of doubling the number of items worked on the test and by including more difficult division problems. The results here suggest that the task was still too easy for

the high-ability subjects.

The interaction between ability and treatment did not reach significance. What may be relevant here are several considerations. First, ability levels were derived from a teacher-rated sheet where each child was to be scored as either low, average or high in math ability. In addition to the limited scope of this questionaire, there may be even further problems regarding the accuracy of the information gathered. The second problem was that the children participating in the study were all enrolled in a summer program which had a heavy emphasis on remedial reading. Little or no math was done in the summer classroom. Third, while most of the teachers knew the children prior to summer enrollment, not all had worked with these children in their math program. Fourth, teachers of the older children tended to score children as high in math ability whereas teachers of the younger children tended to score children as low in ability. This may have been the result of the teachers' knowledge regarding the task to be used in the experiment. In light of these factors, information gathered on ability may not have been a fair estimate of children's math ability.

There is some evidence that children of low ability can improve performance when they are taught a set of strategies which they have not picked up on their own

(Mayer, 1980). The results here indicate that the low-ability subjects did better than those in the control condition on self-efficacy change and accuracy change. There is also evidence that high-ability subjects invest less effort when the task is highly structured (Salomen, 1984). The results here suggest that those of high ability in the self-instructional treatment invested more effort than those in the didactic instruction group. The results, however, are not significant. This may be explained by their pretest scores approaching maximum ceiling, as described earlier.

Age

Most studies in which children have been trained to use self-instructions have been conducted with elementary school-age children. Copeland's (1982) review of subject variables concludes that for younger children and for those low in ability, self-instruction training should be very specific and concrete. On the other hand, a conceptual approach seems better than a concrete method for older elementary school-age children (8-12 year olds). All of the children in this study fell within what the existing literature defines as the older group. This may be helpful in understanding why the results did not reveal any consistent picture as to differences in treatment as a result of age.

In studying elementary-school children of any age,

research has demonstrated that self-perceptions are in a relatively malleable form (Rubin, 1978) and are especially influenced by academic performance and by feedback from teachers (Blumenfeld, Pintrich, Meece & Wessels, 1982; Stipek, 1981).

This experiment has demonstrated significant differences between the younger and older groups on self-efficacy change and accuracy change with the younger group's gain scores being substantially larger. However, as already discussed, there was a tendency among many of the older children to test near the ceiling even at pretest. Although gain scores were much better for the treatment groups than the control, still statistical significance was not reached. An explanation offered is the large standard deviations and the small sample size.

While the younger children made larger gains than the older group, the older children did significantly better than those in the control on all three dependent measures. It seems therefore, that verbal self-instruction treatment or a variation of this technique was helpful for children of all ages.

Social Comparability

The limited scope of the social comparability measure makes for little deduction. In the study here, children were merely asked to judge how they felt about their performance when compared to their partner's performance.

In addition, the meaningfulness of this answer must be understood against a background of an already assumed comparability. Children were matched by sex and were assigned to partners in the same grade and the same class as they were. Still, when looking at group means, children who thought they did best actually did do best. Children who thought they did best also had the greatest self-efficacy change.

Future Research

Continued investigations are necessary to understand the reciprocal relationship between self-efficacy and achievement. Specific avenues of research relevant to results of the present study could include: 1. The removal of the adult model from the first two steps of the five step procedure followed in this experiment. Instead, a peer model could demonstrate the first two steps to the children being trained and information regarding the influence of peer models versus adult models could be gathered and compared. While there are assumed benefits to peer models in the present study, these can only be speculative. 2. The question of how direct teaching differs from the verbal self-instruction technique used in this experiment can be answered through the inclusion of another control where subjects are exposed to direct teaching only.

3. The training phase of the present experiment lasted only 30 minutes. If the time of this training period were lengthened, or if the number of sessions were extended, intertreatment differences might be easier to understand. 4. Children in this study all had some level of competence in division skill. It is unknown how much weight this past information carried to judgments of self-efficacy or in influencing how much effort was expended. Whether the knowledge of the prerequisite skills was helpful or hindered future performance is also unknown. Using a task unfamiliar to the subjects might bring new information. 5. If the study could be repeated in its present form but on another sample, the findings here could be better established. The division task was one that had to appropriately span four grade levels. The results of the study suggested that the task was most appropriate for fourth and fifth graders. In addition, subjects in the present investigation were primarily females (two thirds of the sample). All subjects were black or Hispanic and all came from lower socioeconomic families. The homogeneous features of the present sample make the results difficult to generalize. 6. The interaction of ability with treatment needs further investigation. The teachers' ratings of subjects' math abilities were imprecise. Due to the remedial nature of the summer program, there is some evidence that the children enrolled may have been

predominantly from the lower ability group of their regular year round classes. 7. The influence of age on self-efficacy and achievement remains problematic. Developmental changes in cognitive processing, in perceptions regarding ability and in judgments of self-efficacy are complex. Future research should therefore be conducted within a developmental framework. 8. A study examining children's differential perceptions of the task and the training would further illuminate some of the questions which have arisen from the present work. Information on children's causal attributions to success and failure would be helpful in understanding children's judgments of self-efficacy and their performance. 9. Questions regarding social comparability need to be examined in more depth. Asking children how difficult they found the task to be, how much effort they expended, what their level of involvement was and how hard the task was for their partners would provide valuable information. 10. The verbal instructions taught in the training phase of this experiment were task specific and cognitive in their content. If instead, statements were more generalized or more affectively based would the influence on self-efficacy and achievement be different, and if so, in what ways would it be different? 11. Finally, questions regarding the value of self-verbalizations over participant cognitive modeling remain unanswered. A way to find out may be to further analyze

the five step verbal self-instruction procedure which was followed here. For example, are all five steps necessary? Would two of the five steps have proven effective? If so, which two? Is the step which requires whispering helpful or necessary? Can the verbal steps be said covertly at an earlier time?

Educational Implications

One of the major objectives of the present study was to investigate instructional procedures for increasing student achievement. The skill was one necessary for elementary school learning. Children were trained in using a set of cognitive strategies with the ultimate purpose being to improve performance. Both the verbal and cognitive strategies were academically specific, problem-solving steps for an arithmetic problem. The results revealed that this was, in fact, a very effective intervention technique for increasing achievement.

The training program in this study was modeled after Meichenbaum and Goodman's (1971) format. These procedures are easy for children, teachers and parents to learn across situations (Douglas, Parry, Marton & Garson, 1976). The advantages of using this technique over other classroom programs, for example, behavior modification, have been well documented in the literature (Douglas et al.,1976; Greiger, Mordock & Breyer, 1970; Winett & Winkler, 1972)

with an important difference being that this approach encourages the child to rely on internal cognitive strategies.

Even after just one training session in self-instructions, children's increase in performance was dramatic. These results suggest that teachers could adapt their arithmetic programs to include lessons in self-instructional training and expect to see gains in children's achievement.

Of central concern to educators is whether the self-instructional skills taught in the experiment can be generalized into the classroom. The materials used in the training phase were achievement related and the possibility of generalization would probably be best in similar areas. The statements rehearsed were those helpful to solving division problems. It is very likely that children would rely on this approach the next time they solved division problems. The subjects, many of whom found the more difficult pretest problems impossible to tackle, learned that solution came through following a series of simple arithmetic steps. Additional sessions with teachers to encourage them to take a metacognitive perspective across subject domains and to verbalize their own strategies while solving problems would foster generalization. Training in verbal self-instructions

involves learning how to learn rather than learning a rote skill. Therefore, transfer to other content areas is more likely.

Another aspect of the training that seems to have been especially helpful and relevant to the classroom teacher is that the children were paired with peer partners. The results suggest that the best combination of paired peers is when each partner contributes something to the task. Lessons well learned may be attributed to the cooperative nature of their content. Although it is difficult to discern, because of the heavy composition of females in the present sample, it does seem that sharing responsibilities in a task is especially helpful to girls. Using peer models to train other children in a problem solving activity appears to be a promising method for raising judgments of self-efficacy and achievement.

Historically, most educational research has focused on studying the cognitive processes which foster achievement with much less attention being given to expectations and how they relate to performance. This experiment considered both. Since the results suggest an interrelation between self-efficacy and achievement, teachers should consider using self-instructional interventions, not only to improve skill, but also to

enhance self-efficacy. The children in the study had a heightened sense of efficacy, perhaps from the combined influence of observing their own progress as well as their partner's progress.

Conclusion

The present investigation has explored, for the first time, how training in verbal self-instructions can affect self-percepts of efficacy. The idea that self-efficacy is influenced by prior accomplishments but is not a mere reflection of them (Bandura & Schunk, 1981; Schunk, 1981,1982) is further supported by the results here. Perceptions of one's own efficacy were shown to play an important role in subsequent performance. Self-efficacy was a significantly good predictor of accuracy change even when treatment levels and persistence change were controlled.

Self-instruction technique was found to be an effective method for improving skill and self-efficacy on an arithmetic task. It appears that the best way to present self-instructions may have to do with subject variables. In the present study gender, ability and age were considered. Future studies could include race, socioeconomic status, attributional style and level of child involvement.

There are several treatment components that, if separated out, might independently account for the findings of the present research: First, the modeling component; second, the verbalization component; third, the specificity and cognitive nature of the self-instructions; fourth, the peer partner influence.

It has been demonstrated in the literature that modeling alone can be an effective intervention for enhancing performance (Rosenthal & Bandura, 1978). Verbalizations that are self-rehearsed rather than verbalizations listened to from an adult speaker may enhance (Bender, 1976; Genshaft & Hirt, 1980; Palkes, Stewart & Freedman, 1972) or impede (Denney, 1975) subsequent performance. This experiment attempted to clarify what aspects of the self-instructions were most helpful in promoting skill and self-efficacy. While significant differences among treatments were not found, an examination of gain scores revealed interesting trends. Direct participation at only one level, be it motor or verbal, combined with vicarious experience, be it motor or verbal, was better than direct participation at both levels and also better than vicariously experiencing both aspects of the task.

There were interesting differences between boys and girls in their response to self-instruction training. Girls did best when training involved one direct element and one vicarious element. Boys, in contrast, did best when both elements were direct.

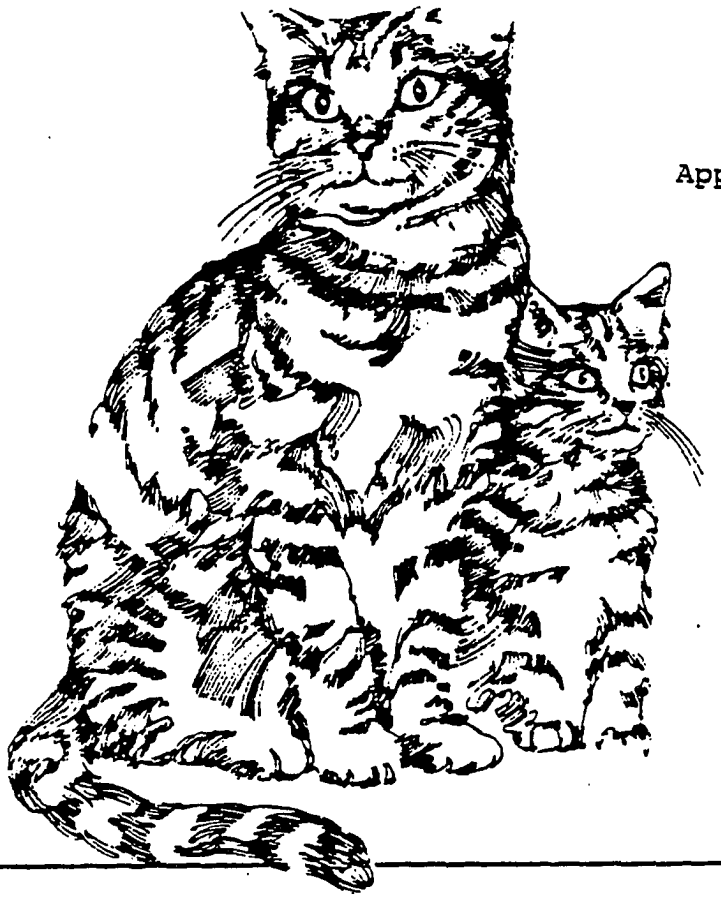
For most of the children in this study, a combination of vicarious and direct participation was the best approach to increasing skill and enhancing self-efficacy. Perhaps the dual combination of direct and vicarious involvement led to more effective memory strategies and may have given children more time to relate their newly acquired information to prior knowledge. There was little difference between those who directly worked and vicariously listened and those who directly talked and vicariously observed. The influence of the paired peer partners could also be important in understanding why the performance of these two groups was best. Relying on a peer to help achieve the correct solution may have been the most critical factor in promoting self-efficacy and achievement. This team approach to learning may be a helpful tool to use when teaching children.

The self-efficacy measure designed for the present study was especially helpful in getting at children's accurate appraisals of self-efficacy. Children in all grades understood how to use the measure. The self-

efficacy measure used in the pilot research was one modeled after a measure developed earlier (Bandura, 1977a). The measure as it has been developed here is offered as a more sensitive instrument.

Finally, it can be stated that self-instruction technique proved to be an effective vehicle for testing self-efficacy theory. This kind of intervention significantly increased accuracy and percepts of efficacy in a group of elementary school-age children. The attempt to partial out the subcomponents of verbal self-instruction revealed trends of relevant interest to future investigations. In addition, using peers as models appears to be a useful way to increase achievement. Further investigations along these lines would provide valuable information about how children learn.

Appendix A



NAME _____

GRADE _____

CLASS _____

AGE _____

Date of Birth: _____

BOY ☐ GIRL ☐

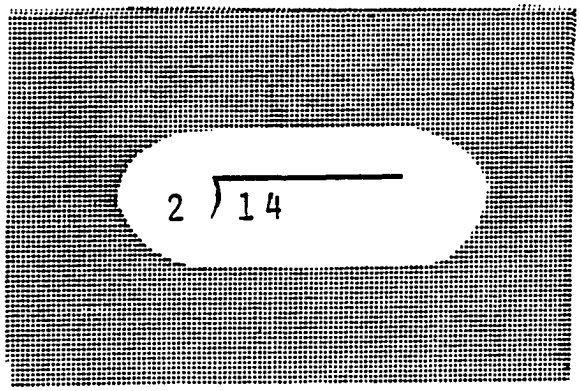
PRE ☐

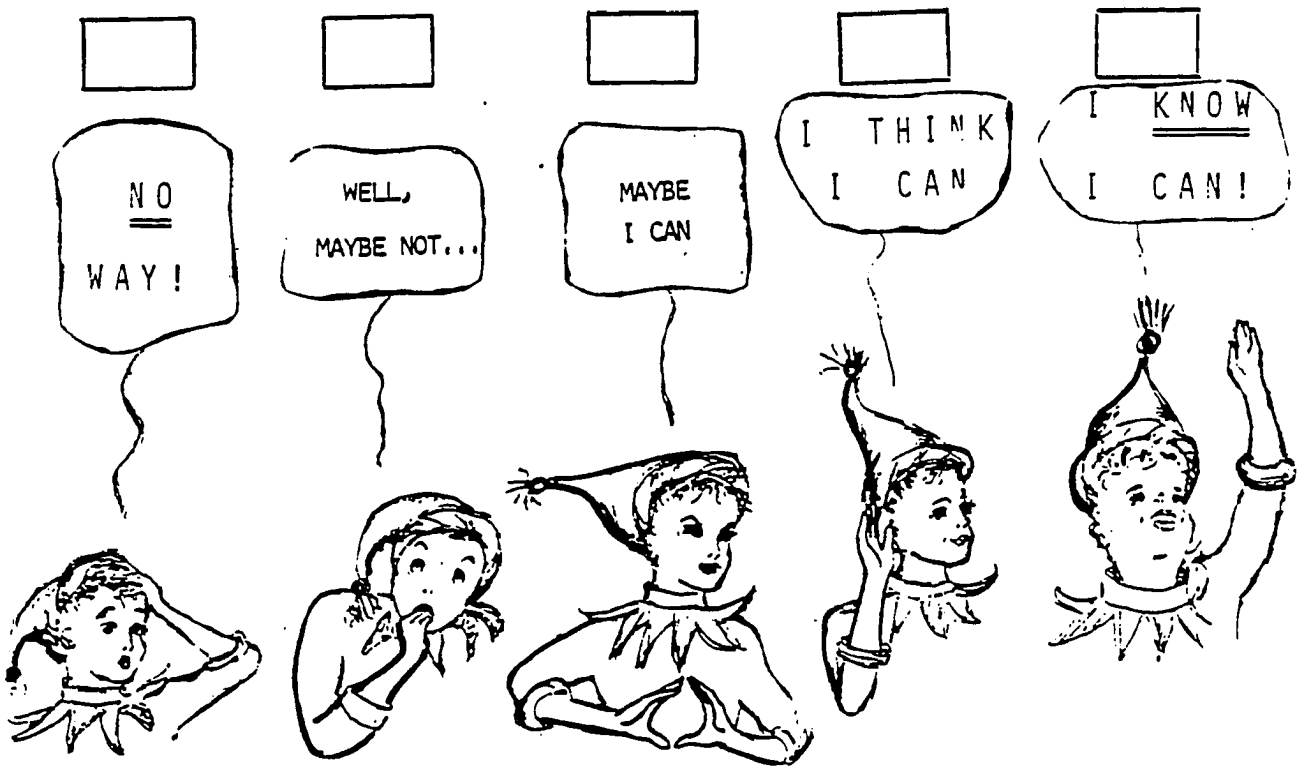
(Sample)

$$2\overline{)12}$$

PRE

(Sample)



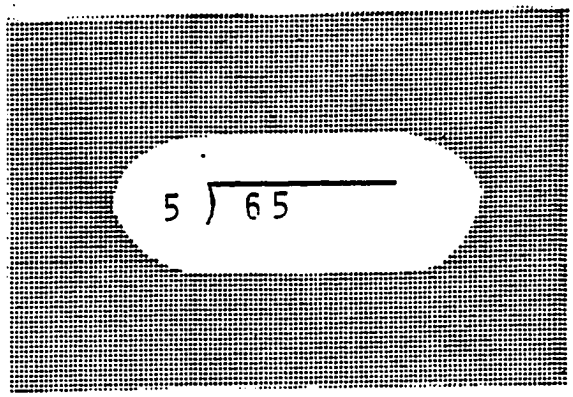


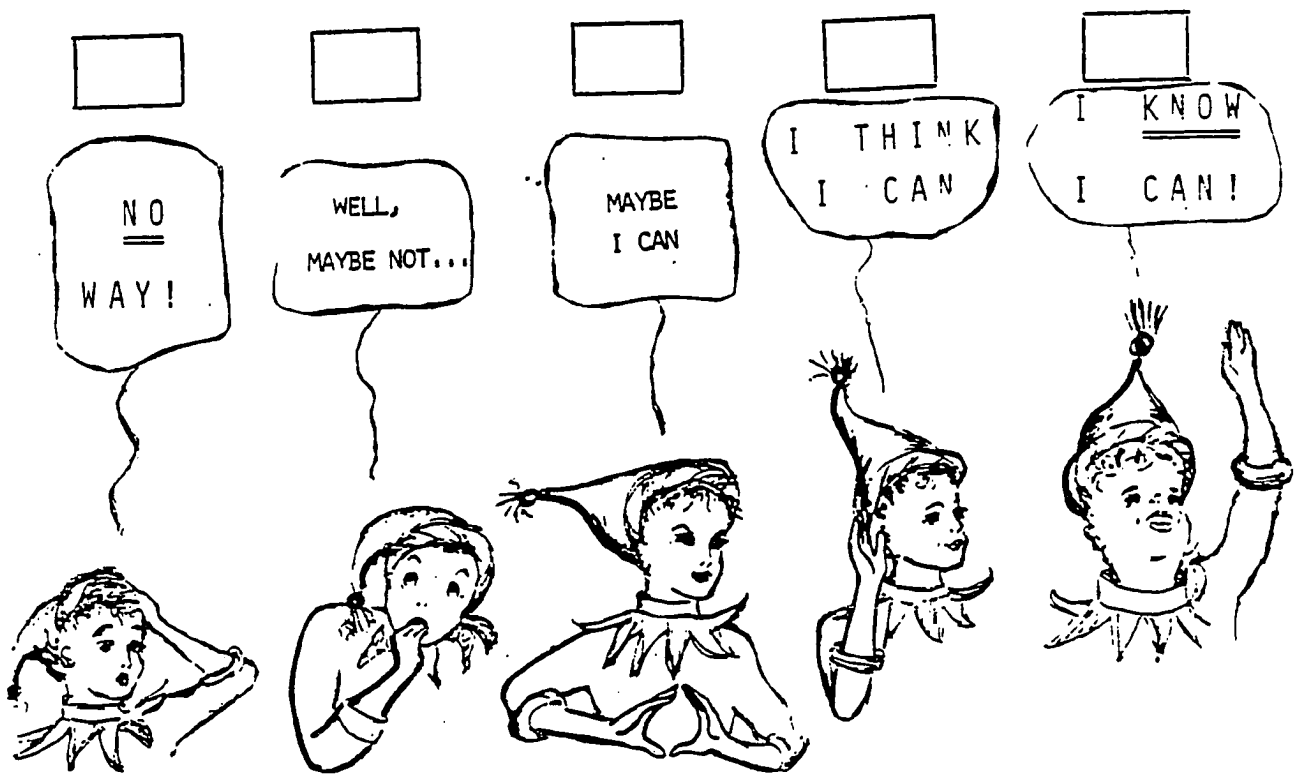
(Sample)

$4\overline{)64}$

PRE

(Sample)





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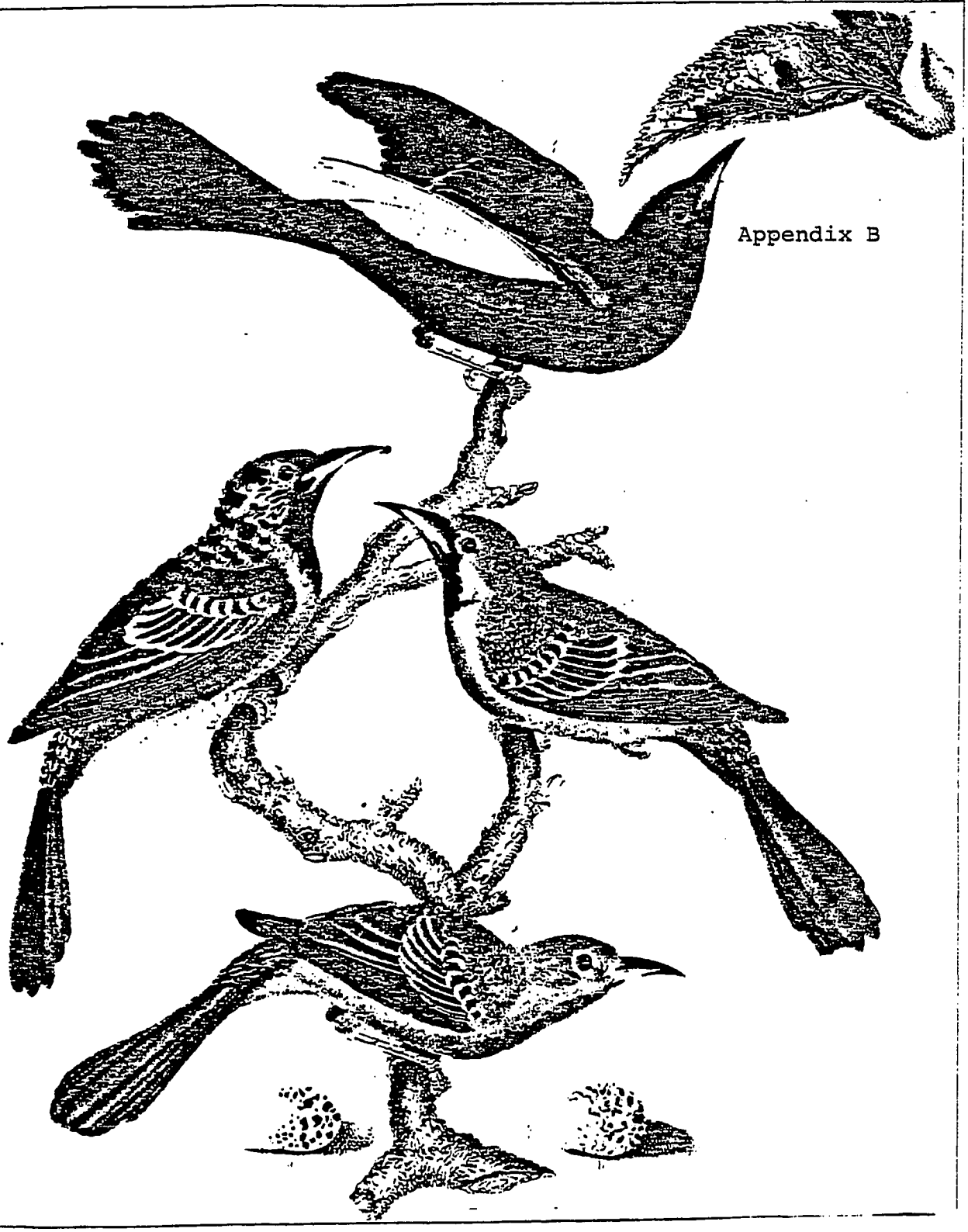


Appendix B

DIVISION PROBLEM

Example 1.

1. How many?
2. Multiply
3. Subtract
4. Bring down,
   Return to Step 1

$$
\begin{array}{r}
764 \\
5\overline{)\,3820} \\
-35 \\
\hline
32 \\
-30 \\
\hline
20 \\
-20 \\
\hline
0
\end{array}
$$

1. How many 5's in 38 ?
2. Multiply 7 X 5 = 35
3. Subtract 38
   -35
4. Bring down 2
   Return to 1

1. How many 5's in 32 ?
2. Multiply 6 X 5 =
3. Subtract 32
   -30
4. Bring down 0,
   Return to 1

1. How many 5's in 20 ?
2. Multiply 4 X 5
3. Subtract 20
   -20

DIVISION PROBLEM

Example **2**

1. How many ?
2. Multiply
3. Subtract
4. Bring down,

   Return to Step 1

```
        9 6 8
    ------------
4 ) 3 8 7 2
    - 3 6 ↓
      2 7
    - 2 4 ↓
        3 2
      - 3 2
        0
```

1. How many 4 's in 38?
2. Multiply 9 X 4
3. Subtract 3 8
   − 3 6
4. Bring down 7

Return to 1.

1. How many 4's in 27 ?
2. Multiply 6 X 4
3. Subtract 2 7
   − 2 4
4. Bring down 2,

Return to 1.

1. How many 4 's in 32 ?
2. Multiply 8 X 4
3. Subtract 3 2
   − 3 2

DIVISION PROBLEM

$$3\overline{)2562}$$

1. How many ?
2. Multiply
3. Subtract
4. Bring down,

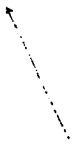
Return to Step 1

TR

DIVISION PROBLEM

4) 1976

1. How many ?
2. Multiply
3. Subtract
4. Bring down,
   Return to Step 1



TR

$$5 \overline{)\,2380}$$

1. How many ?
2. Multiply
3. Subtract
4. Bring down,
   Return to Step 1

TR

$$7 \overline{)\,4634}$$

1. How many ?
2. Multiply
3. Subtract
4. Bring down,

   Return to Step 1

TR

$8\overline{)5864}$

1. How many ?
2. Multiply
3. Subtract
4. Bring down,

Return to Step 1

TR

$$6\overline{)3984}$$

1. How many ?
2. Multiply
3. Subtract
4. Bring down,

   Return to Step 1

TR

$$9\overline{)7578}$$

1. How many ?
2. Multiply
3. Subtract
4. Bring down,

Return to Step 1

TR

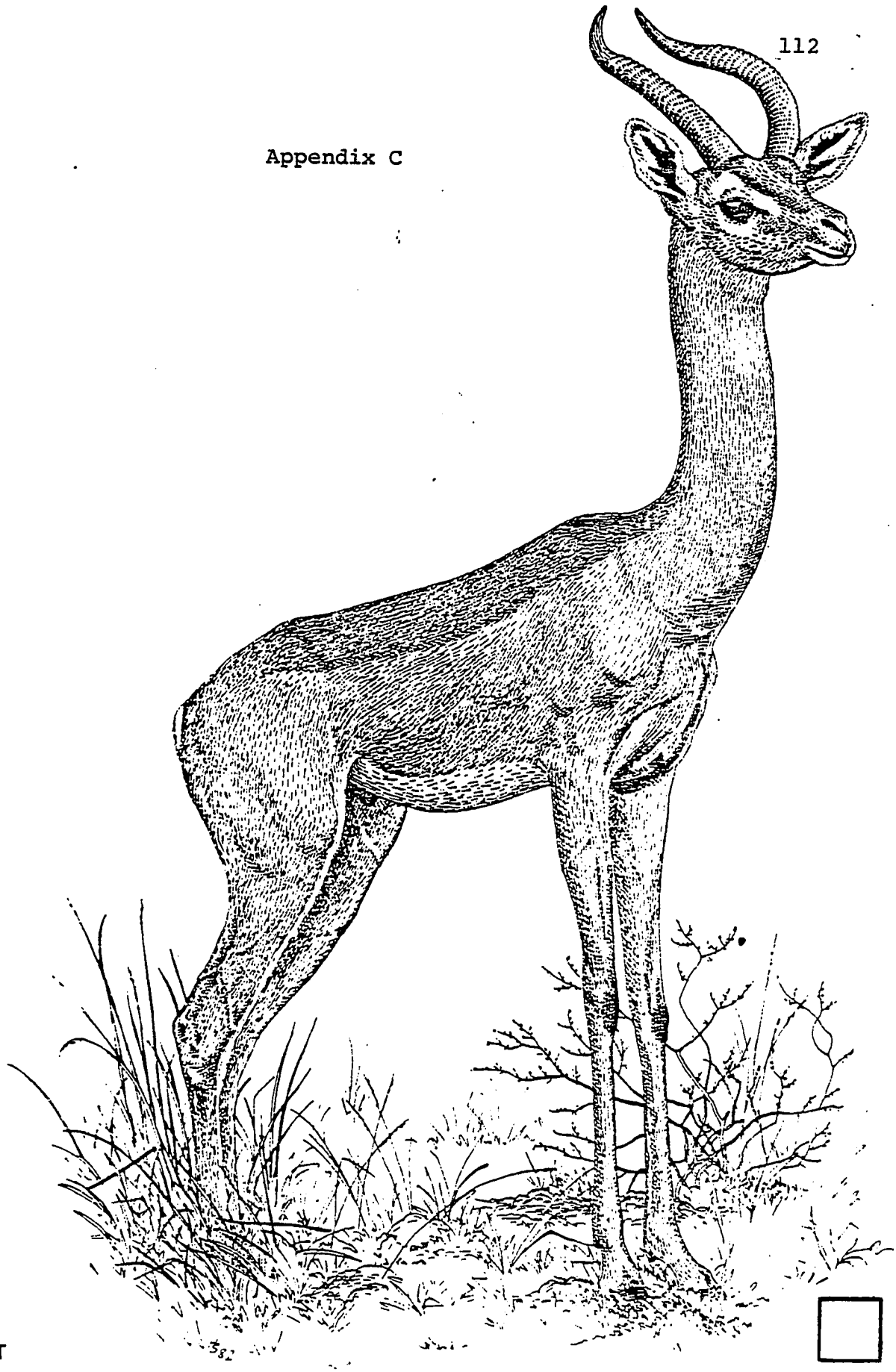
$$5 \overline{)\,3\,7\,3\,4\,5}$$

1. How many ?
2. Multiply
3. Subtract
4. Bring down,

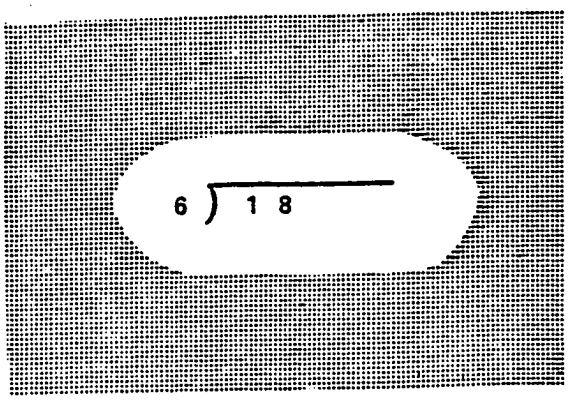
   Return to Step 1

TR

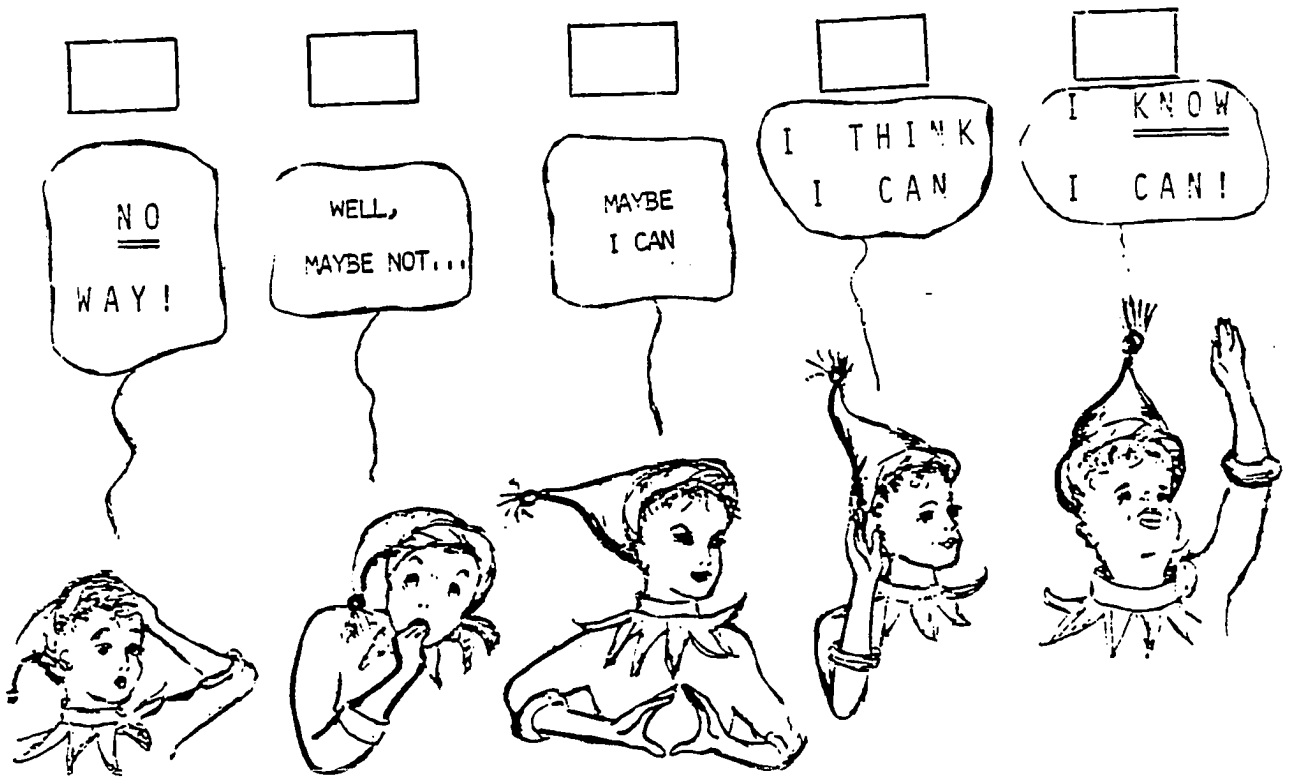
Appendix C



POST



(Sample)

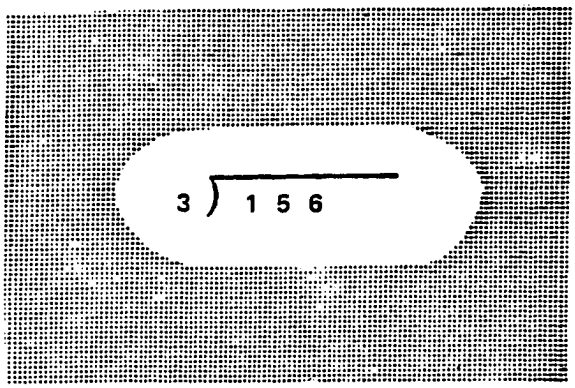


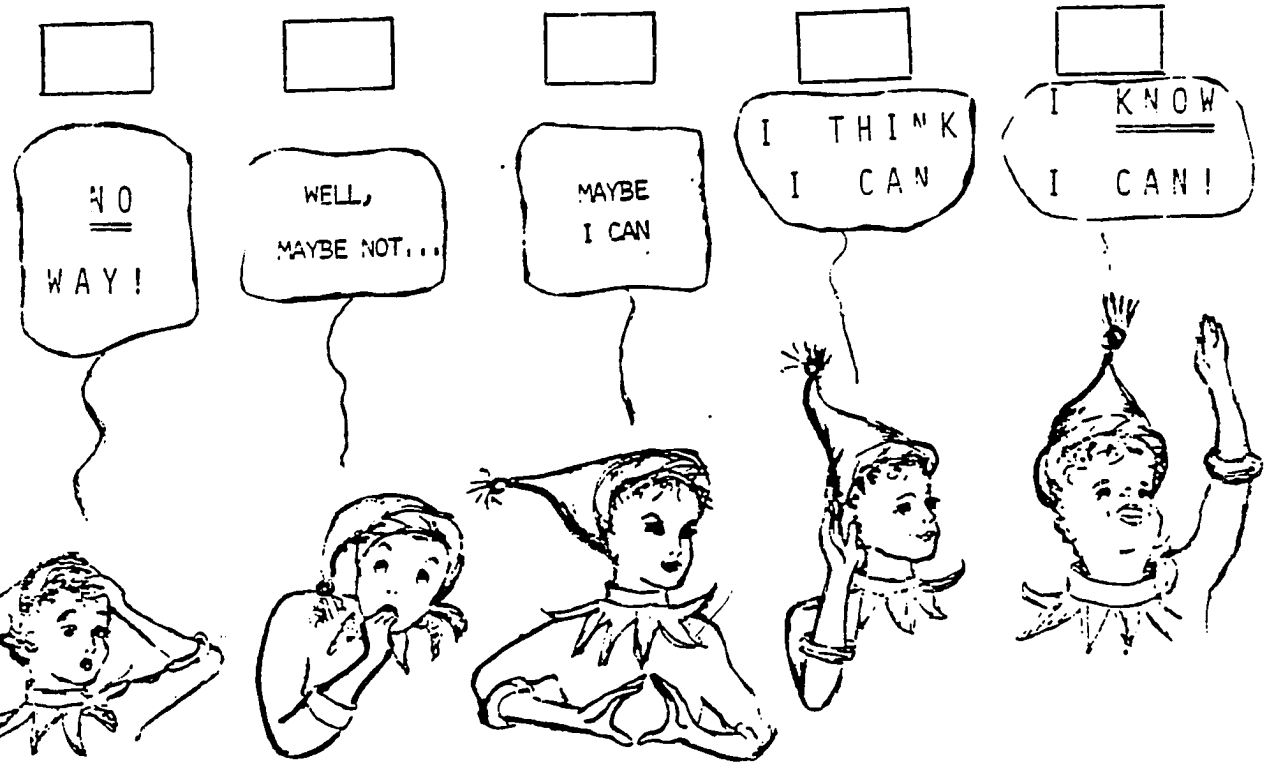
start

POST

(Sample)

$5\overline{)15}$





POST

(Sample)

$$4\overline{)172}$$

Name: _____

Class: _____

No. : _____

1. Do you believe you did BETTER than your partner? ☐

or 2. Do you feel you did just as well as your partner ? ☐

or 3. Did your partner do much BETTER than you did ? ☐

Appendix E

Please rate each student on a scale from 1 to 3 on Math Ability

STUDENT NAME	1 = Low Ability	2 = Average Ability	3 = High Ability
1.	☐	☐	☐
2.	☐	☐	☐
3.	☐	☐	☐
4.	☐	☐	☐
5.	☐	☐	☐
6	☐	☐	☐
7.	☐	☐	☐
8.	☐	☐	☐
9.	☐	☐	☐
10.	☐	☐	☐
11.	☐	☐	☐
12.	☐	☐	☐
13.	☐	☐	☐
14.	☐	☐	☐
15.	☐	☐	☐
16.	☐	☐	☐
17.	☐	☐	☐
18.	☐	☐	☐
19.	☐	☐	☐
20.	☐	☐	☐
21.	☐	☐	☐
22.	☐	☐	☐
23.	☐	☐	☐
24.	☐	☐	☐
25.	☐	☐	☐
26.	☐	☐	☐
27.	☐	☐	☐

Reference Notes

1. Mednick, E.S. (1984). Self-instruction technique: effects on children's self-efficacy, achievement and persistence. Unpublished manuscript. Ph.D. Program in Educational Psychology, Graduate Center, CUNY.

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