INFORMATION TO USERS

The most advanced technology has been used to photograph and reproduce this manuscript from the microfilm master. UMI films the original text directly from the copy submitted. Thus, some dissertation copies are in typewriter face, while others may be from a computer printer.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyrighted material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each oversize page is available as one exposure on a standard 35 mm slide or as a 17″ × 23″ black and white photographic print for an additional charge.

Photographs included in the original manuscript have been reproduced xerographically in this copy. 35 mm slides or 6″ × 9″ black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

Accessing the World's Information since 1938

300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA

Order Number 8821074

An investigation into the error coping component of self-instruction training

Colassano, Frank, Ph.D.

City University of New York, 1988

U·M·I
300 N. Zeeb Rd.
Ann Arbor, MI 48106

PLEASE NOTE:

In all cases this material has been filmed in the best possible way from the available copy. Problems encountered with this document have been identified here with a check mark ✓.

1. Glossy photographs or pages _____
2. Colored illustrations, paper or print _____
3. Photographs with dark background ✓
4. Illustrations are poor copy _____
5. Pages with black marks, not original copy _____
6. Print shows through as there is text on both sides of page _____
7. Indistinct, broken or small print on several pages ✓
8. Print exceeds margin requirements _____
9. Tightly bound copy with print lost in spine _____
10. Computer printout pages with indistinct print _____
11. Page(s) _____ lacking when material received, and not available from school or author.
12. Page(s) _____ seem to be missing in numbering only as text follows.
13. Two pages numbered _____. Text follows.
14. Curling and wrinkled pages ✓
15. Dissertation contains pages with print at a slant, filmed as received ✓
16. Other _____

_____

_____

AN INVESTIGATION INTO THE ERROR COPING COMPONENT OF SELF-INSTRUCTION TRAINING

by

FRANK COLASSANO

A dissertation submitted to the Graduate Faculty in Educational Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

1988

This manuscript has been read and accepted for the Graduate Faculty in Educational Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

3/23/88
date

Marian C. Fish
Chair of Examining Committee

3/23/88
date

Carol Kehr Tittle
Executive Officer

Robin H. Haigh

Stanley C. Feldman
Supervisory Committee

Abstract

AN INVESTIGATION INTO THE ERROR COPING COMPONENT OF SELF-INSTRUCTION TRAINING

by

Frank Colassano

Advisor: Professor Marian C. Fish

The present study investigated the active components which contribute to the overall effectiveness of self-instruction training. A review of previous component studies suggested that the effectiveness of the self-verbalization training step was mediated by the presence or absence of a content component for responding to errors. A two factor (error coping X verbalization) design was used to test this interaction hypothesis and to assess the error coping component itself. One-hundred twenty third graders were selected and randomly assigned to one of the following treatment conditions: error coping verbalizers, externally guided error copers, non-error coping verbalizers, externally guided non-error copers, practice only control. All subjects received two 30 minute training sessions. Three dependent variables were assessed: performance accuracy, self-efficacy, and persistence. The results did not support the utility of the error coping component. Verbalization had a marginally significant effect on both accuracy and self-efficacy. However, the effect for verbalization was not mediated by the error coping factor.

Although the results did not support the hypothesized relationship, the present findings are consistent with the pattern of previous results suggesting that the verbalization effect relates to the occurrence of errors during training.

Acknowledgements

I would like to express my appreciation to Dr. Marian Fish, my committee chairperson. Dr. Fish always provided both instructive comments and helpful suggestions when progress was stalled. More importantly; her sensitivity, enthusiasm and support provided the added impetus I often needed to complete this dissertation.

I also wish to thank the members of my committee: Dr. Shirley Feldmann and Dr. Phillip Saigh. Their thoughtful, incisive feedback enhanced my understanding and enriched this dissertation.

This dissertation is dedicated to:

My Family

Whenever I needed help over these last few years; my parents James and Louise, my brother Jim and his wife Laura, and my sister Theresa, her husband Eric and their children Kurt and Rachel have been there to help me. To say that I would not have completed this dissertation without them is an understatement.

TABLE OF CONTENTS

TABLE OF CONTENTS (CONT.)

TABLE OF CONTENTS (CONT.)

LIST OF TABLES

LIST OF FIGURES

CHAPTER ONE

Review of the Literature

Introduction

Self-instruction training (Meichenbaum, 1977) is a procedure wherein children are taught to talk to themselves in order to direct and control their non-verbal response. It is an instructional procedure which seeks to develop in the learner a sense of self-regulated learning. A youngster engages in self-regulated learning to the extent that he/she employs certain cognitive activities, such as planning and monitoring, while learning academic tasks (Corno and Mandinach, 1983). Self-instruction makes use of both sequential training steps and content components in order to develop self-regulated learning skills. The training steps are: cognitive modeling, external guidance, overt self-instruction, faded self-instruction, and covert self-instruction. The content components are: problem definition, response guidance, attention focusing, self-reinforcement, error coping skills and options for correcting errors.

The present study focuses on content components. Specifically, the use of the error coping component is investigated within the context of an error feedback situation. Error feedback occurs when a youngster is told that his/her answer is incorrect. Studies have shown that providing such feedback has different effects for different

types of youngsters. For highly motivated youngsters, error feedback can enhance subsequent performance (Chaiken, 1971; Diener & Dweck, 1978; Tomarken & Kirschenbaum, 1982). For helpless youngsters, error feedback leads to performance deterioration (Diener & Dweck, 1978).

Error coping statements are the self-instructional components used for optimizing the effect of error feedback. Coping statements are adaptive responses to the occurrence of error feedback. Youngsters are taught to give themselves messages such as: "I'll have to try harder on the next problem" when they fail. Such error coping statements are designed to sustain effort and renew the youngster's task focus.

The present study hypothesizes that error coping statements can enhance academic performance via the intervening variable of motivation. The motivational benefits of error coping statements will be studied using persistence and self-efficacy as dependent variables.

This study also hypothesizes that the verbalization of error coping messages is more beneficial than the observation of a model emitting the same messages. Since coping messages are exclusively verbal in nature, direct practice in verbalization is suggested to be superior to observational learning.

The Self-instruction Methodology

Self-instruction training was originally designed to

enhance children's self-control (Meichenbaum & Goodman, 1971). Because of its success in ameliorating cognitive impulsivity (Readence & Bean 1978), the intervention has generated a wide range of applications with a variety of subject populations.

For example, self-instruction has been used with mentally retarded youngsters (Borkowski & Varnhagen, 1984; Burgio, Whitman & Johnson, 1980), with hyperactive children (Brown, Wynne & Medenis, 1985; Bugenthal, Whalen & Henker, 1977; Douglas, 1980) and with emotionally disturbed subjects (Kendall & Finch, 1978). It has been explored as a method for enhancing attentional deployment (Billings & Wasik, 1985; Bornstein & Quevillon, 1976; Bryant & Budd, 1982; Burgio et. al., 1980; Friedling & O'Leary, 1979; Kendall & Braswell, 1982; Shepp & Jensen, 1983). It has been investigated as a means for reducing disruptive behavior (Coats, 1979; Kendall & Finch, 1978; Kendall & Wilcox, 1980; Kendall & Zupan, 1981).

Self-instruction training has been used to enhance serial recall strategies (Asarnow & Meichenbaum, 1979), improve performance on block design tasks (Jackson & Calhoun, 1982) and on perceptual perspective taking (Schleser, Meyers & Cohen, 1981). Increasingly, self-instruction training is being used to enhance learning in academic subject areas (Cameron & Robinson, 1980; Genshaft & Hirt, 1980; Kendall & Braswell, 1982; Robin, Armel &

O'Leary, 1975; Swanson, 1985; Swanson & Scarpati, 1984; Thackwray, Meyers, Schleser & Cohen, 1985).

In the present study, the self-instruction method of self-talk is applied to an academic subject area: mathematics. Because the treatment makes use of both component training steps and content components, self-instruction is considered a comprehensive methodology (O'Leary & Dubey, 1979; Roberts & Dick, 1982). The present study investigates the active components which contribute to the method's overall effectiveness.

There are five sequential training steps to the self-instruction method. Each step in the sequence represents a closer approximation to the goal of self-regulated learning. These five steps are: 1. cognitive modeling: the trainer performs a task while telling the child how it is done, 2. external guidance: the trainer provides verbal direction while the child completes the task, 3. overt self-guidance: the child performs the task while instructing him/herself aloud, 4. faded self-guidance: the child whispers directions during performance, 5. covert self-instruction: the child performs while silently repeating the directions (Fish & Pervan, 1985). As the training progresses through these five steps, control for the learning transfers from instructor to child so that eventually the youngster is regulating the use of the strategies taught.

During each of these training steps, component content messages are practiced. These messages are the self-administered, performance relevant instructions the child gives him/herself. The component messages include statements to guide each of the following performance skills. In problem definition, the youngster identifies the task needing to be completed. For example, he/she may be taught to say: "What is the problem? I have to multiply 25 by five." In response guidance, the youngster verbalizes the various steps to solution: "Five times five is 25. I put the five here and carry the two. Five times two is 10 plus the two I carried is 12 and I put the 12 here." In attention focusing, the youngster reminds him/herself to pay attention to the task: "I have to go slowly and be careful."

In self-reinforcement the youngster praises him/herself for an accurate response: "My answer is 125. Now I check it; it's correct. I did a good job." In evaluative coping statements, the youngster attempts to adjust to the implications of an incorrect answer. For example: "My answer is 35. Now I check it. Oh, the correct answer is 125. I'll have to pay more careful attention to my strategy next time." In error correcting strategies, the youngster attempts to uncover the reasons for his mistake. For example: "My answer isn't correct. Let me review what I did to see if I can figure out what I did wrong. Oh, I forgot

to carry etc.."

Corno and Mandinach (1983) list alertness, selectivity, connecting, planning and monitoring as the component processes of self-regulated learning. These processes are concretized in self-instruction by means of the content components. Alertness is operationalized in the attention focusing component. Selectivity is related to problem definition in that both involve focusing on the essential aspects that define the task. Response guidance involves the planning process essentially but also response guidance can include elements of connecting new learning with old. Self-reinforcement, error coping and error correcting are all specific instances of the monitoring process. Thus, viewed in this way, both the training steps and content components of self-instruction can be viewed as a method for developing self-regulation skills in the learner.

In applying the self-instruction methodology to academic tasks, it is important to determine both the training steps and the content components which actively contribute to improvements. The present study maintains that certain content components, namely error coping messages, are important contributors to the methodology's success. To date, content components have not been studied by investigators interested in analyzing the methodology. However, as the following two sections will show, the

success of self-instruction, as well as the significance of self-verbalization as a training step seems to revolve around this content component.

Self-instruction Component Studies

In the past, component studies exploring the self-instruction method have compared the various steps of the training procedure rather than content. The steps that have been compared include: cognitive modeling, external guidance and one or more of the self-verbalization steps (Roberts & Dick, 1982). These studies have sought to determine the academic gains produced by self-verbalization beyond the effects attributable to either cognitive modeling or externally guided practice. The results from such comparisons have inconsistently supported the utility of self-verbalization.

In the area of reading, Malamuth (1979) examined the effects of self-instruction components with fifth grade readers. There were two treatment groups. A cognitive modeling group was exposed to the same materials and tasks as the self-instruction group. The major difference was that the latter group was explicitly instructed in the use of self-direction via internal speech. Training tasks involved match to sample items and stories followed by comprehension questions. On the reading comprehension post test, self-instructors outperformed the modeling group by a margin that nearly reached statistical significance (i.e.

.06). On the Audiovisual Checking Test, a task measuring sustained attention, a highly significant treatment effect revealed a systematic deterioration over time in the performance of the modeling group but not the self-instruction group. The results suggest that self-verbalization enhanced reading comprehension via improvements in sustained attention or persistence.

Borkowski & Varnhagen (1984) also examined the importance of the verbalization component for enhancing reading skills. Using educable mentally retarded fifth graders, the authors compared a didactic strategy training procedure (involving both modeling and exernal guidance) to self-instruction training. This study was concerned with developing both an anticipation strategy to enhance serial recall of pictures and a paraphrasing strategy to enhance gist recall of sentences. Although both training groups improved significantly more than a practice-only control group, there were no significant differences between strategy training and self-instruction on post test measures of picture recall, gist recall of sentences and gist recall of stories. Thus, self-verbalization did not enhance the learning of specific recall strategies for reading comprehension.

Using mathematics training tasks, Roberts and Dick (1982) reported findings from an unpublished study to show that self-instruction did not improve arithmetic skills any

more than a cognitive modeling condition.

Also in the area of mathematics, Mednick (1986) examined four variations of strategy instruction for long division. Youngsters were trained in dyads during one 30 minute training session. In one dyad children self-instructed when solving problems and partners observed both their performance and verbalizations. In dyad two, youngsters worked the division problems while listening to partners who verbalized the strategies but did not work the problems. All four variations of training led to improved long division performance compared to a practice control. However, training groups did not differ from each other on the division post test.

Contrary to the above findings, Davis & Hajacik (1985) suggested that self-instruction added significantly to treatment efficacy for multiplication of decimals. Using a multiple baseline design across seven subjects, the authors compared the effect of strategy training, involving both cognitive modeling and external guidance, to self-instruction which added the verbalization component. Their findings indicated that the self-instruction phase enhanced both attention, defined as on-task behavior, and multiplication accuracy, defined as number of problems solved correctly over a predetermined interval. As in the Malamuth study, enhanced attentional skills were implicated as one of the positive outcomes stemming from introduction

of the verbalization component.

Thackwray et. al.(1985) employed an experimental design to compare the following treatment conditions: general self-instruction where youngsters learned a broadly applicable problem solving strategy, specific self-instruction where a content focused plan was taught and didactic instruction where the experimenter modeled and externally guided subjects through the same specific strategy used by self-instructors. Training involved addition of two, three and four digit numbers. All training groups showed comparable improvements on the addition post test. However, the specific self-instructors performed significantly better than other groups on the math subtest of the Peabody Individual Achievement Test. The general self-instructors improved more than either of the specific groups on the spelling and general information subtests of the Peabody Individual Achievement Test. Once again, the outcomes pattern from this study would suggest that the benefits resulting from verbalization were not attributable to enhanced strategy learning since all training groups improved equally on the addition post test. However, these findings indicate that one benefit of verbalization is increased generalization.

Several studies have sought to determine the effectiveness of a self-instruction procedure for improving handwriting accuracy, although no investigators have

assessed the effect of the verbalization component specifically. Robin et. al. (1975) compared two procedures for teaching writing skills to kindergarten children. In direct training, performance feedback and social reinforcement were provided as youngsters copied letters. In self-instruction, the direct training components as well as a verbal script for guiding performance were used. Although self-instructors performed significantly better than the group receiving feedback and praise alone, the differences were small compared to the gains made by both groups relative to a no treatment control. Furthermore, it is not clear whether self-instructors' enhanced performance was due to modeling, external guidance or the self-verbalization of instructions.

Burgio et. al. (1982) used a multiple baseline design across five subjects to teach handwriting skills to EMR youngsters via self-instruction. No significant gains were noted. By contrast, Kosiewicz, Hallahan, Lloyd and Graves (1982) were able to increase an upper elementary school student's writing dramatically using a combination of self-instruction and self-correction training.

In summary, research indicates that the verbalization of self-instructions does not enhance learning of specific academic task strategies. On the other hand, self-verbalization appears to become a more significant factor when dependent variables assess a wider range of

performance relevant skills; namely attention, persistence and generalization.

Content of Self-instruction Messages

The suggestion that verbalization may enhance certain performance parameters but not others leads naturally to a consideration of the contents of self-instruction messages. Since Meichenbaum (1977) included different messages to address different performance related skills, it is possible that verbalization adds to the effectiveness of some but not all messages.

Component messages can be placed into two broad categories: learning and performance. Messages dealing with problem definition, attention focusing and response guidance structure the youngster's response to the task and so are concerned with learning. By contrast, messages dealing with self-reinforcement, evaluative coping, and error correction structure the youngster's reactions to frustration, success or failure and thus focus on performance consequences. The rationale for including error coping messages as part of self-instruction was prompted by data showing that impulsive children manifested a marked deterioration in performance following errors (Meichenbaum & Goodman, 1969).

Thus, one might expect learning messages to enhance problem solving strategies directly. On the other hand, messages such as self-reinforcement seem responsible for

other performance-related skills. For example, self-reinforcement performance messages, if they act in a manner consistent with other positive reinforcers, will increase the occurrence of a self-instructional response and promote strategy maintainence.

This distinction between learning and performance messages, viewed in the context of the analysis of verbalization studies, generates the hypothesis that self-verbalized performance messages may be important for enhancing skills such as sustained attention, motivation and generalization. However, the verbalization of learning messages would seem to add little to actual strategy acquisition.

Additional support for such a position can be gathered by examining the messages used in the previously reviewed verbalization studies. If there are differences in the type of performance messages across studies and, if these differences discriminate successful from unsuccessful outcomes; then there is added reason to suggest that verbalization adds to the effectiveness of performance messages.

It is difficult to compare exactly the contents of self-instructions across studies since detailed scripts are not frequently included in reports. Malamuth (1979) listed self-reinforcement and coping with errors as the performance messages of her effective self-instructional

reading remediation. Borkowski & Varnhagen (1984) included self-reinforcement as their sole performance message and found self-instruction to be insignificant for improving recall strategies.

Among the training procedures for mathematics computations, Mednick (1986) included specific response guidance messages with each long division problem. No performance messages were practiced and self-verbalization was not significant for improving accuracy, self-efficacy or persistence. Davis and Hajacik's script (1985) included a self-reinforcement performance message. The authors noted accuracy gains stemming from enhanced on task behavior. Thackwray et. al. (1985) modeled performance messages involving error correction and self-reinforcement. However, it is unclear how these components were applied during youngsters' self-directed performance. Nevertheless, computational and generalization gains were noted.

Of the studies that used self-instruction to improve handwriting, Burgio et. al. (1982) used self-reinforcement and distraction inhibiting performance messages. The intervention proved unsuccessful. Kosiewicz et. al. (1975) employed self-reinforcement and error correction to successfully improve a youngster's handwriting. Robin et. al. (1975) used self-reinforcement and error correction and found gains resulting from self-instruction, although the significance of these gains was somewhat mitigated by the

nature of the control condition.

This analysis supports the relevance of performance messages and reflects a trend among studies applying self-instruction to academic areas. Generally, those studies that included performance messages for responding to errors show self-verbalization to enhance functioning. By contrast, the studies that did not include performance messages for coping with or correcting errors indicate that self-verbalization did not contribute significantly to improvements. The results of the above cited studies are summarized in Table 1.

Error Feedback and Error Messages

In order to understand error coping messages, it is first necessary to define the error feedback situation. Error feedback is a response consequence wherein a youngster is informed when his/her response is wrong. Error feedback is analogous to the operant contingency of punishment in that it involves the presentation of an aversive stimulus contingent upon an incorrect response. Like punishment, error feedback is expected to decrease the probability of future incorrect responses. However, as subsequent sections will document, error feedback does not bring about this desired effect with all children.

Error coping messages are self-instructional strategies designed to protect the youngster from the negative effects of the error feedback situation. Error coping messages take

Table 1

Summary of Content Messages used in Self-instruction(SI) Verbalization Studies

	Message Components*					
	learning			performance		
Study	pd.	rg.	fa.	sr.	es.	Outcome
Borkowski & Varnhagen, 1984	X	X		X		ns.* effect for SI on reading tasks.
Burgio et al,1980	X	X	X	X	X	SI improved math skills and attn.*
Davis & Hajacik, 1985	X	X	X	X		SI improved attn.
Kosiewicz et al, 1975	X	X	X	X	X	SI improved handwriting.
Malamuth, 1979	X	X	X	X	X	SI improved attn. and reading comp.
Mednick, 1986		X				ns. effect for SI in math.
Robin et al, 1975	X	X		X	X	SI. improved writing.
Thackwray et al,	X	X	X	X	X	SI improved math and spelling.

*Note. pd=problem definition, rg=response guidance, fa=attention focusing, sr=self-reinforcement, es=error statements, ns.= not significant, attn.=attention.

many concrete forms. For example, a youngster may be taught to say to him/herself: "I'll have to try harder next time" or "I know I can do these problems" or "Even if I make a mistake, I can go on slowly and carefully." The common element in all such responses is that they represent adaptive responses to the stimulus of error feedback. All such coping messages are designed to keep the youngster actively task engaged and to prevent him/her from giving up. Error correcting messages, by contrast, have a more specific function and, because of this, are not addressed in the present paper.

Although the literature seems to point towards error coping statements as an important component to be verbalized, no systematic investigation has addressed the relevance of error coping statements. As has been mentioned previously, very few studies have examined content parameters at all. Consequently, the present study examines the relevance of error coping statements. The study seeks to answer the question: does verbalization of error coping statements improve subsequent functioning, and if so how? A further understanding of the nature of this question requires consideration of the following issues.

1. discussion of a theoretical framework (i. e. social learning theory) within which both the self-instructional method and error coping messages can be understood, 2. an examination of the effect of error feedback on performance

parameters, 3. an understanding of the relationship between error feedback and error coping, 4. a rationale for the value of verbalization to error coping.

Social Learning Theory and Self-instruction

Social learning theory (Bandura, 1977b) provides a framework within which self-instruction training can be viewed. Bandura distinguishes response acquisition from response performance (see Figure 1). Acquisition or learning is regulated by the observation of events prior to a response. Such observational learning involves the components of attention and retention; a youngster must both attend to modeled acts and have some way of remembering the acts in order to acquire a response.

Response performance is guided by its positive and negative consequences. Performance involves motor reproductive and motivational components. In order for a youngster to perform a response, he/she must have some way of translating the retained act into motor behavior and he/she must have some incentive or reason for doing so.

Within the context of social learning theory, response acquisition is seen as serving a primarily informative function. A youngster acquires a response by observing and gathering information from a model. Secondarily, observational learning may also have motivational implications. For example, if a model is of the same sex as an observer, the observer will be more likely to imitate

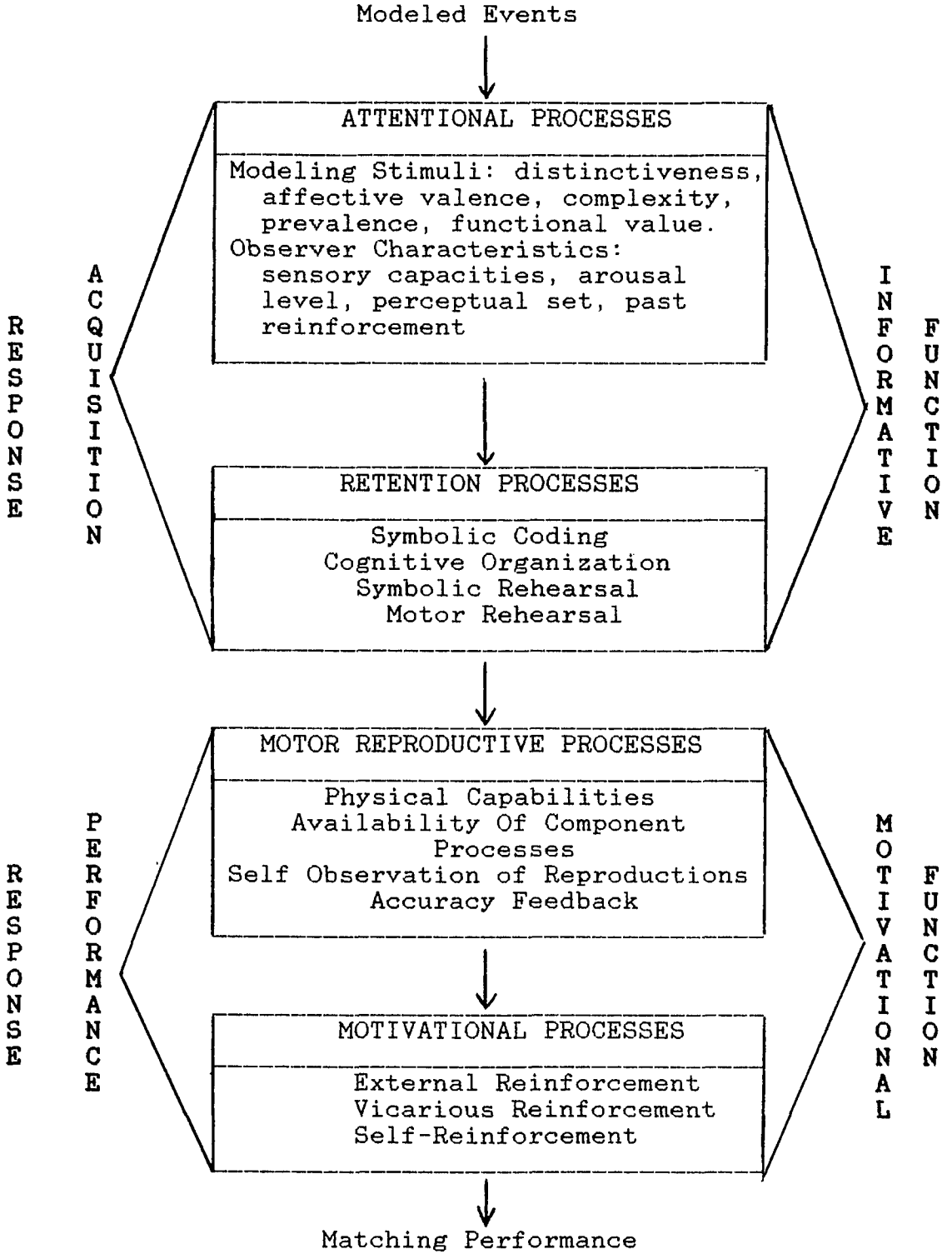


Figure 1 Component processes governing observational learning in the Social Learning analysis (from Bandura, 1977b, p. 23).

the model's behavior.

Response performance, by contrast, is seen as primarily motivational in function. A youngster's performance of a response is dependent upon what he/she has gotten for performing in the past and what is anticipated for the present. Reinforcement is the name given for the various kinds of response consequences that raise the child's motivation to perform. Punishment is the name given to consequences that decrease the likelihood of a response. Response performance does have an informational function, but it is secondary and involves the refinements a youngster makes from practicing a response.

Romberg and Carpenter (1985) have commented that theories of learning are often estranged from methods of instruction. Learning theories tend to be descriptive in that they identify how children learn and think. Instruction, on the other hand, is prescriptive; it establishes procedures for how children should be taught. In the present case, however, social learning theory does have an instructional counterpart: self-instruction training.

Self-instruction includes message components that mirror the four processes involved in acquisition and performance. Problem definition and attention focusing remind the youngster to focus on the task at hand. As such, they reflect the attentional process required for

acquisition. Response guidance is basically a script that subdivides an overall response into subroutines. Therefore it is concerned with the retention portion of the acquisition process.

Performance encompasses self-reinforcement, error correction and error coping. Self-instruction performance messages are motivational in function. For example, self-reinforcement acts in a way to raise the probability of a future accurate response. In this way, it provides the same motivational incentives as do other positive reinforcers. Error coping is also motivational in nature. When a youngster is confronted with potentially aversive error feedback, error coping messages seek to maintain a positive outcome expectancy.

At its most concrete level, self-instruction training is a method for teaching youngsters specific skills. However, as the procedure is repeated, youngsters can internalize the training components themselves and, in this way, use these components as a method for approaching new tasks. From this perspective, self-instructions become theoretically equivalent to what Corno and Mandinach (1983) call a self-regulated learning schema. They help develop the metacognitive skill of "learning how to learn."

Error Feedback and Motivation

When failure contributes to an expectancy of negative future outcomes, such error feedback lowers motivation

(Bandura, 1977b). However, error feedback need not lead to such an expectancy. Outcomes affect expectancies at an aggregate rather than momentary level (Bandura, 1977b). Thus, an expectancy of ultimate success can sustain one's motivation when confronted with error outcomes. In fact, significant evidence exists to suggest that motivational indices are enhanced by increased rates of error feedback (Chaikin, 1971; Chapin & Dyck, 1976; Roth & Kubal, 1975). Moreover, in some instances, respondents self-monitoring of error outcomes is more faciliative than monitoring positive outcomes (Tomarken & Kirschenbaum, 1982). The question emerging at this point is: under what conditions are positive expectancies maintained or enhanced by error feedback?

Diener and Dweck (1978) examined this question by recording the spontaneous verbalizations of both mastery oriented and helpless children during a condition of error feedback. Among the mastery oriented youngsters, error feedback led to enhanced strategy self-monitoring. Error feedback led the helpless youngsters to emit a higher incidence of negative self-statements (e. g., "I've never been good at this"). Motivation, assessed in terms of persistence, and subsequent performance were enhanced for the mastery oriented youngsters. Motivation and subsequent performance deteriorated among the helpless children. Thus, the results of this study indicate that when youngsters are

high in mastery, motivation may be increased by error feedback.

A number of studies have found a relationship between task persistence and the motivational construct of self-efficacy (Mednick, 1986; Schunk, 1981, 1983). Self-efficacy theory (Bandura, 1977a) distinguishes expectations of personal efficacy from outcome expectations. One has high self-efficacy to the extent that he/she feels confident of being able to perform a given response. By contrast, outcome expectancy has to do with the extent to which such a response will lead to a desired outcome.

Performance accomplishments are the primary source of knowledge about self-efficacy (Bandura, 1977a). However, the learner's interpretation of both task requirements and the method of instruction also affect his/her sense of efficacy (Corno & Mandinach, 1983). In general, error feedback will lower a youngster's self-efficacy, but once a strong sense of efficacy is developed an occasional error will not have much effect (Schunk, 1984). Consequently, high self-efficacy, as well as the high mastery condition, are both conditions where motivation can be maintained in the face of error feedback.

By contrast, where mastery is low and self-efficacy weak, error feedback can have a debilitating motivational effect. A higher incidence of negative self-statements has been found to co-exist with a variety of performance

deficits. Included in this group are: lack of assertiveness (Schwartz & Gottman, 1976), poor math performance (Zatz & Chassin, 1985), test anxiety (Bruch, 1978) and heterosexual anxiety (Cacioppo, Glass & Merluzzi, 1979). Thus, where self-efficacy is precarious, error feedback can have a disruptive effect on motivation.

The above analysis suggests that error feedback can have differing effects on youngsters' motivation. Where self-efficacy and/or skill mastery are high, error feedback can raise or, at least, maintain motivation. On the other hand, where skill mastery and/or self-efficacy are low, error feedback seems to lower motivation and to lead to negative self-statements. The high mastery condition brings with it greater familiarity with the response so that error feedback can lead to redoubled persistence regarding response performance. Low mastery, by contrast, is characterized by a lack of sophistication regarding response competence and error feedback leads to discouragement and giving up. High self-efficacy allows youngsters to tolerate an occasional error. Low self-efficacy debilitates the motivation to keep trying.

Error Coping Statements as Performance Strategies

Self-instructional error messages are designed to maintain motivation in the case of failure. Messages for coping with errors come from a cognitive restructuring orientation (Mahoney & Arnkoff, 1978). This orientation

assumes that maladaptive thoughts can interfere with mediational processes. Such thoughts are implicated in a variety of stress reactions. Thus, children taught competence related coping messages reduced their fear of the dark (Kanfer, Karoly & Newman, 1975). Speech anxious college students taught to replace negative self-statements (e. g., "I will sound stupid") with coping self-statements (e. g., "I can only improve") reduced speech anxiety (Fremouw & Zitter, 1978). Test anxious college students taught coping skills improved in both grade point average and self-report scales (Meichenbaum, 1972; Wine, 1971).

Yet, other researchers have reported that training in coping messages has failed to improve the performance of anxious subjects (Bruch, 1978; Fox & Houston, 1981). In fact, a higher incidence of coping statements has been found among test anxious children (Zatz & Chassin, 1985). Coping strategy use has been correlated positively with frequency of negative self-statements (Bruch, 1978). Several researchers have commented that coping statements may distract youngsters from a task and impair performance (Fox & Houston, 1981; Zatz & Chassin, 1985).

Error coping messages vary in content. Some messages are designed to bolster self-esteem: "I know I can do just as well in math as in other subjects" (Genshaft & Hirt, 1980). Others are effort related: I'll be more careful next time" (Thackwray et. al., 1985). Still others are focused

on counteracting the potentially negative effects of error outcomes "...even if I make a mistake, I can go on slowly" (Meichenbaum, 1977). The salient point is that they are performance based as opposed to acquisitional in nature. Consequently, they can augment performance only by sustaining motivation. In the event that a youngster has not yet learned the response, coping messages cannot be expected to aid his/her performance. Error coping statements may sustain motivation following one error. But, even this function will deteriorate when a youngster is faced with repeated errors. Therefore, error coping statements function as motivators. To the extent that a child knows the basic elements of a correct response, such coping statements sustain motivation. However, for the youngster who has not acquired the elements of a response, coping messages can only forestall the more elementary acquisition process.

The preceding sections have suggested that self-instructional content messages are based on the social learning components of acquisition and performance. In addition, it was stated that content messages dealing with error coping are concerned with motivational parameters. Such parameters are the same as those involved in the error feedback situation. In this feedback situation, it was demonstrated how youngsters high in self-efficacy and/or mastery derived motivational benefits on constructs such as

persistence and self-efficacy. Finally, error coping messages were presented as strategies designed to enhance these motivational benefits for youngsters having a basic grasp of the target response.

Error Coping Statements and Verbalization

Assuming that self-instructional coping messages are appropriate strategies for responding to errors, what reasons can be forwarded to suggest that these messages are enhanced by verbalization? Other than the previously reviewed results from training studies, these reasons are largely speculative.

Self-instruction derives largely from Luria's model of the developmental relationship between speech behavior and motor behavior (Meichenbaum, 1977). According to this model, speech exerts an increasing control over motor responses between the ages of 2 and 5 (Luria, 1961).

For the 2 year old, motor behavior is the predominant response mode. Speech can initiate an action, but it cannot alter an activity once it has been started. For the 3 year old, speech assumes a primary role. It is easier for the 3 year old to respond to a signal with a word than with an action. However, speech impels action at this stage. A word cue leads to a response even if the word cue is "stop". The 4 year old learns to regulate rather than impel action by speech. At this stage, the significative function of words such as "stop" assumes self-regulatory control. Beyond 5

years of age, action directing speech is abbreviated and internalized so that motor behavior is regulated by covert self-verbalization.

Attempts to corroborate this developmental sequence, however, have raised considerable doubt about the controlling function of words over actions (Roberts & Dick, 1982). A classroom observational study suggested that motor responses control and direct speech acts (Roberts, 1979). Miller, Shelton and Flavell (1970) found that, among 4 year olds, motor responding to a signal preceded verbalization despite specific instructions to speak before acting. They also found that overt self-direction did not facilitate a motor response in any condition. These authors concluded that self-instruction involves an added response requirement and detracts from performance efficacy.

In evaluating Luria's model, Roberts & Dick (1982) review several studies which suggest that verbal and motor response capabilities develop along quasi-independent courses. They conclude that it is best to view motor and verbal courses as separate streams of behavior which can reciprocally influence each other under certain reinforcement conditions.

It is maintained here that the error feedback situation is one such condition. Having executed a motor response and having received error feedback, the youngster would seem to be in need of an alternate response system with which to

evaluate the preceding motor act. The verbal stream, being predominantly cognitive and conceptual, is well suited to this purpose. Thus, it is suggested that self-instruction influences motor performance via an evaluative rather than a directing function. Within this framework, verbalizing coping strategies is an important aspect of the component's success.

CHAPTER TWO

The Study

This study compares the use of self-instruction with error coping statements to self-instruction without error coping statements during the error feedback situation. The study attempts to show that the use of error coping messages enhances performance accuracy through the intervening variable of motivation. Thus, the basic thesis is that self-instruction becomes a more effective intervention when it includes messages for coping with errors.

A secondary hypothesis involves the importance of self-verbalization as a training step. The verbalization of error coping messages is compared to the observation of a model making error coping statements. It is maintained that error coping is an essentially verbal response. It is also maintained that youngsters become competent at this skill in the same way that they develop competence with other responses: by practice. Consequently, a secondary thesis is that self-verbalization becomes a significant factor when training includes error coping messages.

The third hypothesis assesses the effects of error coping messages on motivation. It is suggested that, by maintaining effort despite failure, error coping messages have a directly beneficial effect on motivational variables.

The above relationships are examined in the area of academic instruction. The training task is arithmetic computations involving the multiplication of whole numbers.

Two independent variables are explored using a 2 verbalization X 2 instructional content factorial design (see Table 2). There are two conditions of the instructional content variable. In training groups one and two, error coping messages are included within the self-instruction content components. In training groups three and four, only problem definition, attention focusing, response guidance and self-reinforcement are used. There are also two conditions for the verbalization variable. In training groups one and three, the trainer verbalizes all training messages. Training steps include only cognitive modeling and external guidance. In training groups two and four, youngsters learn to self-instruct messages. Training steps include cognitive modeling, external guidance, overt self-instruction, faded self-instruction, and covert self-instruction. There is also a practice only control group (i. e. condition five). Subjects in this group are exposed to the same materials as experimental subjects, but receive no instruction.

An analysis of covariance is being used to evaluate treatment effects. The pretest measures will serve as the covariate. There are two varieties of dependent measure. One dependent variable is multiplication competence,

Table 2

Levels of Treatment for the Study

Instructional content	Verbalization: Verbalization	Verbalization: No verbalization
Error coping	condition 1 self-verbalized, error coping messages	condition 2 externally guided, error coping messages
Non error coping	condition 3 self-verbalized pd, fa, rg, sr*	condition 4 externally guided pd, fa, rg, sr
No instruction		condition 5 practice-only control

Note. pd=problem definition, fa=attention focusing, rg=response guidance, sr=self-reinforcement.

operationalized as performance accuracy on a computations test. The other measures represent motivational constructs. Two different indices are used: self-efficacy and persistence. Self-efficacy is assessed via rating scales completed by the subjects. Persistence is operationalized as the amount of time subjects spend working optional practice problems.

Hypotheses

The first group of hypotheses focus on the competency gains anticipated from self-instructional content variation.

1. Subjects in training conditions one through four will manifest competency gains that are significantly greater than the gains achieved by the practice only group.

2. Subjects in conditions one and two, where error coping statements are taught, will manifest competency gains that are significantly greater than the gains achieved by subjects in conditions three and four where no error coping is practiced.

The next group of hypotheses focus on the competency gains proposed as a result of the verbalization variable.

3. There will be no significant difference in competence between verbalizers and non-verbalizers.

4. Where error coping statements are not practiced, there will be no significant difference in competence between verbalizers (condition 3) and non-verbalizers

(condition 4).

5. Where error coping statements are practiced, subjects who verbalize these messages (condition 1) will manifest competency gains that are significantly greater than the gains made by subjects who do not verbalize these messages (condition 2).

The next group of hypotheses have to do with the proposed effects of treatments on motivation.

6. Subjects practicing error coping statements (conditions 1 and 2) will show significantly greater persistence than subjects who do not practice error coping statements (conditions 3 and 4).

7. Subjects practicing error coping statements will show significantly greater self-efficacy than subjects who do not practice error coping.

8. There will be no significant difference in persistence between verbalizers and non-verbalizers.

9. There will be no significant difference in self-efficacy between verbalizers and non-verbalizers.

10. Where error coping statements are practiced, subjects who verbalize these messages (condition 1) will manifest gains in persistence that are significantly greater than the gains made by subjects who do not verbalize these messages (condition 2).

11. Where error coping statements are practiced, subjects who verbalize these messages (condition 1) will

manifest gains in self-efficacy that are significantly greater than the gains made by subjects who do not verbalize these messages (condition 2).

CHAPTER THREE

Method

Subjects

The subjects for this study were selected from a parochial school population in New York City. The entire third grades of five such elementary schools were screened on the Preskills Multiplication Facts Test (see Appendix B). This 15 item test assessed students' readiness for learning training task skills by examining their familiarity with multiplication table facts. A mimimum score of 70% on this test was necessary in order to be selected as a subject for this study. One hundred-twenty subjects were selected via this screening procedure.

Assessment Procedures

The dependent variables for this study were assessed in the following ways. Multiplication competence was operationally defined as performance accuracy on the Multiplication of Whole Numbers Test (see Appendix C). This 15 item experimenter constructed test assessed subjects' competence in solving two by two digit multiplication problems. The items on this test were similiar to examples used during training.

The Multiplication of Whole Numbers Test was formatted so that a self-efficacy measure could be derived (see Mednick, 1986). Immediately prior to each page on which a problem is worked, a five point Likert scale was developed

assessing how sure each subject was that he/she could solve the problem accurately (see Appendix C). The scale was organized so that the higher the number, the more confident the youngster was that he/she could solve the problem. The sum of these ratings was the operational definition of the self-efficacy motivational construct. Thus, self-efficacy ranged from a low of 15 to a high of 75. Both self-efficacy and multiplication competence were assessed in groups of approximately 10 subjects.

Following pretest administration of the Multiplication of Whole Numbers Test, subjects were randomly assigned to one of five training groups. In order to insure that the youngsters selected actually needed instruction in this area, only those who scored below 50% on the Multiplication of Whole Numbers Pretest were accepted as subjects in ths study.

Subjects' persistence was assessed by means of a supplemental practice session conducted immediately prior to the first session (pretest) and immediately following the last session (post test). Each child was given a booklet containing 10 practice problems. The instructions for the pretest session were as follows:

> You have been picked to take part in a special project to see how well you can learn to solve these problems. You are going to take a multiplication test in a few days and it is

> important that you get the best mark that you can on that test. To help you get ready for the test, I'm going to give you a chance to practice on these problems. You can practice for as long as you want and you can do all the problems or just some of them or none of them if you don't want to. When you want to stop, raise your hand.

The instructions for the post test session were similiar to those for the pretest. Subjects' persistence was defined as the total time spent working on these practice problems. Persistence was assessed in groups of four subjects at a time.

Treatment Conditions

Following the pretest assessment of persistence, subjects were given two training sessions of approximately 30 minute duration. These sessions provided practice and instructional guidance in the multiplication of whole numbers. Subjects were seen in groups of two. Training was initiated with the following instructions:

> During the next two days, I am going to teach you how to solve problems like this one (points to the first problem). While we are working on these problems, don't say anything if you see that I have made a mistake. Some errors are being made on purpose to help you learn better.

The training routine used in this study followed the

procedures outlined by Meichenbaum (1977). A sample script for a training problem follows.

```
    7 3
  X 3 6
  4 3 8
2 1 9
2 6 2 8
```

Okay, what do I have to do on this problem? I have to multiply 36 times 73 (problem definition). I start on this right side and first multiply 6 times 3. That equals 18. I put the 8 here and carry the 1 to here (response guidance). I have to remember to go slowly and pay attention to what I'm doing (attention focusing).

Now I do 6 times 7 equals 42 plus the one I carried is 43 and I put that number here. Okay, now 3 times 3 equals 9. There's nothing to carry so I put the 9 over here. Now, 3 times 7 equals 21 and I put that number here (response guidance). Almost done now, just keep taking my time (attention focusing). Now I draw a line and add it up. Eight plus nothing is still 8. Three plus 9 equals 12. I put the 2 here and carry the 1. Four plus 1 equals 5, plus the 1 I carried equals 6. I put that here. Two plus nothing equals 2 and I put that here. So, my answer is 2628 (response guidance). Now I have to check to see if it's right. It's right!

Hey, I really did a good job on that problem (self-reinforcement).

Complete scripts for both training sessions can be found in Appendix D.

Although training was administered to groups of subjects, the nesting of groups within treatment conditions appeared unwarranted. Training instructions for this study were organized according to standardized scripts so that there was no variation across groups within a condition. Thus, because training was so standardized it is assumed that the grouping factor is not a significant source of variability in the dependent measures.

Trainers for these sessions were two graduate students in psychology. The male trainer was a masters level school psychology student. The female trainer was a doctoral level student in social psychology. Trainers were instructed in the mechanics of the self-instructional procedure during two one hour training sessions by the experimenter. Trainers were naive as to both the experimental conditions and the hypotheses being tested.

Intertrainer reliability was established in the following way. Sessions were tape recorded. As mentioned previously, both the cognitive modeling and externally guided problems were standardized so that each of the trainers said the same words as he/she instructed the children in problem solving. An independent judge randomly

selected 20 tapes from session one and 20 tapes from session two. The judge then rated the content on a problem by problem basis according to whether the trainer's words agreed or disagreed with the script for that problem. Intertrainer reliability was defined as the number of agreements divided by the number of problems sampled (i.e. 120 problems for each session).

Subjects were assigned randomly to one of five treatment conditions.

Self-instructed Task and Error Coping Messages (Condition 1) Subjects in this condition received training in problem definition, attention focusing, response guidance, self-reinforcement and error coping messages. Further, subjects in this condition were exposed to cognitive modeling, external guidance, overt, faded and covert self-instruction. During each session, subjects received four modeling trials, two externally guided trials, two overt self-instructed trials, two faded self-instructed trials and two covert self-instructed trials. On two modeling trials per session, the trainer's strategy led to an incorrect answer. At this point the trainer modelled an appropriate error coping message. On the other two modeling trials, the trainer's strategy led to a correct answer and the trainer delivered an appropriate self-reinforcing message. During the six self-instructed trials per session, subjects' errors were monitored so that a

total number of errors per subject per session was computed.

Externally Guided Task and Error Coping Messages (Condition 2) Subjects in this condition received training in the same content components as subjects in condition 1. However, in this condition, subjects were exposed only to cognitive modeling and external guidance. During each session, subjects received 8 modeling trials and 4 externally guided trials. The number of errors that the trainer commits during training in this condition was matched to the errors per subject per session of youngsters in condition 1. In this way, the same number of reinforcement and error coping messages was received by Ss. in both conditions.

Self-instructed Task Messages (Condition 3) Subjects in this condition received training in problem definition, attention focusing, response guidance and self-reinforcement but got no practice in error coping messages. As in condition one, subjects in this condition were exposed to cognitive modeling, external guidance, overt, faded and covert self-instruction. Sessions for subjects in this condition were the same as those for subjects in condition one. There were four modeling trials, two externally guided trials, two overt, two faded and two covert self-instruction trials. However, during the error trials only error feedback was provided. Subjects in this

condition received no self-instructional training in error coping messages. However, the number of errors committed by subjects in this condition was recorded by the trainer.

Externally Guided Task Messages (Condition 4) Subjects in this condition received training in problem definition, attention focusing, response guidance and self-reinforcement as the subjects in condition three. Regarding the training steps, subjects in this condition were only exposed to cognitive modeling and external guidance. During the eight cognitive modeling trials per session, the number of trainer errors were arranged so as to mirror the number of a matched subject in condition three.

Statistical Analysis

As mentioned previously, a multiple analysis of covariance (MANCOVA) was used to evaluate the effects of treatments. In all cases, pretest scores served as the covariate. A MANCOVA was conducted on the post test competency measure. The analysis was conducted as outlined by Keppel (1982) using a 2 X 2 factorial with a single "outside" control group. Main effects for verbalization and error coping were calculated for the experimental groups as they are depicted in Table 2. As a second step, the experiment was treated as a single factor design using the computational formulas for single degree of freedom comparisons between the control condition and the various treatment groups.

Hypothesis 1, comparing the control mean and the mean for the four combined factorial groups, was tested using a coefficient of +1 for the control mean and a coefficient of -1/4 for each of the four factorial groups. The remaining hypotheses dealing with the competency measure were tested via the 2 X 2 factorial.

A MANCOVA was conducted on the post test self-efficacy measure as well as on the data on persistence. Pretest self-efficacy ratings and pretest persistence time scores were used as the covariates. The statistical procedures were the same as those outlined above for a 2 X 2 factorial with a single "outside" control group.

CHAPTER FOUR

Results

Intertrainer reliability for training sessions was evaluated by an independent judge who assessed session content according to its agreement with session scripts. Overall reliability for both sessions was measured to be 84% (202 of the 240 problems assessed followed the script). For session one, reliability was 80% (96 of the 120 problems were consistent with the script). For session two, reliability was 88% (106 of 120 problems adhered to the script).

Table 3 displays the means and standard deviations of the dependent measures. Both pretest and post test scores are presented.

All groups had pretest accuracy scores of zero. Therefore, the examination of performance accuracy employed an analysis of variance on post test scores alone. Table 3 shows that the pretest to post test accuracy improvements ranged from 1.83 for practice controls to 6.46 for error coping verbalizers.

Inspection of the self-efficacy scores in Table 3 indicates that pretest efficacy tended to be high. Self-efficacy was assessed by means of a rating scale where scores ranged from 5 to 75. The displayed pretest efficacy means range from 57.21 to 65.5.

Post test self-efficacy scores for Group 1 (error

Table 3

Means and Standard Deviations of Treatment Groups on Dependent Measures

	Accuracy		Self-efficacy[a]		Persistence[b]	
Condition	Pre	Post	Pre	Post	Pre	Post
Group 1						
M	0	6.46	57.9	61.9	9.7	13.5
SD	0	4.38	14.4	10	4.3	7.1
Group 2						
M	0	4.21	57.2	56	9.5	10.9
SD	0	3.92	15.6	10.9	5.3	8.2
Group 3						
M	0	4.58	61.5	61.3	14.1	15
SD	0	5.22	14	11.9	7.8	9.4
Group 4						
M	0	3.42	60.8	59	11.8	14.4
SD	0	3.93	17.3	14.4	5.5	9
Group 5						
M	0	1.83	58.1	63.3	12.9	7.8
SD	0	4.08	16.7	12	5.7	4.1

Note. Gp. 1 = error coping verbalizers, Gp. 2 = externally guided error copers, Gp. 3 = non-error coping verbalizers, Gp. 4 = externally guided non-error copers, Gp. 5 = practice control. *a* range = 5 to 75, *b* scores in minutes.

coping verbalizers) and Group 5 (practice control) were higher than the pretest scores. Self-efficacy remained virtually the same from pretest to post test for Group 3 (non error coping verbalizers). Post test self-efficacy scores were lower among subjects in Group 2 (externally guided error copers) and Group 4 (externally guided non error copers).

Visual inspection of the persistence data from Table 3 shows that experimental groups' scores increased from pretest to post test. By contrast, Group 5 became less persistent losing an average of 5.11 minutes.

The hypotheses of this investigation will be presented individually. An alpha level of .05 was selected to test for the statistical significance of each hypothesis. In addition to the investigation of hypothesized relationships, post hoc tests were also conducted in order to compare the benefits that subjects derived from the specific treatment conditions. The Tukey test was used to adjust the levels of significance for dependent measures. The Tukey test was selected rather than the more stringent Scheffe' test, because all conditions had equal numbers of subjects (Hays, 1973) and because the focus of the analysis was pairwise comparisons (Keppel, 1982).

Analysis of Covariance

Both persistence and self-efficacy data are being studied via an analysis of covariance procedure. To

ascertain the appropriateness of this procedure, a preliminary analysis of these dependent measures was conducted.

A one way analysis of variance was conducted on pretest persistence and self-efficacy. Table 4 contains the results of the analysis for persistence. A significant between groups effect was found, $F(4, 115)=2.78$, $p=.03$. The existence of significant pretreatment group differences supports the utility of the analysis of covariance.

Results of the analysis of self-efficacy data are presented in Table 5. No significant pretest differences were found between groups, $F(4, 115)=.36$, $p=.83$.

Table 4

Summary of ANOVA for Pretest Persistence

Source of Variation	df	MS	F	p
Between Groups	4	94.47	2.78	.03
Within Groups	115	33.94		

Pre and post test scores for efficacy and persistence were compared using a Pearson correlation coefficient. A significant correlation was found between pretest persistence and post test persistence, $r=.51$, $p=.001$. A significant correlation was also found between pretest

efficacy and post test efficacy, r=.52, p=.001. The existence of a significant relationship between dependent measures and the covariant supports the utility of the analysis of covariance. Such a relationship lowers the amount of random variability in dependent measures.

Hypothesis 1

Subjects in training groups one through four will manifest competency gains that are significantly greater than the gains achieved by the practice only group.

Post test multiplication accuracy scores were compared in a one way analysis of variance. The results of this analysis are summarized in Table 6. A significant treatment effect was found, F(4,115)=3.64, p=.007, indicating

Table 5

Summary of ANOVA for Pretest Self-Efficacy

Source of Variation	df	MS	F	p
Between Groups	4	86.97	.36	.83
Within Groups	115	243.67		

significant differences between groups.

The pooled scores of the four treatment groups were contrasted with the scores of the practice control group. A planned comparison was used wherein treatment group means.

Table 6

Summary of One Way ANOVA on Post Test Accuracy

Source of Variation	df	MS	F	p
Between Groups	4	68.47	3.64	.007
Within Groups	115	18.81		

were weighted by -1/4 and the control mean was weighted by +1. The results of this analysis are summarized in Table 7.

Table 7

Summary of Planned Comparison Between Pooled Treatment Scores and Control

	Value	S.Error	T	df	Tprob.
Contrast 1	11.33	3.96	2.86	115	.005

Table 7 demonstrates that a significant difference did exist between the control group and treatment groups, $T(115)=2.86$, $p=.005$. Therefore, hypothesis 1 is supported at the .005 level. It is concluded that training variants of self-instruction were significantly better than practice

alone for improving multiplication accuracy among third grade youngsters.

In order to determine exactly which variants of self-instruction are superior to practice alone, group means were compared by means of Tukey's HSD post hoc procedure. The results of this analysis are summarized in Table 8. Table 8 shows that only treatment group 1 (error coping verbalizers) was significantly different from the practice group in accuracy.

Table 8

Post Test Mean Differences in Accuracy Using Tukey HSD Test

Group	Gp. 1	Gp. 2	Gp. 3	Gp. 4	Gp. 5
Group 1	0	2.25	1.88	3.04	4.63*
Group 2		0	.38	.79	2.38
Group 3			0	1.16	2.75
Group 4				0	1.58
Group 5					0

Note. * = $p<.05$

It is noteworthy that individual treatment conditions did not differ significantly from each other. This shows that none of the variations of self-instruction was superior to any other. However, compared to practice alone,

the data indicate that verbalized self-instructions which include messages for coping with errors were significantly better for developing multiplication competence in normal, third grade youngsters.

Hypothesis 2

Subjects in conditions 1 and 2, where error coping statements are taught, will manifest competency gains that are significantly greater than the gains achieved by subjects in conditions 3 and 4 where no error coping is practiced.

The post test accuracy scores of the four treatment groups were analyzed using a two way (error coping X verbalization) analysis of variance. The results of this analysis are displayed in Table 9. The main effect for the error coping factor was not statistically significant, $F(1,92) = 2.21$, $p = .14$. Therefore, hypothesis 2 is not supported at the .05 level. It is concluded that practicing error coping statements when mistakes are made did not enhance the multiplication competence of normal, third grade youngsters.

Hypothesis 3

There will be no significant difference in competence between verbalizers and non-verbalizers.

The post test accuracy scores of the four treatment groups were analyzed using a two way (verbalization X error coping) analysis of variance. The results of the ANOVA in

Table 9

Summary of Two Way ANOVA for Accuracy Data

Source of Variation	df	MS	F	p
Verbalization	1	70.04	3.62	.06
Error Coping	1	42.67	2.21	.14
Verbalization X Error	1	7.04	.364	.55
Residual	92	19.34		

Table 9 indicate that the main effect for verbalization was not statistically significant, $F(1,92) = 3.62$, $p = .06$. It is concluded that practice in verbalizing task strategies did not significantly improve two digit multiplication competence among normal, third grade youngsters.

Although verbalization did not have a significant effect, the analyzed effect did approach a significant level suggesting that some competency benefits were derived by youngsters who verbalized self-instructions. On the other hand, since a nonsignificant effect was hypothesized for verbalization, it is difficult to estimate the weight of these benefits. Consequently in order to clarify the meaning of the present findings, a power analysis (Cohen, 1969) was conducted on the ANOVA results for verbalization. The probability value derived from this analysis can

clarify whether the effect for verbalization was a more or less powerful indicator of statistical significance. The power value computed for verbalization was .50. Thus, there is only a 50% chance that the verbalization effect was truly significant. This analysis shows that the results for verbalization need to be interpreted cautiously since there is an equal 50% probabilty that said results occurred by chance.

Hypothesis 4

Where error coping statements are not practiced, there will be no significant difference in competence between verbalizers (condition 3) and non-verbalizers (condition 4).

The mean accuracy scores of verbalizers (group 3) and non-verbalizers (group 4) in the non-error coping condition were compared by means of Tukey's HSD procedure. This comparison can be found in Table 8. The difference between these group means was 1.16. This difference was not statistically significant and hypothesis 4 fails to be rejected. Thus, where no error coping is practiced, the verbalization of self-instructions does not significantly improve multiplication competence among normal third graders.

Hypothesis 5

Where error coping statements are practiced, subjects who verbalize these messages (condition 1) will manifest

competency gains that are significantly greater than the gains made by subjects who do not verbalize these messages (condition 2).

The post test accuracy scores of verbalizers (group 1) and non-verbalizers (group 2) in the error coping condition were contrasted via Tukey's HSD procedure. The results are summarized in Table 8. The difference score 2.25 failed to reach statistical significance. Consequently, hypothesis 5 is rejected. When error coping is practiced, the verbalization of self-instructions does not significantly improve multiplication competence among normal third graders.

Implicit in hypotheses 4 and 5 was the assumption that the significance of verbalization as a training step would be mediated by the use of error coping messages during training. Thus, it was proposed that the verbalization factor interacted with the error coping factor for improving competence. The two way ANOVA for post test accuracy scores (see Table 9) reveals that this was not the case. The verbalization X error coping interaction failed to reach statistical significance, $F(1, 92) = .364$, $p = .55$. Error coping was not a necessary precondition for verbalization to enhance performance.

Hypothesis 6

Subjects practicing error coping statements will show significantly greater persistence than subjects who do not

practice error coping statements.

Using persistence pretest scores as the covariate, post test persistence scores were analyzed in a two way (error coping X persistence) analysis of covariance. The results of this analysis are summarized in Table 10. The main effect for error coping did not reach statistical significance, $F(1, 91) = .05$, $p = .832$. Therefore, hypothesis 6 is rejected at the .05 level. It is concluded that practicing error coping statements when errors are made does not significantly enhance persistence among normal, third grade youngsters.

Hypothesis 7

Subjects practicing error coping statements will show significantly greater self-efficacy than subjects who do not practice error coping.

Self-efficacy was analyzed by means of a two way (error coping X verbalization) analysis of covariance. The results of this analysis are summarized in Table 11. No significant main effect was found for the error coping factor, $F(1,91) = .013$, $p = .91$. Based on this analysis, hypothesis 7 is rejected at the .05 level. The result shows that the use of error coping statements for dealing with mistakes has no significant effect on self-efficacy among normal, third graders.

Hypothesis 8

There will be no significant difference in persistence

Table 10

Summary of Two Way Analysis of Covariance for Persistence

Source of Variation	df	MS	F	p
Covariate	1	2259.03	57.7	.0001
Verbalization	1	7.03	.18	.673
Error Coping	1	1.78	.05	.832
Verbalization X Error	1	79.08	2.02	.159
Residual	91	39.15		

between verbalizers and non-verbalizers.

Hypothesis 8 was tested within the same two way ANCOVA as hypothesis 6 (see Table 10). The main effect for verbalization was not statistically significant, $F(1, 91) = .18$, $p = .67$. Therefore, hypothesis 8, stated in the null form, fails to be rejected. It is concluded that practice in verbalizing response strategies has no significant effect on the persistence of third grade youngsters.

The lack of a verbalization effect on persistence was unlike its effect on subjects' performance accuracy. Because of this discrepancy, it was decided to compare subjects' persistence to their relative levels of competence to ascertain if these dependent measures were related in any meaningful way. Pearson product moment

Table 11

Summary of Two Way Analysis of Covariance for Self-Efficacy

Source of Variation	df	MS	F	p
Covariate	1	3652	35	.0002
Verbalization	1	351.7	3.37	.07
Error Coping	1	1.34	.013	.91
Verbalization X Error	1	77.77	.746	.39
Residual	91	104.3		

correlation coefficients compared both pre and post test persistence with post test accuracy. The results indicated that neither pretest persistence ($r = -.21$), nor post test persistence ($r = -.04$) was significantly related to post test multiplication competence.

Hypothesis 9

There will be no significant difference in self-efficacy between verbalizers and non-verbalizers.

Using pretest efficacy scores as the covariate, post test self-efficacy was analyzed by means of a two way (error coping X verbalization) analysis of covariance. A summary of this analysis is found in Table 11. The main effect for verbalization was not statistically significant, $F(1,91) = 3.37$, $p = .07$. Therefore, hypothesis 9, stated in

the null form, fails to be rejected at the .05 level.

Although non-significant, the effect of verbalization on self-efficacy does approach a significant level. This suggests that self-efficacy was enhanced somewhat by the verbalization of reponse strategies. However, as was the case with hypothesis 3, the fact that such a finding was not anticipated gave rise to a power analysis of the effect of verbalization on self-efficacy. The computed power value was .46. This indicates that the probability that the verbalization effect is truly significant is only 46%. The power of the verbalization effect for self-efficacy is essentially equivalent to the power of verbalization for performance accuracy. In both cases, the low power value limits the utility of the nearly significant findings.

The similarity in the relationship between verbalization and efficacy on the one hand and verbalization and performance accuracy on the other prompted an analysis of the relationship between efficacy and performance accuracy.

The pretest self-efficacy scores of the four treatment groups were compared to their accuracy scores using a Pearson correlation coefficient. The resulting correlation revealed no significant relationship between these variables ($\underline{r}$ = -.02).

The post test efficacy scores of the treatment groups were also compared to their accuracy scores. The

correlation between post test efficacy and accuracy was significant, r = .32. p<.05. This relationship indicates that post test efficacy was a modestly accurate predictor of post test competence. It also suggests that, through the course of training, subjects in this study developed a more accurate awareness of their multiplication competencies.

Efficacy scores were also compared with the data on persistence. No significant relationships were found between pretest efficacy and pretest persistence (r =-.11), pretest efficacy and post test persistence (r = .06), post test efficacy and pretest persistence (r = -.2), and post test efficacy and post test persistence (r = -.14).

Hypothesis 10

Where error coping statements are practiced, subjects who verbalize these messages (condition 1) will manifest persistence gains that are significantly greater than the gains made by subjects who do not verbalize these messages (condition 2).

In essence, this hypothesis proposes that the effect of verbalization upon persistence will be mediated by the error coping factor. An interaction effect is sought. The ANCOVA for persistence is outlined in Table 10. The interaction between verbalization and error coping did not reach statistical significance, $F(1, 91) = 2.02$, p = .159. Hypothesis 10 is rejected at the .05 level. The analysis shows that the relative effect of verbalization on

persistence was not significantly altered by the presence or absence of error coping strategies.

In order to compare group means more directly, a one way analysis of covariance was conducted on the persistence data. This analysis is summarized in Table 12. The results indicate a significant between groups difference, $F(4, 114) = 6.44$, $p = .001$. Thus, although neither independent variable altered persistence, significant group differences did occur as a result of treatment.

Table 12

Summary of One Way Analysis of Covariance for Persistence

Source of Variation	df	MS	F	p
Covariate	1	1940.15	51.92	.0005
Group	4	240.79	6.44	.001
Residual	114	37.36		

A Tukey HSD post hoc analysis was employed to identify the significant pairwise group comparisons. Table 13 summarizes the results of this analysis.

One comparison was statistically significant; the comparison between group 1 (error coping verbalizers) and group 5 (practice control). This contrast shows that the

verbalization of error coping strategies is significantly better than practice alone for improving persistence.

Table 13 shows that all training conditions, compared to the control group, approached a significant difference level. On the other hand, there was very little difference between experimental groups.

Table 13

Summary of Tukey HSD Test for Adjusted Post Test Persistence Means

Group	Gp. 1	Gp. 2	Gp. 3	Gp. 4	Gp. 5
Group 1	0	-2.39	-1.49	-.525	-7.924*
Group 2		0	.9	1.868	-5.53
Group 3			0	.968	-6.431
Group 4				0	-7.399
Group 5					0

NOTE *=p<.05

Hypothesis 11

Where error coping statements are practiced, subjects who verbalize these messages (condition 1) will manifest self-efficacy gains that are significantly greater than the gains made by subjects who do not verbalize these messages

(condition 2).

The proposal here is similiar to that of hypothesis 10; an interaction between error coping and verbalization on the self-efficacy measure. The two way ANCOVA for self-efficacy is found in Table 11. The interaction between verbalization and error coping failed to reach statistical significance, $F(1, 91) = .746$, $p = .39$. Based on this analysis, hypothesis 11 is rejected at the .05 level. It is concluded that the relative effect of verbalization on self-efficacy is not mediated by the error coping factor. Thus, the nearly significant effect of verbalization on efficacy appears to be the result of slight improvements made by all groups who verbalized self-instructions.

A one way analysis of covariance was carried out on the efficacy data to determine if any significant differences were present between groups. The results of this analysis are presented in Table 14. No significant group differences were found, $F(4, 114) = 1.78$, $p = .138$. Consequently, no treatment condition (including the practice controls) was different from any other treatment condition in its effect on self-efficacy

Summary

The present study proposed that experimental manipulation of the error coping and verbalization variables would result in significant group differences on accuracy, persistence and self-efficacy dependent measures.

Table 14

Summary of One Way ANCOVA for Self-Efficacy

Source of Variation	df	MS	F	p
Covariate	1	3985.7	36.63	.0001
Group	4	193.3	1.78	.138
Residual	114	108.8		

In the area of performance accuracy, no significant differences were attributable to the error coping factor. The verbalization factor had a marginally significant effect on performance. However, there were no significant differences due to the interaction of error coping and verbalization. The comparison of specific group means revealed that subjects taught to verbalize error coping messages showed significantly greater competence than subjects who practiced response strategies alone.

Analysis of the persistence data reveals that the use of error coping strategies did not enhance persistence. Similiarly, verbalization did not significantly affect persistence. The interaction of verbalization and error coping also had no impact on persistence. The comparison of specific group means revealed that those subjects who verbalized error coping strategies persisted significantly

longer than the practice only control group. Finally, neither pretest nor post test persistence was significantly related to accuracy.

The data on self-efficacy again showed that the use of error coping messages had a non-significant effect. Verbalization effected nearly significant differences on the efficacy variable. The interaction of verbalization and error coping did not have a significant effect on efficacy. Analysis of efficacy differences by specific groups revealed that none of the treatment groups differed in self-efficacy. A correlational analysis comparing post test self-efficacy and accuracy showed a significant relationship so that the higher the self-efficacy the higher the accuracy score. Self-efficacy was not related to persistence.

CHAPTER FIVE

Discussion

Persistence

Persistence was not significantly related to the other dependent variables in this study. This is somewhat puzzling since persistence has been significantly related to both self-efficacy and performance accuracy in the past (Mednick, 1986). Although unexpected, this result is not entirely unprecedented. In a study where similiar dependent measures were assessed, Schunk (1983) found a negative correlation between persistence and self-efficacy.

In the present study, the absence of a relationship between persistence and other variables may have been due to the method used to measure persistence. This variable was operationalized as subjects' total time on task during an optional practice session. The experimenter observed that the vast majority of subjects completed all practice problems during these sessions, despite instructions that they may stop at any time. Since most subjects completed all problems, their time on task would appear to be less a function of persistence and more a matter of individual differences in typical response speed. Thus, the measure may not have been sensitive enough to identify individual differences in persistence.

A major contention of this study had been that the use of error coping messages would enhance persistence. The

data do not support this contention. Persistence increments in the error coping groups were negligible. Perhaps, if the measure had been more sensitive, more significant differences would have emerged. However, the present data on persistence do not validate the utility of the error coping component.

A review of the literature on verbalization had indicated that it was not a significant factor for enhancing persistence. It was suggested that only when error coping messages were self-administered would verbalization prove to be significant.

As anticipated, verbalization did not have a significant effect on persistence. Although the proposed relationship between verbalization and error coping was not supported by the persistence results, it is noteworthy that only error coping verbalizers differed significantly from the control group in persistence. Thus, the results for persistence provide some support, albeit minimal, for the interactive effect of verbalization and error coping.

Accuracy

The uniform pretest accuracy scores reveal that this study was subjects' first exposure to two digit multiplication problems. Although this was not anticipated when the study was designed, no minimum competency standards, beyond the preskills test, were deemed necessary for selection. However, in retrospect, the method of

instruction used in this study was not suited to the needs of the subjects selected for the study. The preponderance of errors during training sessions served to retard subjects' acquisition of the response strategy.

It was proposed that the use of error coping messages would enhance competence. The findings do not support that contention. However, the sample's lack of pretest competence tends to mitigate this result. The subjects in this study needed to acquire the response skill. It has been stated previously that error coping messages affect competence indirectly by sustaining effort. Consequently, any potential benefit stemming from error coping may have been obscured by subjects' more basic need to learn the multiplication response.

Although no competency gains due to verbalization were proposed, verbalization had a nearly significant effect on performance accuracy. This effect is consistent with studies showing that verbalization enhances performance (Burgio et al., 1980; Kosiewicz et al., 1975; Malamuth, 1979; Thackwray et al., 1985) but inconsistent with studies that found it does not (Borkowski & Varnhagen, 1984; Mednick, 1986). However, the results of the power analysis point up the tentative nature of both the verbalization effect and the following explanation of this effect.

The effect for verbalization may have been related to the nature of the treatment conditions. The number of

errors committed by subjects in the verbalization conditions was matched by the trainers in the externally guided conditions. In the verbalization groups, subjects were making their own errors and perhaps learning from their mistakes. In the externally guided groups, the mistakes were made by the trainer. In these groups, the connection between the error and the response strategy may not have been so clear. In fact, the occurrence of errors in these latter groups may have implied more about the trainer and his/her expertise than it did about the response strategy. Thus, the analysis suggests that the informative value of the performance feedback may have been greater in the verbalization groups than it was in the externally guided groups.

The accuracy data provides meager support for the interactive effect of verbalization and error coping. As was the case with persistence only those youngsters who verbalized error coping strategies performed significantly better than controls. This lends some credence to the proposed relationship. However, the lack of any significant interaction effect, as well as the absence of significant differences between error coping verbalizers and other treatment groups, casts doubt on the contention that verbalization becomes a significant factor only when error coping messages are used.

Self-Efficacy

Pretest self-efficacy was extremely high given the fact that subjects showed no competence at the task. The self-efficacy scale from which the present measure was adapted has been shown to provide a close estimate of performance (Mednick, 1986). The discrepancy seems attributable to the different ages of the subjects in the two studies. The subjects of the former study ranged from the fourth to seventh grade whereas, in the present study, subjects were third graders. Younger children tend to overestimate abilities. This is because they believe that effort is the primary cause of performance outcomes and they view ability as an extension of effort (Schunk, 1984). By the age of nine, a distinct conception of ability begins to emerge. However, effort and ability are not clearly differentiated until a child is about eleven years of age (Nicholls, 1978; Stipek & Tannatt, 1984). Developmentally, the youngsters in the present study were only beginning to define their conception of ability. Further, they lacked any efficacy information about this particular problem type. Consequently, their unrealistic and exaggerated pretest scores seem to reflect the immature belief that if they tried hard enough they would get the correct answer even if they did not know how to solve the problem.

The significant correlation between post test efficacy and accuracy is consistent with previous findings showing a

significant relationship between these two variables (Schunk, 1981; Schunk, 1984). In the present study, this relationship was a direct result of experimental treatment since no such correlation between efficacy and competence was obtained for the control group. Indeed, for the controls self-efficacy improved more than in any other group while their actual competence improved the least of all groups.

In order to examine pre and post test efficacy performance more carefully, subjects' scores are presented graphically in Appendix E. Appendix E-1 reveals that most subjects rated themselves in the highest score interval for self-efficacy. This characteristic implies that a ceiling response set may have been operating. Many subjects apparently checked the highest score repetitively rather than actually rating their skill. Likert scales, such as the one used here for efficacy, raise the possibility that response set tendencies will distort scale ratings (Kerlinger, 1973). This possibility was exacerbated in the present study by the fact that subjects did not receive any training in how to make efficacy judgements. In a previous study using third graders, subjects were provided with considerable opportunities for practice in making such judgements (Schunk, 1984b).

Further inspection of Appendix E-1 shows that increases from pretest to post test were concentrated in the middle

intervals. This suggests that training effected a kind of first step toward normalizing the distribution. This pre-post test trend is even more pronounced when control group scores are removed from the distribution. The experimental groups' ratings are displayed in Appendix E-3. Visual inspection shows that incidence increased only in the middle two intervals. By contrast, ratings in the four extreme intervals either decreased or remained thr same. The control group's ratings (see Appendix E-2) tended to increase in a relatively consistent manner from pretest to post test.

The results did not support the hypothesis that training in error coping would enhance self-efficacy. Bandura (1977a) lists four factors that can affect self-efficacy. They are, in order of importance: 1) performance accomplishments, 2) vicarious experiences, 3) verbal persuasion, 4) emotional arousal. The preceding analysis of the efficacy-accuracy relationship provides support for the first of these factors. Subjects in the training groups received preformance feedback for each problem they completed and adjusted self-efficacy accordingly. Subjects in the control group received no such feedback so that their sense of efficacy was as inflated and naive as it had been for the pretest. Error coping messages represent an attempt to affect self-efficacy by means of the third factor: verbal persuasion. The present results are

consistent with Bandura's analysis that verbal persuasion is a minor factor affecting self-efficacy.

Similiar to the accuracy data, verbalization had a marginally significant effect on self-efficacy as well as a mediocre level of power. However, the fact that this result was consistent across two dependent measures would suggest that the effect for verbalization was not random.

It is suggested that verbalization enhanced self-efficacy in the same manner that it enhanced accuracy. For verbalizers, performance feedback provided first hand knowledge about efficacy. For non-verbalizers, feedback was more vicarious in nature.

The data on self-efficacy provided no significant support for the contention that error coping statements were effective only when verbalized. No significant group differences emerged, no interaction effects were found. It is interesting, however, that only error coping verbalizers went up in self-efficacy from pre- to post test. For all other treatment groups, self-efficacy went down. Although this finding provides only minimal support for the proposed relationship; it, together with the accuracy and persistence data suggest that the present line of inquiry merits further investigation.

Error Coping

Subjects in this study reacted to modelled errors in a variety of ways. Some stared in disbelief. Some were

sympathetic. Some were shocked and some laughed. The experience of observing a teacher making a mistake was apparently quite novel for these youngsters. A substantial number of errors were committed by subjects during treatment so that they had ample opportunity to practice the coping statements provided.

The review of the literature on self-instruction had indicated that error coping messages were concerned with aspects of performance rather than learning. Therefore, it was proposed that error coping would affect academic competence through the intervening variable of motivation. The review also intimated that error coping messages were most effective when they were verbalized.

Subjects in the present study appeared highly motivated from the outset of training. They were also uniformly lacking in competence. Since error coping was suggested to affect performance rather than learning, this was not an ideal sample for assessing the effect of error coping strategies. Nevertheless, the fact that practice in error coping did not significantly improve functioning on any variable tends to disconfirm the significance of this component within the self-instruction methodology.

The present study's failure to find significant effects stemming from coping skills training is consistent with previous findings in academic areas (Bruch, 1978; Fox & Houston, 1981; Zatz & Chassin, 1985). Such results have

prompted some researchers to comment that coping statements may distract youngsters from the academic task (Fox & Houston, 1981; Zatz & Chassin, 1985). Also, practicing these statements may needlessly focus the learner's attention on his/her errors. Finally, the coping statements themselves may be so extraneous to the academic task that they are of little practical use to the student. In any event, the failure of the purely motivational error coping messages implies that, in academic areas, motivation is not so divorced from learning.

Corno and Mandinach's (1983) self-regulation model relates academic motivation more closely to the learning process. Other motivational models view the student's cognitive interpretation of his/her aptitudes, of the academic task and the learning environment as contributing to the level of motivation. Such models view this assessment as occurring prior to or as a consequence of learning. In the self-regulation model, such interpretations affect the type of cognitive engagement the learner will employ. The level of engagement in turn impacts on subsequent interpretations so that a learning-motivation cycle constantly operates in the classroom.

From the perspective of this model, error coping statements provide no information to augment the learner's cognitive interpretations. Neither do they effect changes in the type of cognitive engagement the student will

employ. Thus, coping strategies appear to have a very limited role in the learning-motivation cycle as outlined in this model. The present results are consistent with this conclusion.

Verbalization

Many subjects in the verbalization groups were hesitant to self-instruct. Most often they appeared self-conscious or afraid that they would make a mistake. Often, considerable coaxing was needed in order to convince the youngsters to repeat the response strategies.

The literature review had suggested that verbalization would enhance general performance related skills, such as attention and motivation only when error strategies were verbalized. Consequently, no significant treatment effects were hypothesized for the verbalization factor. Contrary to expectation, verbalization approached significance as a factor enhancing both self-efficacy and accuracy. Although mitigated by the lack of statistical power, the present results are consistent with the pattern of previous findings (see Table 1). Error trials were included in training and verbalization appears to have affected two variables.

Initial examination of the pattern of previous results had generated the hypothesis that the effect for verbalization was due to the practice of error coping statements. The present study provides only suggestive

evidence for this hypothesis. However, the fact that the pattern of verbalization results is maintained in this study indicates that the verbalization effect relates to factor(s) having to do with the error condition of the training procedure.

In a previous section, it was noted that subjects who verbalized strategies may have benefitted more from error feedback than subjects who observed or were guided to make mistakes. Verbalization may have played a similiar role in previous studies. Thus, the present results generate the hypothesis that verbalization enhances the salience of error feedback. This apparent relationship between verbalization and error feedback warrants further study.

Self-instruction

In the present study, self-instruction effected only modest competency gains. This is in contrast to previous studies where academic improvements were more pronounced (Genshaft & Hirt, 1980; Leon & Pepe, 1983; Mednick, 1986; Swanson, 1985; Swanson & Scarpati, 1984; Thackwray et al., 1985). The small size of these gains may be partially attributable to the fact that subjects were trained in pairs rather than individually. However, the limited academic improvement appears due primarily to the use of errors in the training procedure and the short duration of treatment. Though gains were relatively small, self-instruction led to significantly greater competence than

practice alone. The condition where all components were employed produced the largest accuracy improvements.

Regarding the data on motivation, self-instruction did not enhance self-efficacy more than practice alone. Mednick (1986) had found that self-instruction significantly improved self-efficacy. Two explanations are suggested for this discrepancy in results. The first is that the subjects of the former study had prior experience with the training task whereas the present study was subjects' first experience with two digit multiplication. Perhaps, prior experience is necessary for self-instruction to enhance efficacy. By contrast, using self-instruction as an initial exposure to a content area may lead to efficacy judgements that are simply more consistent with levels of competence.

The second explanation is that the training procedures of the two studies also differed. In the present study, the performance feedback and error trials may have negated the efficacy benefits found previously. Further research is needed to clarify the relationship between self-instruction and self-efficacy by examining the effect that different training components have at different points in the learning process.

Greater persistence was achieved in all groups receiving self-instruction training whereas persistence in the control group deteriorated. Although only one treatment group was significantly superior to practice, all variants

of self-instruction approached this level. It is important to note that only the condition where all components were used produced gains on all dependent variables.

Motivational gains hypothesized to result from self-instruction training in the present study seem to have been obscured by the previously outlined shortcomings of the indices used to measure motivation. Perhaps, alternate motivational measures would have been more sensitive to changes in motivation. One such alternative measure involves the subject's free choice to continue the experimental task or engage in an alternate activity. For example, the experimental task is presented to subjects along with a variety of other academic activities (e.g., reading a story, solving word problems, adding numbers, subtracting numbers etc.). Subjects are asked to pick the activity they would like to do most. The measure could be further elaborated by observing how long the child chooses to engage in this activity. Another variation of this index of motivation involves reading a variety of activities to each subject. Following each activity, the youngster responds as to whether he/she: likes it a lot or a little, doesn't like it a lot or a little, or has no feeling about it. Though this subjective rating of liking for a task is different from self-efficacy, it does provide an estimate of how motivated the child is to work on the task.

The results of the present study tend to support the

utility of the verbalization training steps. This finding was consistent with the pattern of previous results and led to the suggestion that verbalization serves to enhance the effect of error feedback.

Self-instruction training steps are designed to gradually transfer control of response strategies from the trainer to the learner. Cognitively modeled response strategies are controlled by the trainer. When strategies are externally guided, the learner participates in the implementation of the strategy but the trainer continues to play a directive role. Only when response strategies are self-verbalized does the learner control the strategy. It is suggested that this issue of "ownership" is involved with the processes that take place during performance feedback. Specifically, when the youngster owns the response, he/she is in a position to learn from success and failure. When the youngster does not own the response, successes and mistakes are observed.

This position is consistent with Schunk's findings regarding the effect of verbalization. In a study assessing the effect of strategy verbalization on division competence and self-efficacy, he found that applying the strategies while verbalizing them led to greater increases in division skill and self-efficacy than did conditions involving strategy verbalization alone or no verbalization (Schunk, 1982). He concluded that verbalization of a strategy as it

is being applied may create a sense of control over learning.

In a later study (Schunk & Rice, 1985), fourth and fifth graders' reading comprehension skills were improved more by a combination of guided practice and strategy verbalization than by guided practice alone. Also, verbalizers attributed their performance more to ability than non-verbalizers. This reinforces the idea that verbalization fosters a sense of control or ownership of a strategy.

Finally, Schunk and Cox (from Schunk, 1986) compared the effectiveness of continuous verbalization, discontinued verbalization and no verbalization for improving the subtraction competence of middle school students. The results indicated that only continuous verbalizers improved significantly in subtraction competence and self-efficacy. The implication; that verbalization is important during the latter, more application oriented stages of learning; is also consistent with implications from the present findings

The present study examined the relative contribution made by the error coping component of self-instruction. The results provide no support for the use of error coping. Consequently,at least in the area of academic instruction, error coping seems to be an unnecessary component of the self-instruction procedure. Self-instruction uses two components for responding to error feedback: error coping

and error correcting. In the present study, error coping was focused on. However, the analysis of these results suggests that error correcting may be the more useful component for academic instruction.

In error correcting, the learner responds to error feedback by reviewing the strategy in an attempt to locate the mistake. The error correcting component turns an error outcome into a learning experience by teaching youngsters how to learn from their mistakes. The recursive aspect of this component is consistent with the model of academic motivation proposed by Corno and Mandinach (1983). Further, the explanation proposed herein for the verbalization effect implies that some error correcting occurs spontaneously when error feedback accompanies verbalization. Based on these observations, error correcting seems to be a component deserving of experimental investigation.

Educational Implications

Several instructional implications can be deduced from the results of this study. The first is that the use of coping strategies for dealing with mistakes appears to be of limited value. The present findings indicate that these statements do affect competence and persistence but only when they are verbalized. In the classroom, such strategies can be used by students to maintain a positive outcome expectancy. Though some evidence is present to support

this limited use, such coping statements appear to have little real value for the youngster.

In the classroom, students are routinely given performance feedback for their work. There are tests, independent seatwork, discussions, question and answer periods etc. The present study suggests that performance feedback affects motivation. However, the evidence suggests that this effect is not always a positive one. Performance feedback when a youngster is first learning a task may be detrimental to motivation. Thus, the present results indicate that performance feedback is most profitably provided after students are able to demonstrate some minimal level of competence so that they are not overly discouraged.

Present results show that youngsters learn better when they verbalize response strategies. This implies that teachers should encourage such verbalization during lessons. However, such an implication may be difficult to implement in a classroom. For one thing, teachers are primarily concerned with maintaining order and control in class (Romberg & Carpenter, 1986). Having 30 youngsters repeat a response strategy is not only unwieldy but can also be disruptive. Encouraging verbalization during small group or individual instruction may be more realistic. But, teachers often don't have the opportunity for these forms of instruction. Perhaps, the best method of implementation,

at least in the area of mathematics, is to ask students to verbalize how they solve problems as they take turns working at the blackboard.

Blackboard practice is often initiated after students have had some exposure to learning material. The pattern of outcome studies seems to indicate that verbalization effects are tied to the utilization of feedback. Thus, employing verbalization at this application stage seems not only practical but also theoretically advisable.

Youngsters in the present study learned more than a response strategy for two digit multiplication problems. They also learned something about their own aptitudes and abilities for solving these problems. Such efficacy learning goes on all the time in schools but tends to be ignored. This is unfortunate since this kind of learning provides teachers with an opportunity to involve and praise students who are not learning academic content as well as their peers. Also, the development of an accurate sense of one's aptitudes, skills and weaknesses may ultimately prove to be quite valuable and useful for students in later life.

The final area to be addressed involves the educational implications of the self-instruction method as a whole. In their review of the field of mathematics, Romberg and Carpenter (1986) note that learning mathematics involves a process whereby knowledge is constructed by the learner. By contrast, schools have traditionally viewed learning as a

process of absorption. Self-instruction conceives of learning as a transfer of knowledge in which the youngster gradually builds a response strategy. The steps of modeling, external guidance and verbalization allow the youngster to assume greater control of the strategy and provide him/her with the opportunity to construct new knowledge. The content components provide a way of conceptualizing and analyzing a problem domain. Although self-instruction does not mirror the constructive learning process that Romberg and Carpenter describe, it does seem to be the instructional complement for such a process. Consequently, the gradual nature of the training steps and the schematic format of the content components can be important ways for students to construct knowledge in the classroom.

In their review, Romberg and Carpenter (1986) state that scientific studies of math instruction have failed to provide teachers with instructional procedures that will insure learning. The self-instruction method employs three. The instructional advantages of modeling have been well documented (Rosenthal & Bandura, 1978; Rosenthal & Zimmerman, 1978). Similiarly, external guidance, the self-instructional equivalent of participant modeling, also has supportive evidence (Bandura, 1977a; Corno & Mandinach, 1983). Though the literature is equivocal at present, these support the instructional utility of self-verbalization.

The judicious use of these component procedures by teachers can be expected to enhance learning among their pupils.

Future Research

The results of the present study generate several recommendations for future research.

1. In the present study, subjects were not previously exposed to the training task. This fact may have obscured the effects of the experimental variables; in particular the error coping variable and the interaction of error coping and verbalization. Therefore, it is recommendd that the present results be replicated using subjects who had been exposed to training task problems.

2. The nearly significant effect for verbalization in this study led to the suggestion that aspects of performance feedback rendered verbalization a significant factor. The relationship between verbalization and performance feedback, especially error feedback, needs to be examined more closely. Therefore, it is recommended that the effect of verbalization be contrasted across the following conditions: no feedback, success feedback, error feedback, success and error feedback. In this way, any interactive relationships can be identified and isolated.

3. The utility of the error coping component of self-instruction was disconfirmed in the present study. The demonstration that certain components are unnecessary makes the procedure briefer and more focused. This is especially

important in self-instruction where verbatim training routines can be quite lengthy and difficult for youngsters to remember. It is recommended that research be directed toward validating the other content components (i.e. problem definition, attention focusing, response guidance, self-reinforcement, error correcting) of the procedure.

4. Although no significant interaction between error coping and verbalization was found, the results generally showed that group differences were in the hypothesized direction. Perhaps, a more adequate error strategy would have significantly interacted with the verbalization step. Error correcting strategies have also been used as part of the self-instruction procedure. Error correcting strategies seem to fit an interactive learning-motivation model better than the coping messages. Consequently, it is suggested that the effect for verbalization be compared and contrasted in the presence and absence of the error correcting component.

5. In the present study, subjects developed a more realistic sense of efficacy. This effect was attributed to the provision of performance feedback. For many subjects in this study self-efficacy deteriorated. This effect was also attributed to performance feedback. These attributions suggest that more needs to be known about the effects of performance feedback. Does such feedback benefit all learners, only some or none? Does feedback benefit

youngsters beginning to learn a response or is it only helpful later on? Are the effects of performance feedback the same as the effects of other operant contingencies? What are the differences between success only feedback and success/error feedback? These and other questions relating to performance feedback need to be investigated.

6. The present study has documented that self-instruction is increasingly being used as a method for academic instruction. With this in mind, it is suggested that self-instruction be explored as a method for teaching groups of youngsters. This study trained subjects in groups of two and found that academic gains were not as pronounced as previous findings indicate. Thus, for reasons of both instructional efficacy and practicality future research might explore whether self-instruction can be used effectively with several youngsters at one time. The results of such investigations could sharpen the conceptualization of self-instruction as either a specialized technique for remedial instruction of individual youngsters or a procedure that is more directly applicable to classroom instruction.

7. Although it has enhanced self-efficacy in the past, self-instruction had no such effect on efficacy in the present study. It is important that the instructional factors which led to these differential findings be identified. The present analysis leads to the

recommendation that the effects of performance feedback on efficacy be studied at different points in the learning process.

8. Self-instruction training steps are implemented sequentially but usually the sequence is rapid. Typically, there are one or two modeling trials followed by one or two guided trials followed by one or two verbalization trials. In subsequent sessions the same pattern is repeated. It is possible that different training steps are most efficacious at different points in the learning process. Consequently, the standard procedure might be compared to one where an entire session or more is devoted to each component. The resulting comparisons could provide enlightening information about the sequence and timing of each step.

Conclusion

The present study explored the use of self-instruction as a method for teaching mathematics to third grade youngsters. The method proved to be effective for enhancing youngsters' math competence. However, self-instruction did not significantly increase motivation. Rather, it seemed to make youngsters more realistic in their performance expectations and generally more persistent. Several variations of the self-instruction procedure were used in this study. The condition where the full procedure was implemented was the only condition where gains were noted on all dependent measures. These results support the

applicability of self-instruction to the classroom.

The verbalization training steps of self-instruction were the focus of the present investigation. Analysis of previous findings had suggested that the effect of the verbalization training step resulted from its interaction with the error coping content component.

The present results did not support such an interaction. However, the efficacy of the verbalization component was supported. This finding was interpreted as an indication that the effect of verbalization was a function of performance feedback. More specifically, it was suggested that when youngsters verbalize a response, they assume more responsibility for the response and they therefore attend more closely to the feedback provided. The present findings suggest a need for further research into the effect of the verbalization component of self-instruction.

This study investigated the effect of the error coping component of self-instruction. A review of the coping skills literature led to the contention that the error coping component would affect motivational parameters and through such parameters would affect learning. The error coping component did not significantly affect either learning or motivational variables in the present study. Consequently, it was concluded that the practice of error coping statements does not contribute to the effectiveness

of self-instructions. The present findings also imply that coping skills training in general appears to have limited educational applicability.

The present findings regarding error coping serve to emphasize the importance of conducting similiar analyses on other self-instruction content components. In this way, the procedure can be made more efficient. In this way, self-instructions can focus on what is truly essential to learning.

APPENDIX A

May 6, 1987

Dear Parent:

A doctoral research study is being conducted with the third grade class of _____. I am writing this letter to request that your child might participate in this project. The study examines several alternate methods for teaching youngsters simple arithmetic computations. With your approval, your child will spend two sessions learning how to solve simple math problems and will be tested in several areas related to math achievement. This study is being conducted at _____ school with the full knowledge and consent of _____, principal.

If you consent to have your child participate, please sign below in the appropriate space and return this letter to the classroom teacher tomorrow.

Yours truly

Frank Colassano

I, _____, consent to allow my child,

_____ to participate in the math doctoral study.

APPENDIX B

Preskills Multiplication Facts Test

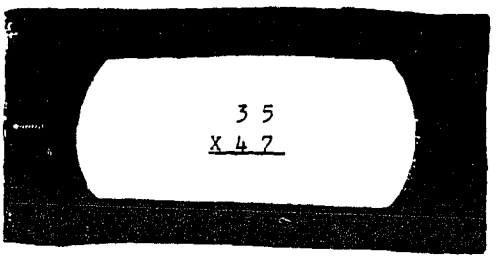
7 X 3 =	6 X 4 =
6 X 9 =	7 X 9 =
8 X 4 =	7 X 6 =
3 X 5 =	2 X 3 =
8 X 7 =	9 X 9 =
9 X 3 =	5 X 6 =
9 X 8 =	7 X 6 =
7 X 5 =	

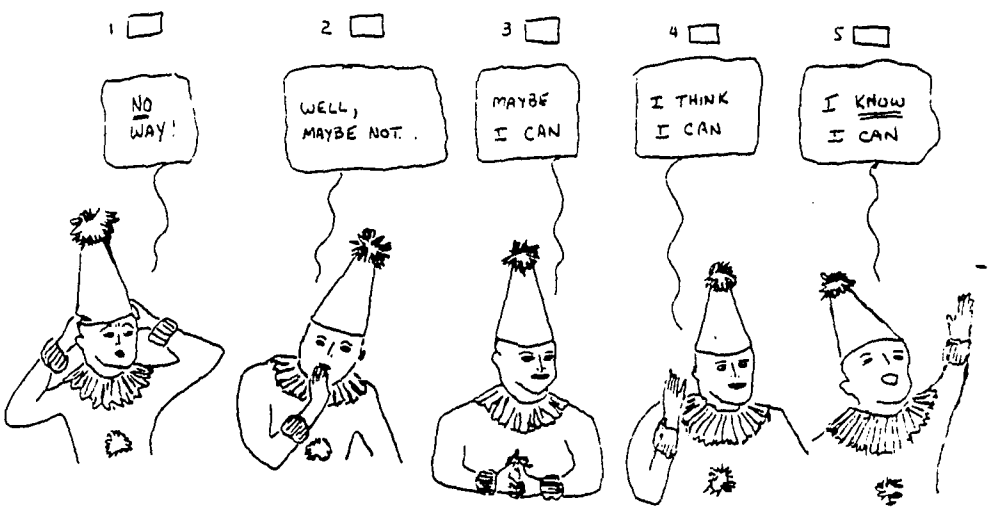
APPENDIX C

MULTIPLICATION OF WHOLE NUMBERS TEST

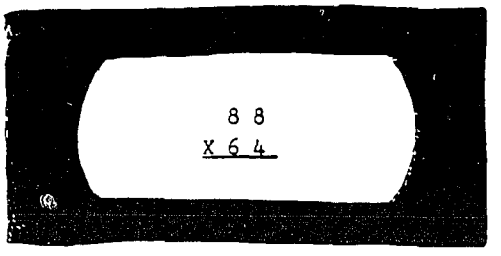
AND

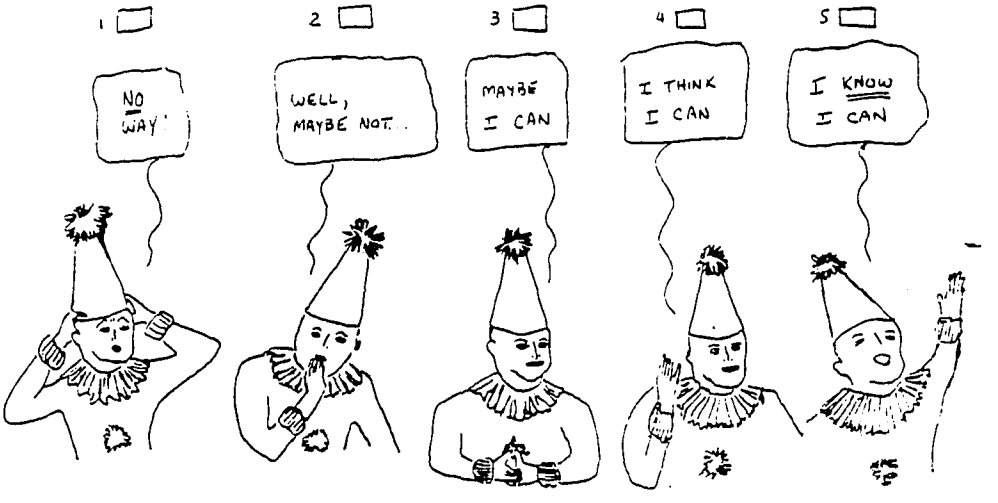
SELF-EFFICACY SCALE


35
X 47


1
NO WAY!
2
WELL, MAYBE NOT.
3
MAYBE I CAN
4
I THINK I CAN
5
I KNOW I CAN

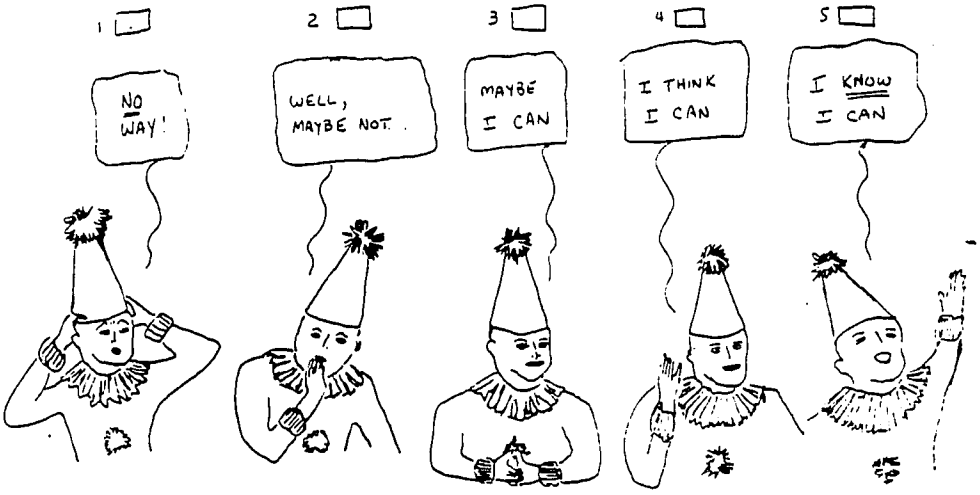
35
X47


8 8
X 6 4

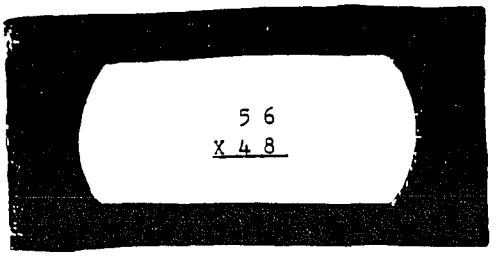

1
NO WAY!
2
WELL, MAYBE NOT..
3
MAYBE I CAN
4
I THINK I CAN
5
I KNOW I CAN

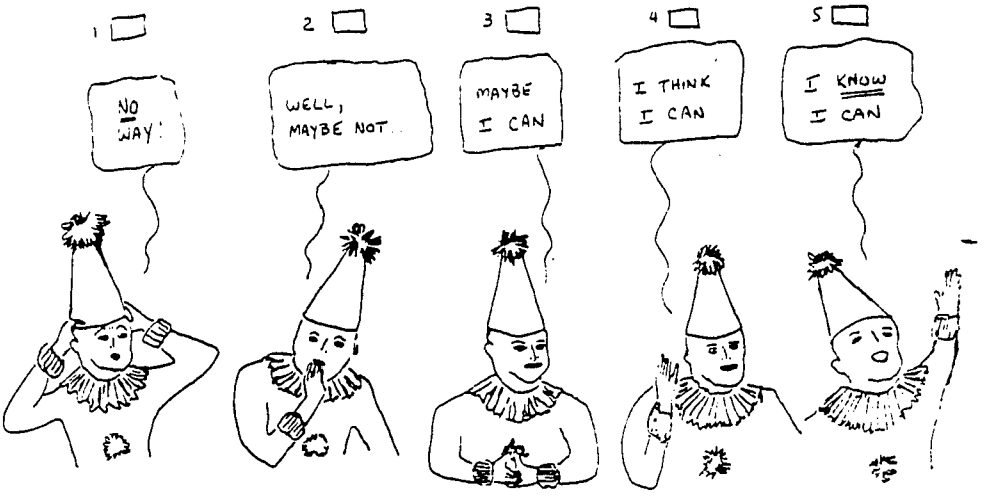
88

x64

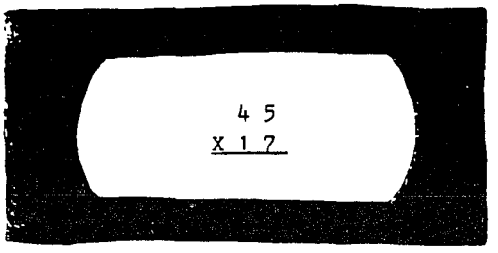

1
NO WAY!
2
WELL, MAYBE NOT.
3
MAYBE I CAN
4
I THINK I CAN
5
I KNOW I CAN

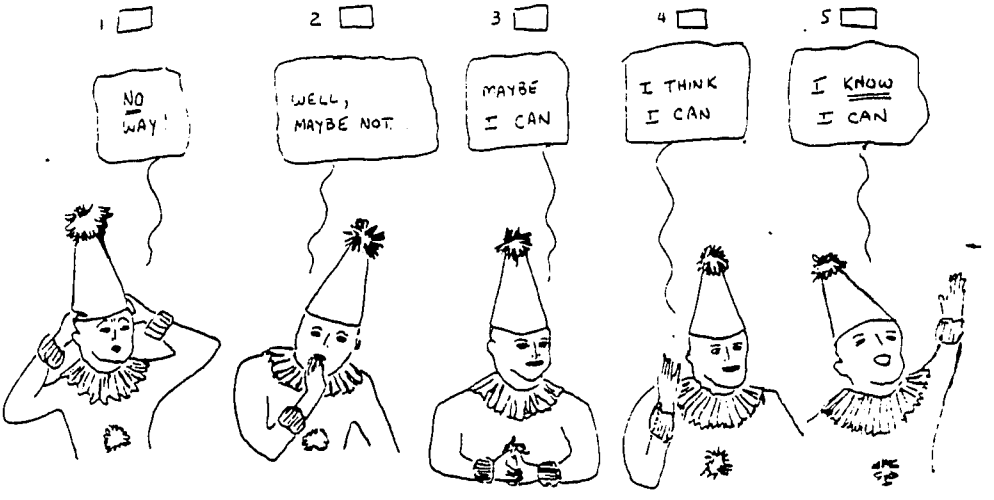
$$\begin{array}{r} 76 \\ \times\ 46 \\ \hline \end{array}$$


5 6
X 4 8

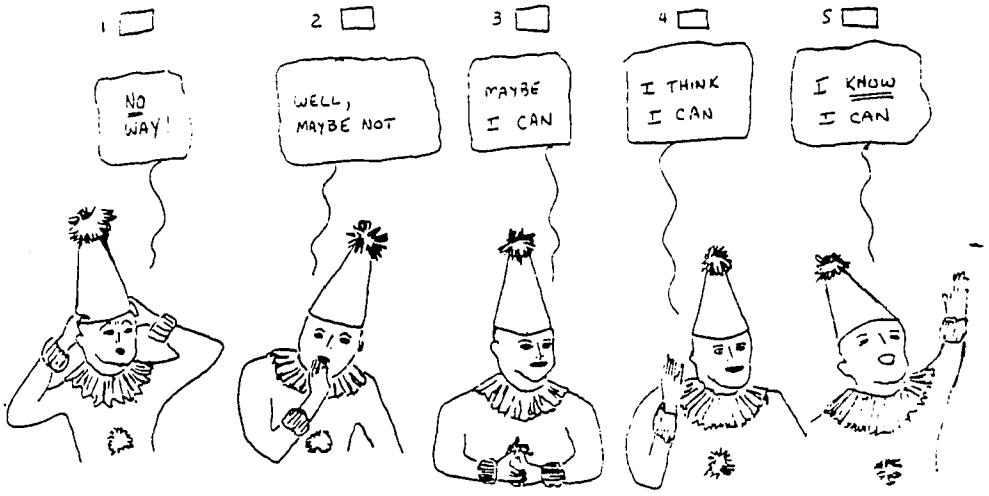

1
NO WAY!
2
WELL, MAYBE NOT
3
MAYBE I CAN
4
I THINK I CAN
5
I KNOW I CAN

$$\begin{array}{r} 56 \\ \times\ 48 \\ \hline \end{array}$$

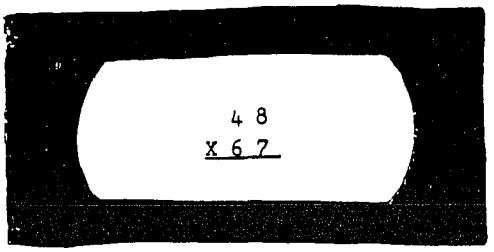

45
X 17

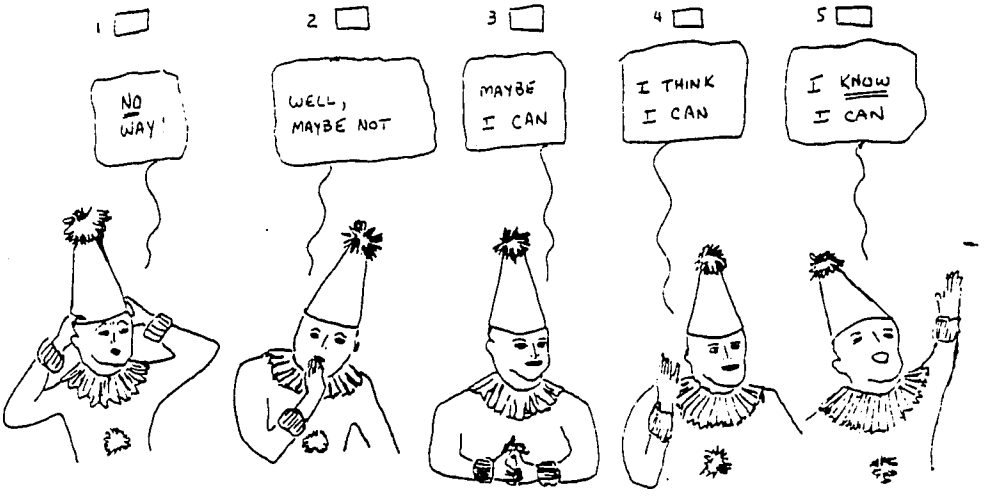

1
NO WAY!
2
WELL, MAYBE NOT.
3
MAYBE I CAN
4
I THINK I CAN
5
I KNOW I CAN

$$\begin{array}{r} 45 \\ \times 17 \\ \hline \end{array}$$


1
NO WAY!
2
WELL, MAYBE NOT
3
MAYBE I CAN
4
I THINK I CAN
5
I KNOW I CAN

$$\begin{array}{r} 91 \\ \times 75 \\ \hline \end{array}$$


4 8
X 6 7


1
NO WAY!
2
WELL, MAYBE NOT
3
MAYBE I CAN
4
I THINK I CAN
5
I KNOW I CAN

$$\begin{array}{r} 48 \\ \times\ 67 \\ \hline \end{array}$$

APPENDIX D

Script for Session One

1. Cognitive modeling

   of self-reinforcement

$$\begin{array}{r} 7\ 3 \\ \times\ 3\ 6 \\ \hline 4\ 3\ 8 \\ 2\ 1\ 9\ \ \\ \hline 2\ 6\ 2\ 8 \end{array}$$

" Okay what do I have to do on this problem? I have to multiply 36 times 73. I start on this right side and first multiply 6 times 3. That equals 18, I put the 8 down here and carry the one to here. I have to remember to go slowly and pay attention to what I'm doing. Now 6 times 7 equals 42 plus the 1 I carried is 43 and I put that number over here. Okay, now 3 times 3 equals 9, there's nothing to carry so I put the 9 here. Three times 7 equals 21 and I put that number over here. Almost done now, just keep taking my time. Now I draw a line and add it all up. Eight plus nothing is still 8. Three plus 9 equals 12. I put the 2 down here and carry the 1. Four plus 1 equals 5, plus the 1 I carried is 6. I put that number here. Two plus nothing equals 2 and I put that here. So, my answer is 2628. Now I have to check it. It's right! I really did a good job on that one.

2. Cognitive modeling

of error coping statements

```
  8 2
X 5 6
-----
  4 3 2
4 1 0
-------
4 5 3 2
```

" What about this problem? I'm multiplying 56 times 82. First, I do 6 times 2, that equals 12. The 2 goes down here and I carry the 1. Now, 6 times 8 equals 42 plus the 1 I carried equals 43 and that goes down here. Remember: take my time. Now, 5 times 2 equals 10. I put down the zero and carry the 1. Five times 8 equals 40 plus 1 equals 41. Almost done, just a little bit more now. Two plus nothing equals 2. Three plus zero equals 3. Four plus 1 equals 5. And, 4 plus nothing equals 4. So, my answer is 4532. Now, I check it. Oh, oh I got the wrong answer. I'll have to go more slowly next time and pay more attention to my plan. I know I can do these problems."

3. External Guidance

of self-reinforcement

```
  9 2
X 4 1
  9 2
3 6 8
3 7 7 2
```

" Okay, on this one I have to multiply 41 times 92. I start with 1 times 2 and that equals 2 which goes here. Next, 1 times 9 equals 9 and that goes over here. Slow down, just take your time. Now 4 times 2 equals 8 and that goes here. Then, 4 times 9 equals 36 and that goes over here. Just a little bit more and I'll be finished. Now, 2 plus nothing equals 2 and 9 plus 8 equals 17. I put down the 7 and carry the 1. Now, 6 plus one equals 7 and that goes here. Three plus nothing equals 3 and that goes over here. So, my answer is 3772. Now I check it. It's right, I did a really good job on that one."

4. Overt self-instruction

or

cognitive modeling

```
  7 5
X 4 9
  6 7 5
3 0 0
3 6 7 5
```

" On this one the problem is 49 times 75. Now, I start with the 9 and do 9 times 5 equals 45. I put the 9 down here and carry the 4 to here. Nine times 7 equals 63 plus the 4 I carried is 67 and that goes here. Slow down now, just keep taking your time. Now, 4 times 5 equals 20. I put the zero here and carry the 2. Now, 4 times 7 equals 28 plus the 2 I carried equals 30 and that goes down here. Almost done now, just a little bit more. Five plus nothing equals 5 and that goes here. Seven plus zero equals 7 and that goes here. Six plus zero equals 6 and that goes here. And, 3 plus nothing equals 3 and that goes here. So, my answer is 3675. Now, I check to see if it's right. It's right. I really did a good job on that one or It's wrong. I'll have to try harder the next time and go more slowly. I know I can do these problems."

5. Faded self-instruction

or

Cognitive modeling

```
  7 7
X 4 6
-----
  4 6 2
3 0 8
-------
3 5 4 2
```

" Okay, this one is 46 times 77. I start with 6 times 7 equals 42. I put down the 2 and carry the 4. Six times 7 equals 42 again plus the 4 I carried is 46. That goes here. Rewmember to go slowly and pay attention to my strategy. Four times 7 equals 28. I put the 8 down here and carry the 2. Then, 4 times 8 is 28 plus the two I carried is 30. Almost done just keep going slowly and carefully. Two plus nothing equals 2. Six plus 8 equals 14, put down the 4 and carry the 1. Four plus zero plus 1 is 5 and that goes here. Three plus nothing is still 3. So, my answer is 3542. Now, I check it. It's right. I did a really good job on that one or It's wrong, I'll have to go more slowly next time and try harder to remember my strategy. I know I can do these problems."

6. Covert self-instruction

or

External guidance

```
  8 6
X 5 7
-----
  6 0 2
4 3 0
-------
4 9 0 2
```

" Okay, this is 57 times 86. I start with 7 times 6 and that equals 42. I put down the 2 and carry the 4 to here.

Now, 7 times 8 equals 56 plus the 4 I carried equals 60 and that goes here. Just remember to keep taking your time. Now, 5 times 6 equals 30, put down the zero and carry the 3 to here. Now, 5 times 8 equals 40 plus the 3 I carried equals 43 and that goes over here. Almost finished just a little bit more now. Two plus nothing equals 2 and that goes here. Zero plus zero equals zero over here. Six plus 3 equals 9 and that goes over here and 4 plus nothing equals 4 and I put that here. Okay, so my answer is 4902. Now, I check it. It's right. I really did a good job on that problem. or It's wrong. I'll have to go more slowly next time and remember my strategy. I know I can do these problems."

7. Cognitive modeling of
   error coping statements

```
    6 9
  X 4 7
  -----
    4 7 3
  2 7 6
  -------
  3 2 3 3
```

" Let's see what do I do here? I multiply 47 times 69. Okay, well 7 times 9 equals 63, put down the 3 and carry the 6. Seven times 6 equals 42 plus 6 equals 47 and that

goes here. Just keep taking my time. Four times 9 equals 36, put down the 6 and carry the 3. Four times 6 equals 24 plus the 3 I carried is 27 and I put that here. Almost finished now, just keep taking your time. Three plus nothing equals 3. Seven plus 6 equals 13, put down the 3 and carry the 1. Seven plus 4 is 11 plus the 1 I carried is 12, put down the 2 and carry the 1. Two plus 1 is 3. My answer is 3233. Now lets see if it's right. Oh, oh I got the wrong answer. I'll have to go more slowly and remember my strategy next time. I know I can do these problems."

8. Cognitive modeling of
   self-reinforcement

```
   5 6
 X 7 2
 -----
   1 1 2
 3 9 2
 -------
 4 0 3 2
```

" Okay, now my problem here is 72 times 56. I saart with 2 times 6 and that equals 12. I put down the 2 and carry the 1. Now two times 5 equals 10 plus 1 equals 11 and that goes here. Alright just keep taking my time and pay attention. Seven times 6 equals 42. I put down the 2 and carry the 4 to here. Now 7 times 5 equals 35 plus the 4 I carried is 39. That goes here. Alright, almost done just a little bit more. Now, 2 plus nothing equals 2 and that goes here. Two

plus 1 equals 3 and it goes here. Nine plus 1 equals 10. I put down the zero and carry the 1. Three plus 1 equals 4; it goes here. So, my answer is 4032. Now I check to see if it's right. It's right. Hey, I really did a good job on that problem."

9. External guidance of
   self-reinforcement

```
   6 4
 X 8 4
 2 5 6
5 1 2
5 3 7 6
```

" Okay, now I have to multiply 84 times 64. So, 4 times 4 equals 16, put down the 6 and carry the 1. Then, 4 times 6 equals 24 plus the 1 equals 25 and that goes here. Okay, I'm doing fine just keep going slow and paying attention. Now, 8 times 4 equals 32, put down the 2 and carry the 3. Eight times 6 equals 48 plus the 3 I carried is 51 and that goes here. Okay, almost finished now. Six plus nothing is still 6. Five plus 2 equals 7. Two plus 1 equals 3. Five plus nothing is still 5. So, my answer is 5376. Now I check to see if it's right. Okay, it is right; I did a really good job."

10. Overt self-instruction

or

Cognitive modeling

```
  6 3
X   4
-----
  2 5 2
4 4 1
-------
4 6 6 2
```

" Alright, here I have to multiply 74 times 63. I start with 4 times 3. That equals 12, I put down the 2 and carry the 1. Now, four times 6 equals 24 plus 1 is 25 and that goes here. Now, 7 times 3 equals 21, put down the 1 and carry the 2. Okay, seven times six is 42 plus the two I carried is 44 and that goes here. Almost finished now, just keep going slowly and following my plan. Now, 2 plus nothing is 2 and 5 plus 1 equals 6. Four plus 2 is 6 and 4 plus nothing is still four. So, my answer is 4662. Now I check to see if it's right. It is, hey I did a really good job on that one. or Oh, oh it's wrong. I'll have to pay more careful attention the next time I do this. I know I can get these right."

11. Faded self-instruction

or

Cognitive modeling

```
  6 2
X 7 8
-----
  4 9 6
4 3 4
-------
4 8 3 6
```

" Okay, my problem here is 78 times 62. So, first it's 8 times 2 equals 16, put down the 6 and carry the 1. Then, 8 times 6 is 48 plus the 1 I carried is 49 and that goes here. So far so good, just keep going slowly. Now, 7 times 2 is 14, put down the 4 and carry the 1. Next, 7 times 6 is 42, plus the 1 I carried is 43 which goes here. Okay now, almost done. Six plus nothing is still 6. Nine plus 4 equals 13, put down the 3 and carry the 1. Four plus 3 is 7 plus the 1 I carried is 8 and that goes here. Four plus nothing is still four and it goes here. My answer is 4836. Now I check to see if it's right. It's right, boy I really did a good job on that one or It's wrong. I'll have to pay more careful attention to my strategy the next time. I know I can do these problems."

12. Covert self-instruction

or

External guidance

```
  7 4
X 4 3
-----
  2 2 2
2 9 6
-------
3 1 8 2
```

" Okay, the problem here is 43 times 74. So, I start with 3 times 4 equals 12, put down the 2 and carry the 1. Now, 3 times 7 equals 21 plus the 1 I carried is 22 and it goes here. Just keep taking my time. Now, 4 times 4 is 16 put down the 6 and carry the 1. Four times 7 is 28 plus the 1 I carried is 29 and that goes here. Alright now, almost finished. Two plus nothing is still 2 and 6 plus 2 is 8. Nine plus 2 is 11, put down the 1 and carry the 1. Two plus the 1 I carried is three. Okay, my answer is 3182. Now I check it. IT's right, hey I did a very good job. or It's wrong. I'll have to be more careful next time."

Session Two

1. Cognitive modeling of
   error coping statements

```
  5 7
X 4 6
-----
  3 4 6
2 2 8
-------
2 6 2 6
```

"Okay, what do I have to do on this problem? I have to multiply 46 times 57. I start on this right side and do 6 times 7 equals 46. I put down the 6 and carry the 4. Now, 6 times 5 is 30 plus the 4 I carried is 34. That goes here. Okay, now just keep paying attention. Four times 7 is 28, put down the 8 and carry the 2. Now, 4 times 5 is 20 plus the 2 I carried is 22 and that goes here. Now, just a little bit more I'm almost finished. Six plus nothing still is 6. Four plus 8 is 12, I put down the 2 and carry the 1. Three plus 2 is 5 plus the 1 I carried is 6. And, 2 plus nothing is still 2. So, my answer is 2626. Now I have to check it. Oh, oh my answer is wrong. I'll have to pay more careful attention to my strategy and try harder the next time. I know I can do these problems."

2. Cognitive modeling of
   self-reinforcement

```
  2 6
X 8 3
-----
  7 8
2 0 8
-----
2 1 5 8
```

" Okay, now I have to multiply 83 times 26. I start with 3 times 6. That equals 18, put down the 8 and carry the 1. Next, 3 times 2 equals 6 plus the 1 I carried is 7.

Alright I'm fdoing fine, just keep taking my time. Now, 8 times 6 is 48, put down the 8 and carry the 4. Two times 8 is 16 plus the 4 I carried is 20 and that goes here. Okay now, just a little more and I'm finished. Eight plus nothing is 8. Seven plus 8 is 15, put down the 5 and carry the 1. Zero plus the 1 I carried is 1. Two plus nothing is still two. So, my answer is 2158. Now, I check it to see if it's right. Very good, it's right. I did a fine job on that one."

3. External Guidance of
   self-reinforcement

```
   3 6
 X 6 7
 -----
   2 5 7
 2 1 6
 -------
 2 4 1 2
```

" Now what do I have to do on this problem, it's 67 times 36. I start with 7 times 6 equals 42, put down the 2 and carry the 4. Seven times 3 is 21 plus the 4 I carried is 25. So far, so good, just keep taking my time. Now, 6 times 6 is 36, put down the 6 and carry the 3. Six times 3 is 18 plus the 3 I carried is 21. Almost done now, just a little bit more. Two plus nothing is 2. Five plus 6 is 11, put down the 1 and carry the 1. Two plus 1 is 3 plus 1 is 4.

Two plus nothing is still 2. So, my answer is 2412. Now, I check it. It's right, I really did a great job on that one."

4. Overt self-instruction

or

Cognitive modeling

```
  8 3
X 5 9
-----
  7 4 7
4 1 5
-------
4 8 9 7
```

" Okay, this one is 59 times 83. So, I start with 9 times 3 equals 27. I put down the 7 and carry the 2. Now, 9 times 8 is 72 plus the 2 I carried is 74 and that goes here. I'm doing fine, just keep using my strategy. Now 5 times 3 is 15, put down the 5 and carry the 1. Five times 8 is 40 plus the 1 I carried is 41. Almost finished now, just keep taking my time. Now, 7 plus nothing is still 7. Four plus 5 is 9. Seven plus 1 is 8. Four plus nothing is still 4. So, my answer is 4897. Now, I check it. Hey, it's right. I did a really good job or Oh, oh it's wrong I'll have to go more slowly and pay more attention to my strategy next time. I know I can do these problems."

5. Faded self-instruction

or

cognitive modeling

```
  6 7
X 4 8
-----
  5 3 6
2 6 8
-------
3 2 1 6
```

" Alright, here I have to multiply 48 times 67. So, I start with 8 times 7 equals 56, put down the 6 and carry the 5. Eight times 6 is 48 plus the 5 I carried is 53 and that goes here. Alright, just keep following my strategy. Now, 4 times 7 is 28 put down the 8 and carry the 2. Four times 6 is 24 plus the 2 I carried is 26 and it goes here. Almost finished now, just keep taking my time. So, 6 plus nothing is still 6. Three plus 8 is 11, put down the 1 and carry the 1. Five plus 6 is 11 plus 1 is 12, put down the 2 and carry the 1. Two plus the 1 I carried is 3. So, my answer is 3216. Now, I check it. Hey, it's right, I really did a good job on that one. or Oh, oh it's wrong, I'll have to go more slowly next time. I lnow I can do these problems.

6. covert self-instruction

or

external guidance

```
   7 5
 X 6 9
 ------
   6 7 5
 4 5 0
 -------
 5 1 7 5
```

" Okay, here I have to multiply 69 times 75. I start with 9 times 5 equals 45, put down the 5 and carry the 4. Then, 9 times 7 is 63 plus the 4 I carried is 67 and that goes here. Just keep taking my time. Now, 6 times 5 is 30, put down the 0 and carry the 3. Six times 7 is 42 plus the 3 I carried is 45. Almost finished now just a little bit more. Five plus nothing is still 5. Seven plus 0 is still 7. Six plus 5 is 11, put down the 1 and carry the 1. Four plus 1 is 5. So, my answer is 5175. Now, I check to see if it's right. It is. I really did a great job on that problem. or It's wrong. I'll have to go slower next time and pay more attention to my strategy next time. I know I can do these problems."

7. Cognitive modeling of
   self-reinforcement

```
   4 4
 X 3 7
 ------
   3 0 8
 1 3 2
 -------
 1 6 2 8
```

" Okay, on this one I have to multiply 37 times 44. I start with 7 times 4 equals 28, put down the 8 and carry the 2. Seven times 4 is 28 plus the 2 I carried is 30. I'm doing fine just keep going slowly and carefully. Three times 4 is 12, put down the 2 and carry the 1. Three times 4 is 12 again, plus the 1 I carried is 13 and it goes here. Almost finished now just a little bit more. Eight plus nothing is still 8. Zero plus 2 is 2. Three plus 3 is 6. One plus nothing is still 1. So, my answer is 1628. Now I check it. It's right. Hey, I really did a great job on that one."

8. Cognitive modeling of
   error coping statements

```
   7 1
 X 5 8
 -----
   5 4 8
 3 5 5
 -------
 4 0 9 8
```

" Okay, my problem here is 58 times 71. I start over here with 8 times 1 equals 8. Eight times 7 is 54. Now, just keep going slowly. Five times 1 is 5. then, 5 times 7 is 35. Almost finished now. Eight plus nothing is still 8. Four plus 5 is 9. Five plus 5 is 10, put down the zero and carry the 1. Three plus the 1 I carried is 4. So, my answer is 4098. Now I check it. Oh, oh it's wrong. I'll have to go

more slowly next time and be more careful. I know I can do these problems."

9. External Guidance of
   self-reinforcement

```
  8 6
X 7 4
-----
  3 4 4
6 0 2
-------
6 3 6 4
```

" Okay, here my problem is 74 times 86. Now, I start with 4 times 6 equals 24. I put down the 4 and carry the 2. Four times 8 is 32 plus the 2 I carried is 34, put down the 4 and carry the 3. Alright now, just keep taking my time. Seven times 6 is 42, put down the 2 and carry the 4. Seven times 8 is 56 plus the 4 I carried 60. Almost finished now, just a little bit more. Four plus nothing is still four. Four plus nothing is still four. Four plus 2 is 6. Three plus zero is still 3. Six plus nothing is still 6. My answer is 6364. Now, I check it. Hey, it's right. I did a really good job on this one."

10 overt self-instruction
   or
   cognitive modeling

```
  6 3
X 5 8
  5 0 4
3 1 5
3 6 5 4
```

" Okay, on this problem I have to multiply 58 times 63. I start with 8 times 3 equals 24, put dowm the 4 and carry the 2. Eight times 6 equals 48 plus 2 equals 50. So far so good, just keep taking my time. Now 5 times 3 equals 15 put down the 5 and carry the 1. Five times 6 is 30 plus the 1 I carried is 31. Just a little bit more now almost finished. So, 4 plus nothing is still four. Five plus zero is still 5. Five plus 1 equals 6, and 3 plus nothing is still 3. So, my answer is 3654. Now I check it. Hey, it's right, I really did a good job on that one or Oh, oh it's wrong, I'll have to pay more attention to my strategy next time."

11. faded self-instruction

or

cognitive modeling

```
  8 9
X 3 6
  5 3 4
2 6 7
3 2 0 4
```

" Alright, my problem here is 36 times 89. I start with 6 times 9 equals 54. I put down the 4 and carry 5. Now, 6 times 8 is 48 plus the 5 I carried is 53. Okay, just keep taking my time. So, 3 times 9 equals 27, put down the 7 and carry the 2. Three times 8 is 24 plus the 2 I carried is 26. Almost finished now, just a little more. Four plus nothing is still 4. Three plus 7 is 10, put down the 0 and carry the 1. Five plus 6 is 11 plus the 1 I carried is 12, put down the 2 and carry the 1.Two plus the 1 I carried is 3. So my answer is 3204. Now, I check to see if it's right. It's right; I did a really good job on that problem or. Oh, oh it's wrong, I'll have to pay more careful attention to my strategy next time. I know I can do these problems."

12. covert self-instruction

or

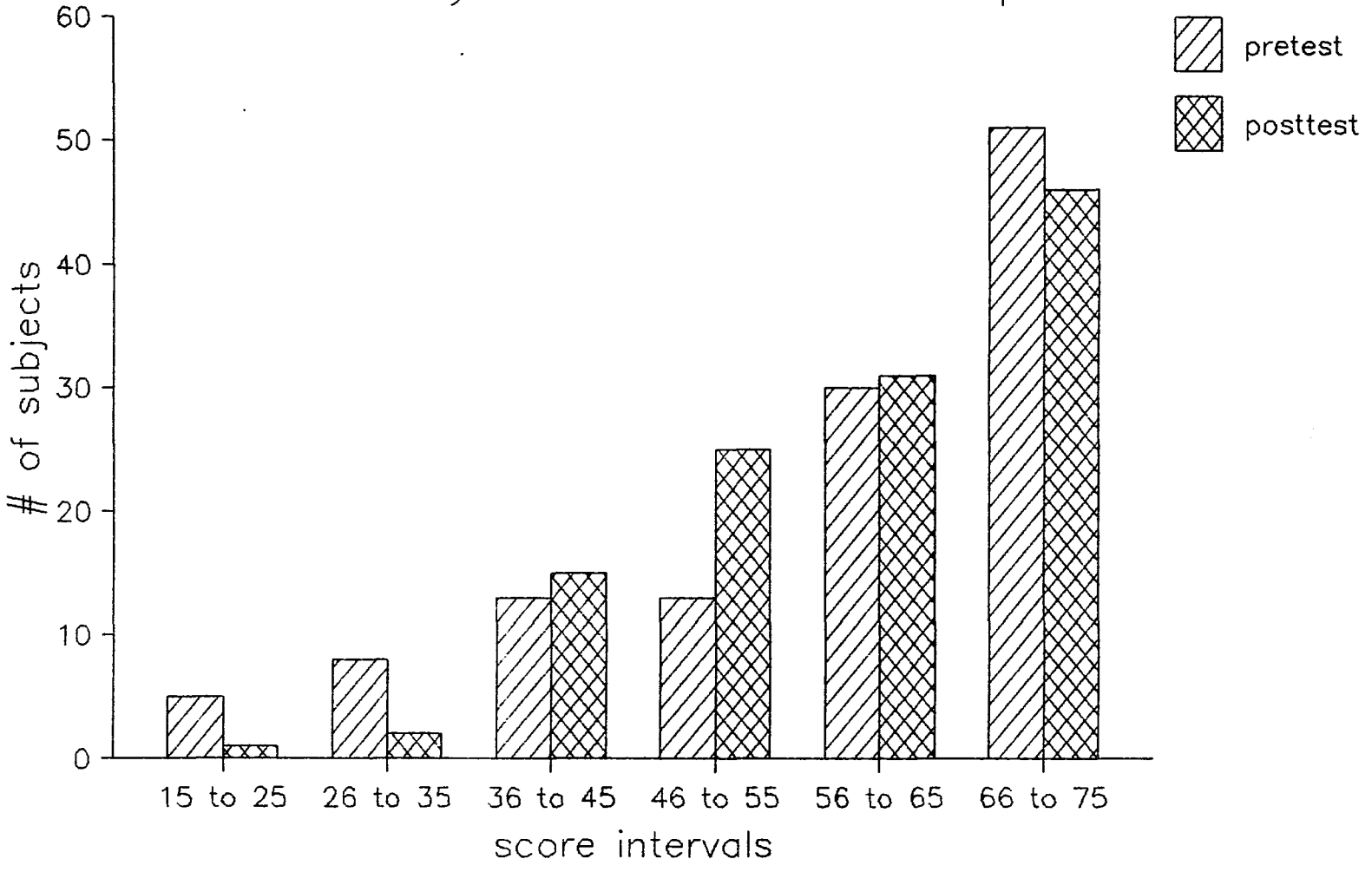
external guidance

```
  4 7
X 5 2
  9 4
2 3 4
2 4 4 4
```

" Alright, on this one I have to multiply 52 times 47. I start with 2 times 7 equals 14, put down the 4 and carry the 1. Then, 2 times 4 is 8 plus the 1 I carried is 9. Keep going slowly. Now, 5 times 7 is 35, put down the 5 and carry the 3. Five times 4 is 20 plus the 3 I carried is 23. Almost done now just a bit more. Four plus nothing is still four. Nine plus 5 is 14, put down the 4 and carry the 1. Three plus the 1 I carried is 4. Two plus nothing is still 2. So, my answer is 2444. Now I check it. It's right, I really did a good job on that one. or Oh, oh it's wrong, I'll have to pay more careful attention to my strategy next time. I know I can do these problems."

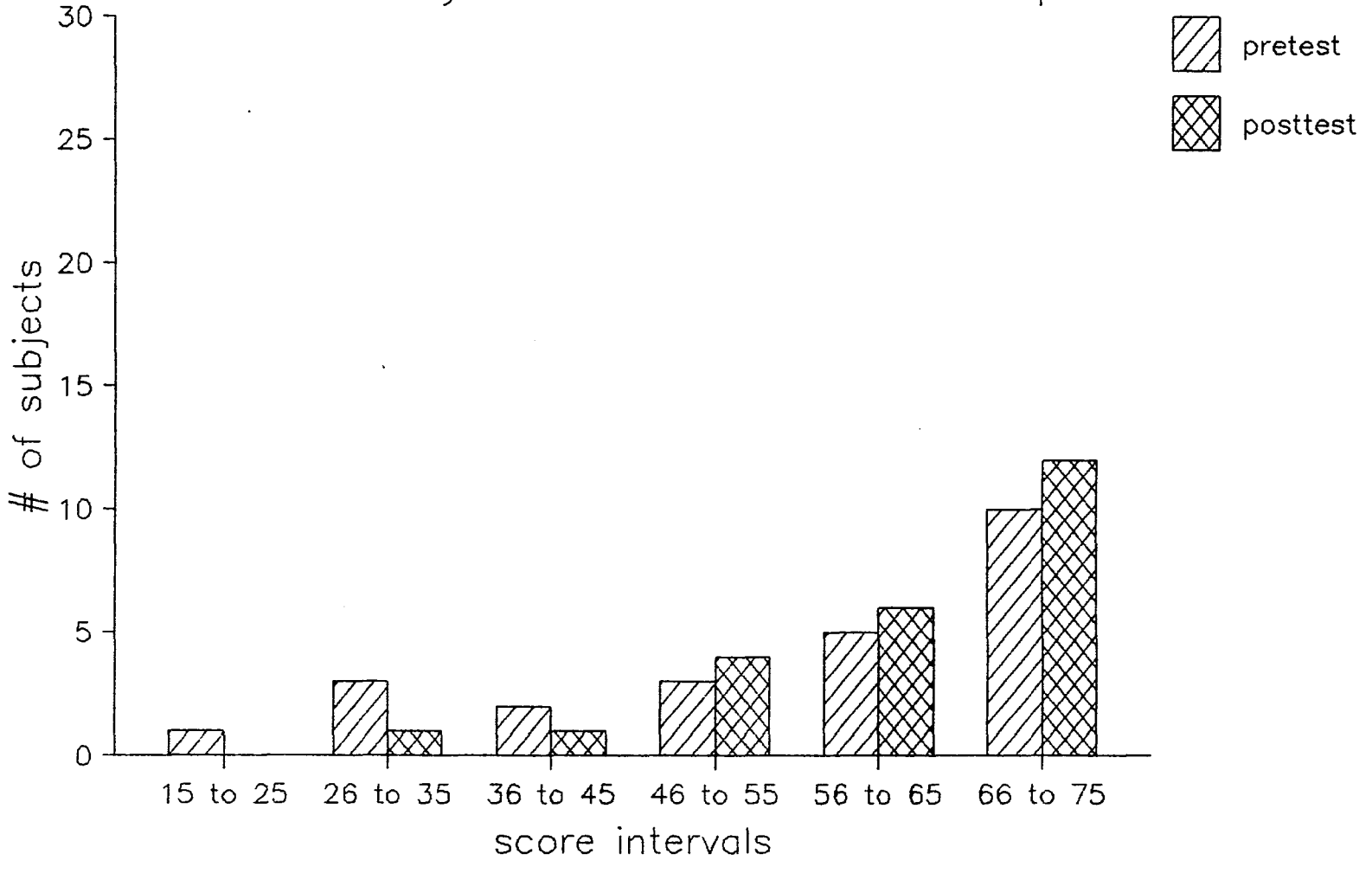
Appendix E–1

Efficacy Raw Scores for Total Sample



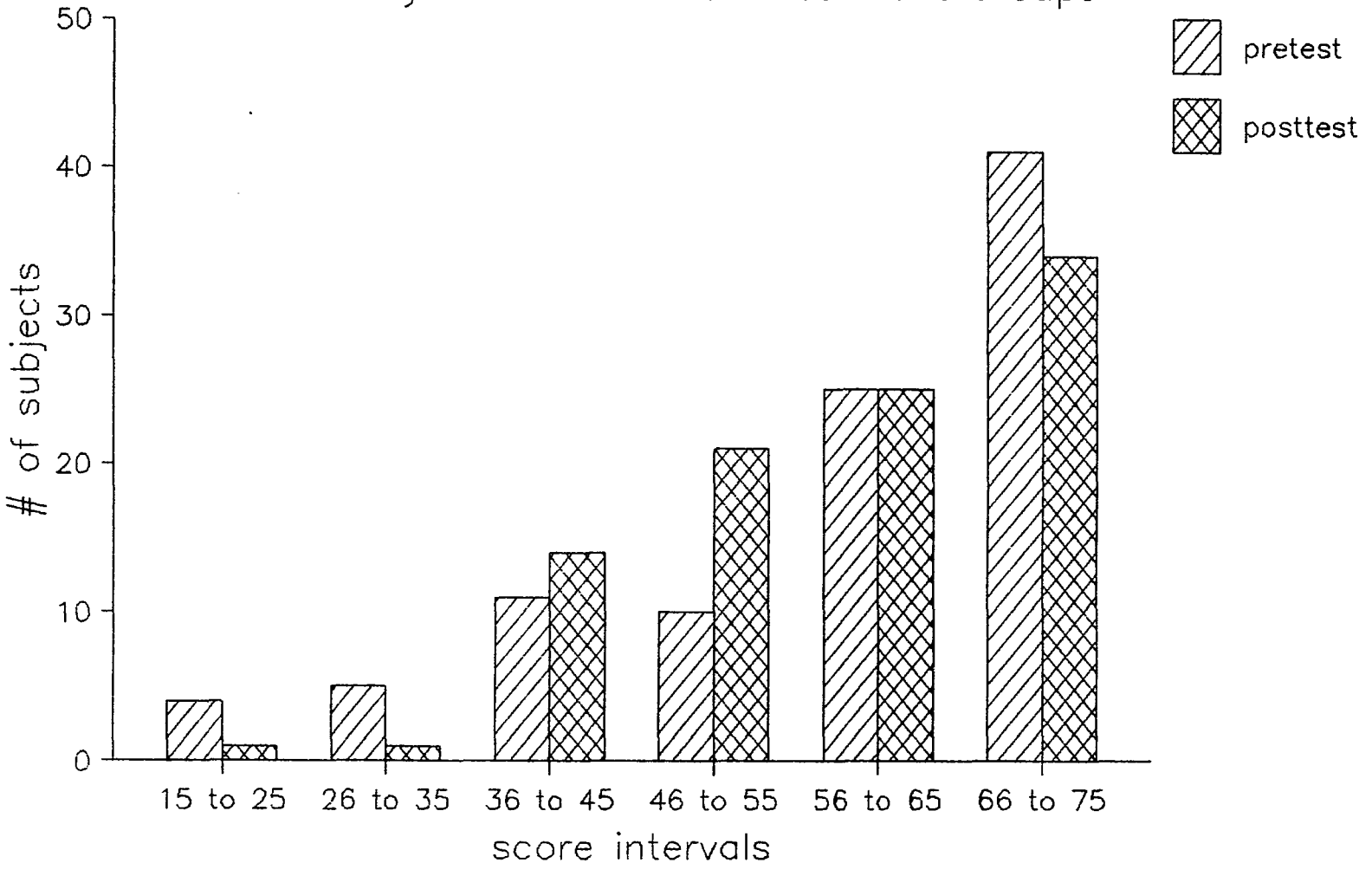
Appendix E-2

Efficacy Raw Scores for Control Group



Appendix E-3

Efficacy Raw Scores for Treatment Groups



References

Asarnow, J.R. and Meichenbaum, D. (1979) Verbal rehearsal and serial recall: The mediational training of kindergarten children. Child Development, 50, 1173-1177.

Bandura, A. (1977a) Self-efficacy: Toward a unifying theory of behavioral change. Psychological Review, 84, 191-215.

Bandura, A. (1977b) Social learning theory. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Billings, D.C. and Wasik, B.H. (1985) Self-instructional training with preschoolers: An attempt to replicate. Journal of Applied Behavior Analysis, 18, 61-67.

Borkowski, J.G. and Varnhagen, C.K. (1984) Transfer of learning strategies: Contrast of self-instructional and traditional training formats with educable mentally retarded children. American Journal of Mental Deficiency, 88, 369-379.

Bornstein, P.H. and Quevillon, R.P. (1976) The effects of a self-instructional package on overactive preschool boys. Journal of Applied Behavior Analysis, 9, 179-188.

Brown, R.T., Wynne, M.E. and Medenis, R. (1985) Methlyphenidate and cognitive therapy: A comparison of treatment approaches with hyperactive boys. Journal of Abnormal Child Psychology, 13(1), 69-87.

Bruch, M.A. (1978) Type of cognitive modeling, imitation of modeled tactics, and modification of test anxiety. Cognitive Therapy and Research, 2(2), 147-164.

Bryant, L.E. and Budd, K.S. (1982) Self-instructional training to increase independent work performance in preschoolers. Journal of Applied Behavior Analysis, 15, 259-271.

Bugenthal, D.B., Whalen, C.K. and Henker, B. (1977) Causal attributions of hyperactive children and motivational assumptions of two behavior change approaches: Evidence for an interactionist position. Child Development, 48, 874-884.

Burgio, L.D., Whitman, T.L. and Johnson, M.R. (1980) A self-instructional package for increasing attending behavior in educable mentally retarded children.

Journal of Aplied Behavior Analysis, 13, 443-459.

Cacioppo, J.T., Glass, C.R. and Merluzzi, T.V. (1979) Self-statements and self-evaluations: A cognitive response analysis of heterosexual anxiety. Cognitive Therapy and Research, 3(3), 249-262.

Cameron, M.I. and Robinson, V.M.J. (1980) Effects of cognitive training on academic and on-task behavior of hyperactive children. Journal of Abnormal Child Psychology, 8(3), 405-419.

Chaikin, A.L. (1971) The effects of four outcome schedules on persistence, liking for the task and attributions of causality. Journal of Personality, 39, 512-526.

Chapin, M. and Dyck, D.G. (1976) Persistence in children's reading behavior as a function of N length and attribution retraining. Journal of Abnormal Psychology, 85, 511-515.

Coats, K.I. (1979) Cognitive self-instructional training approaches for reducing disruptive behavior of young children. Psychological Reports, 44, 127-134.

Cohen, J. (1969) Statistical power analysis for the behavioral sciences. New York: Academic Press.

Corno, L. and Mandinach, E.B. (1983) The role of cognitive engagement in classroom learning and motivation. Educational Psychologist, 18, 88-108.

Davis, R.W. & Hajecek, J.P. (1985) Effects of self-instructional training and strategy training on a mathematics task with severely behaviorally disturbed students. Behavioral Disorders, 10(4), 275-282.

Diener, C.I. and Dweck, C.S. (1978) An analysis of learned helplessness: Continuous changes in performance, strategy and achievement cognitions following failure. Journal of Personality and Social Psychology, 36(5), 451-462.

Douglas, V. (1980) Treatment and training approaches to hyperactivity: Establishing internal or external control. In C.K. Whalen and B. Henker (Eds.) Hyperactive children: The social ecology of identification and treatment. New York: Academic Press.

Fish, M. and Pervan, R. (1985) Self-instructional training: A potential tool for school psychologists. Psychology in the Schools, 22, 83-92.

Friedling, C. and O'Leary, S.G. (1979) Effects of self-instructional training on second and third grade hyperactive children: A failure to replicate. Journal of Applied Behavior Analysis, 12, 211-219.

Fremouw, W.J. and Zitter, R.E. (1978) A comparison of skills training and cognitive restructuring-relaxation for the treatment of speech anxiety. Behavior Therapy, 9, 248-259.

Fox, J.E. and Houston, B.K. (1981) Efficacy of self-instructional training for reducing children's anxiety in an evaluative situation. Behavior Research and Therapy, 19, 509-515.

Genshaft, J.L. and Hirt, M.L. (1980) The effectiveness of self-instructional training to enhance math achievement in women. Cognitive Therapy and Research, 4(1), 91-97.

Hays, W. L. (1973) Statistics for the social sciences. New York: Holt, Rinehart and Winston, Inc.

Jackson, J.L. and Calhoun, K.S. (1982) A comparison of cognitive self-instructional training and externally administered instructions in preschool children. Child Study Journal, 12, 7-20.

Kanfer, F.H., Karoly, P. and Newman, A. (1975) Reduction of children's fear of the dark by competence-related and situation threat-related verbal cues. Journal of Consulting and Clinical Psychology, 43, 251-258.

Kendall, P. and Braswell, L. (1982) Cognitive-behavioral self-control therapy for children: A components analysis. Journal of Consulting and Clinical Psychology, 50, 672-689.

Kendall, P. and Finch, A.J. (1978) A cognitive-behavioral treatment for impulsivity: A group comparison study. Journal of Consulting and Clinical Psychology, 46, 110-118.

Kendall, P. and Wilcox, L.E. (1980) Cognitive-behavioral treatment for impulsivity: Concrete versus conceptual training in non-self-controlled problem children. Journal of Consulting and Clinical Psychology, 48, 80-91.

Kendall, P. and Zupan, B.A. (1981) Individaul versus group applications of cognitive-behavioral self-control procedures with children. Behavior Therapy, 12, 344-

359.

Keppel, G. (1982) Design and analysis: A researcher's handbook. Englewood Cliffs, New Jersey: Prentice-Hall, Inc.

Kerlinger, F.N. (1973) Foundations of behavioral research. New York: Holt, Rinehart and Winston.

Kosiewicz, M.M., Hallahan, D.P., Lloyd, J.W. and Graves, A.W. (1982) Efects of self-instruction and selfcorrection procedures on handwriting performance. Learning Disability Quarterly, 5, 71-78.

Leon, J.A. and Pepe, H.J. (1983) Self-instructional training: Cognitive behavior modification for remediating arithmitic deficits. Exceptional Children, 50, 54-60.

Luria, A.R. (1961) The role of speech in the regulation of normal and abnormal behavior. New York: Pergamon Press, Ltd.

Mahoney, M.J. and Arnkoff, D.B. (1978) Cognitive and self-control therapies. In S.L. Garfield and A.E. Bergin (Eds.) Handbook of psychotherapy and behavior change. New York: John Wiley & Sons.

Malamuth, Z.N. (1979) Self-management training for children with reading problems: Effects on reading performance and sustained attention. Cognitive Therapy and Research, 3(3), 279-289.

Mednick, E.S. (1986) Variations of self-instruction technique: Effects on boys and girls' self-efficacy, achievement and persistence. Unpublished doctoral dissertation, Graduate School and University Center of City University of New York.

Meichenbaum, D. (1972) Cognitive modification of test anxious college students. Journal of Consulting and Clinical Psychology, 39, 370-380.

Meichenbaum, D. (1977) Cognitive behavior modification: An integrated approach. New York: Plenum Press.

Meichenbaum, D. and Goodman, J. (1969) Reflection-impulsivity and verbal control of motor behavior. Child Development, 40, 785-797.

Meichenbaum, D. and Goodman, J. (1971) Training impulsive children to talk to themselves: A means of developing

self-control. Journal of Abnormal Psychology, 77, 115-126.

Miller, S.A., Shelton, J. and Flavell, J.H. (1970) A test of Luria's hypothesis concerning the development of verbal self-regulation. Child Development, 41, 651-665.

Nicholls, J. (1978). The development of the concepts of effort and ability, perceptions of academic attainment and the understanding that difficult tasks require more ability. Child development, 49, 800-814.

O'Leary, S.G. and Dubey, D.R. (1979) Applications of self-control procedures by children: A review. Journal of Applied Behavior Analysis, 12, 449-465.

Readence, J.E. and Bean, T.W. (1978) Modification of impulsive cognitive style: A survey of the literature. Psychological Reports, 43, 327-337.

Roberts, R.N. (1979) Private speech in academic problem solving: A naturalistic perspective. In G. Zivin (Ed.) The development of self-regulation through private speech. New York: John Wiley & Sons.

Roberts, R.N. and Dick, M.L. (1982) Self-control in the classroom: Theoretical issues and practical applications. In T.R. Kratchowill (Ed.) Advances in school psychology (vol 2) Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Robin, A.L., Armel, S. and O'Leary, K.D. (1975) The effects of self-instruction on writing deficiencies. Behavior Therapy, 6, 178-187.

Romberg, T.A. and Carpenter, T.P. (1984) Research on teaching and learning mathematics: Two disciplines of scientific inquiry. In M.C. Wittrock (Ed.) Handbook of research on teaching. New York: Macmillan.

Rosenthal, T.L. and Bandura, A. (1978) Psychological modeling: Theory and practice. In S.L. Garfield and A.E. Bergin (Eds.) Handbook of psychotherapy and behavior change: An empirical analysis. New York: Wiley.

Rosenthal, T.L. and Zimmerman, B.J. (1978) Social learning and cognition. New York: Academic Press.

Roth, S. and Kubal, L. (1975) Effects of noncontingent reinforcement on tasks of differing importance: Facilitation and learned helplessness. Journal of

Personality and Social Psychology, 32, 680-691.

Schleser, R., Meyers, A.W. and Cohen, R. (1981) Generalization of self-instructions: Effects of general versus specific content, active rehearsal and cognitive level. Child Development, 52, 335-340.

Schunk, D.H. (1981) Modeling and attributional effects on children's achievement: A self-efficacy analysis. Journal of Educational Psychology, 73, 93-105.

Schunk, D.H. (1982) Verbal self-regulation as a facilitator of children's achievement and self-efficacy. Human Learning, 1, 265-277.

Schunk, D.H. (1983) Ability versus effort attributional feedback: Differential effects on self-efficacy and achievement. Journal of Educational Psychology, 75, 848-856.

Schunk, D.H. (1984a) Self-efficacy perspective on achievement behavior. Educational Psychologist, 19(1), 48-58.

Schunk, D.H. (1984b) Sequential attributional feedback and children's achievement behaviors. Journal of Educational Psychology, 76, 1159-1169.

Schunk, D.H. (1986) Verbalization and children's self-regulated learning. Contemporary Educational Psychology, 11, 347-369.

Schunk, D.H. and Rice, J.M. (1985) Verbalization of comprehension strategies: Effects on children's achievement outcomes. Human Learning, 4, 1-10.

Schwartz, R.M. and Gottman, J.M. (1976) Toward a task analysis of assertive behavior. Journal of Consulting and Clinical Psychology, 44, 910-920.

Shepp, M.S. and Jensen, B.F. (1983) A comparison of the treatment effects of an operant strategy, a cognitive strategy and a combined approach with a hyperactive boy. School Psychology Review, 12(2), 199-204.

Stipek, D.J. and Tannatt, L.M. (1984). Children's judgements of their own and their peers' academic competence. Journal of Educational Psychology, 76, 75-84.

Swanson, H.L. (1985) Effects of cognitive-behavioral training on emotionally disturbed children's academic

performance. Cognitive Therapy and Research, 9(2), 201-216.

Swanson, H.L. and Scarpati, S. (1984) Self-instructional training to increase academic performance of educationally handicapped children. Child and Family Behavior Therapy, 6(4), 23-39.

Thackwray, D., Meyers, A., Schleses, R. and Cohen, R. (1985)Achieving generalization with general versus specific self-instructions: Effects on academically deficient children. Cognitive Therapy and Research, 9(3), 297-308.

Tomarken, A.J. and Kirschenbaum, D.S. (1982) Self-regulatory failure: Accentuate the positive? Journal of Personality and Social Psychology, 43(3), 584-597.

Wine, J.D. (1971) Test anxiety and the direction of attention. Psychological Bulletin, 76, 91-104.

Zatz, S. and Chassin, L. (1985) Cognitions of test anxious children under naturalistic test taking conditions. Journal of Consulting and Clinical Psychology, 53(3), 393-401.