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Alleviation of Learned Helplessness in
College Freshmen with Performance
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Claudia J. Sowa

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Herbert M. Burks, Jr.

Major professor

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ALLEVIATION OF LEARNED HELPLESSNESS IN
COLLEGE FRESHMEN WITH PERFORMANCE
DIFFICULTIES IN MATHEMATICS

By

Claudia J. Sowa

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ABSTRACT

ALLEVIATION OF LEARNED HELPLESSNESS IN COLLEGE FRESHMEN WITH PERFORMANCE DIFFICULTIES IN MATHEMATICS

By

Claudia J. Sowa

The purpose of this study was to compare the effectiveness of a cognitive restructuring model of instructional design with that of a contingency-based model on the alleviation of inappropriate learned helplessness factors and the improvement of mathematics performance in college freshmen.

A population of college freshmen who saw themselves as personally helpless in regard to mathematics was identified. Criteria were a recent failure experience in mathematics and a lack of personal confidence in ability to perform mathematics. Failure was defined as not passing the arithmetic entrance examination at Michigan State University. Volunteers from those who had failed the examination were pretested to determine a lack of personal confidence in mathematical ability. Those with scores indicating a lack of confidence in ability to do mathematics served as the population and were identified as personally helpless in regard to mathematics.

Potential ability of the population and the level of mathematical performance expected were considered. The acceptance of the population into the University and the ninth grade level of mathematics expected on the arithmetic entrance examination were seen as indicative of the population's potential ability to pass the examination. Not passing the examination, coupled with a lack of confidence in ability to do the level of mathematics required, was deemed inappropriate for persons entering the University. Therefore, the identified population was considered inappropriately helpless in regard to the level of mathematics required. Subjects were blocked on sex. Twelve males and twelve females were then randomly assigned to one of three treatment groups. This procedure resulted in a 3 x 2 randomized level design, with treatment and sex as independent variables.

Three treatment groups were employed. The first treatment was a cognitive-restructuring model. The second treatment was a contingency-based model. The third treatment involved a placebo-control group.

Results of the treatment were analyzed with data collected on two dependent measures, the Fennema-Sherman Mathematics Attitude Scale and the final examination in Math 082. A multivariate analysis of variance was the predominant statistical procedure used in the analysis, with the Confidence in Learning Mathematics Scale and the diagnostic module pretest used as covariates.

The research hypotheses were supported in varying degrees. Relationships between scores on the dependent measures and levels of two sources of variation, sex and treatment-by-sex, were not statistically significant for the total analysis. Significant treatment differences were, however, found in the overall multivariate analysis of variance with the diagnostic module pretest used as a covariate and in the univariate analyses of variance of the scores on the Fennema-Sherman Mathematics Attitude Scale, the Mathematics as a Male Domain Scale, the Usefulness of Mathematics Scale, and the Confidence in Learning Mathematics Scale. In addition, the results of post hoc t-tests indicated that the directionality of the differences between scores on the dependent measures was the result of the significant differences found in the comparison between the cognitive restructuring treatment and the contingency-based treatment. No significant treatment differences were found in the comparisons of the two treatment groups with the control group.

This research may be seen as one stepping stone to a much wider base of knowledge encompassing achievement motivation and self-defeating personality disorders. Conjecture concerning implications for these constructs would seem presumptuous at this time. However, it is hoped that this research provides an impetus for the application

of learned helplessness theory in the field and a beginning at research on the alleviation of helplessness factors within a nonlaboratory, environmental setting.

¹Fennema, E., & Sherman, J. A. Fennema-Sherman Mathematics Attitude Scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. JSAS Catalogue of Selected Documents in Psychology, 1976, 6, 31.

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1980

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TABLE OF CONTENTS

	Page
LIST OF TABLES	vii
FIGURE	x
 Chapter	
I. INTRODUCTION AND REVIEW OF THE LITERATURE . . .	1
Statement of the Problem	1
Definitions	3
Helplessness	3
Learned Helplessness	3
Inappropriate Helplessness	4
Review of the Literature	4
Learned Helplessness	4
Attribution Theory as Applied to Learned Helplessness.	10
Achievement Motivation	15
Synthesis and Overview	19
II. PROCEDURES.	21
Population	21
Sample	21
Instrumentation	23
Fennema-Sherman Mathematics Attitude Scale .	23
Final Examination in Math 082	25
Treatment	26
Overview	26
Cognitive Restructuring Model	27
Contingency-Based Model	30
Control Group	31
Design	31
Hypotheses	33
Data Analysis	34
III. ANALYSIS OF RESULTS	36
Hypothesis Testing	36
Multivariate Analyses of Covariance	36
Analysis of Variance of Subscales	43
Post Hoc t-tests	53

	Page
(Chapter III. Analysis of Results)	
Correlational Comparison	57
Correlational Comparisons for All Subjects .	58
Correlational Comparisons for Subjects in Cognitive Restructuring Treatment	60
Correlational Comparisons for Subjects in Contingency-Based Treatment	62
Correlational Comparison for Subjects in Control Group	62
Exploratory Analysis	65
Exploratory t-Tests	65
Descriptive Statistics of Treatment-by-Sex .	69
Summary of Results	71
IV. DISCUSSION	75
Summary	75
Limitations	79
Sample	80
Instrumentation	82
Design.	84
Methodology	86
Discussion of Results	88
Hypothesis Testing	88
Exploratory Analysis.	95
Implications	97
Implications for Future Research	98
APPENDICES	101
A. FENNEMA-SHERMAN MATHEMATICS ATTITUDE SCALES.	101
B. NEGATIVE SELF-STATEMENTS IN REGARD TO MATHE- MATICS PERFORMANCE	111
C. REINFORCEMENT MENU	112
D. INFORMED CONSENT AGREEMENT	113
REFERENCES.	114

LIST OF TABLES

Table	Page
2.1 Split-Half Reliabilities of the Fennema-Sherman Mathematics Attitude Scale	24
2.2 Randomized Level Design Used to Test Hypotheses.	32
3.1 Summary of Multivariate Analysis of Variance with Confidence in Learning Mathematics Scale as a Covariate	37
3.2 Summary of Analysis of Variance for Performance on Math 082 Final Examination with Confidence in Learning Mathematics Scale as a Covariate .	39
3.3 Summary of Analysis of Variance for Fennema-Sherman Mathematics Attitude Scale with Confidence in Learning Mathematics Scale as a Covariate	40
3.4 Summary of Multivariate Analysis of Variance with Module Diagnostic Pretest as a Covariate.	42
3.5 Summary of Analysis of Variance for Performance on Math 082 Final Examination with Module Diagnostic Pretest as a Covariate	43
3.6 Summary of Analysis of Variance for Fennema-Sherman Mathematics Attitude Scale with Module Diagnostic Pretest as a Covariate . . .	43
3.7 Analysis of Variance on Mother Scale (M) with Confidence in Learning Mathematics Scale as a Covariate	44
3.8 Analysis of Variance on Effectance Motivation in Mathematics Scale (E) with Confidence in Learning Mathematics Scale as a Covariate . .	44
3.9 Analysis of Variance on Usefulness of Mathematics Scale (U) with Confidence in Learning Mathematics Scale as a Covariate	45
3.10 Analysis of Variance on Mathematics Anxiety Scale (A) with Confidence in Learning Mathematics Scale as a Covariate	45

Table		Page
3.11	Analysis of Variance on Father Scale (F) with Confidence in Learning Mathematics Scale as a Covariate	46
3.12	Analysis of Variance on Attitude toward Success in Mathematics Scale (AS) with Confidence in Learning Mathematics Scale as a Covariate	46
3.13	Analysis of Variance on Teacher Scale (T) with Confidence in Learning Mathematics Scale as a Covariate	47
3.14	Analysis of Variance on Mathematics as a Male Domain Scale (MD) with Confidence in Learning Mathematics Scale as a Covariate	47
3.15	Analysis of Variance on Confidence in Learning Mathematics Scale (C) with Confidence in Learning Mathematics Scale as a Covariate .	48
3.16	Analysis of Variance on Mother Scale (M) with Module Diagnostic Pretest as a Covariate . .	49
3.17	Analysis of Variance on Effectance Motivation in Mathematics Scale (E) with Module Diagnostic Pretest as a Covariate	49
3.18	Analysis of Variance on Usefulness of Mathematics Scale (U) with Module Diagnostic Pretest as a Covariate	50
3.19	Analysis of Variance on Mathematics Anxiety Scale with Module Diagnostic Pretest as a Covariate	50
3.20	Analysis of Variance on Father Scale (F) with Module Diagnostic Pretest as a Covariate . .	51
3.21	Analysis of Variance on Attitude toward Success in Mathematics Scale (AS) with Module Diagnostic Pretest as a Covariate	51
3.22	Analysis of Variance on Teacher Scale (T) with Module Diagnostic Pretest as a Covariate . .	52
3.23	Analysis of Variance on Mathematics as a Male Domain Scale (MD) with Module Diagnostic Pretest as a Covariate	52

Table		Page
3.24	Analysis of Variance on Confidence in Learning Mathematics Scale (C) with Module Diagnostic Pretest as a Covariate	53
3.25	Post Hoc t-Tests between Treatment I and Treatment II on Significant Dependent Measures	54
3.26	Post Hoc t-Tests between Treatment I and Treatment III on Significant Dependent Measures	56
3.27	Post Hoc t-Tests between Treatment II and Treatment III on Significant Dependent Measures	57
3.28	Summary of Pearson Product-Moment Correlations for All Subjects	59
3.29	Summary of Pearson Product-Moment Correlations for Subjects in Cognitive Restructuring Treatment	61
3.30	Summary of Pearson Product-Moment Correlations for Subjects in Contingency-Based Treatment.	63
3.31	Summary of Pearson Product-Moment Correlations for Subjects in Control Group	64
3.32	t-Tests between Treatment I and Treatment II on Nonsignificant Dependent Measures	66
3.33	t-Tests between Treatment I and Treatment III on Nonsignificant Dependent Measures	67
3.34	t-Tests between Treatment II and Treatment III on Nonsignificant Dependent Measures	68
3.35	Descriptive Statistics of Treatment-by-Sex on Fennema-Sherman Mathematics Attitude Scale	70
3.36	Descriptive Statistics of Treatment-by-Sex on Performance on Math 082 Final Examination.	71

FIGURE

	Page
Figure 4.1 Comparison of Significant Dependent Measures Across Treatments	92

CHAPTER I

INTRODUCTION AND REVIEW OF THE LITERATURE

Statement of the Problem

This study of the alleviation of inappropriate learned helplessness in college freshmen with performance difficulties in mathematics has been developed from attribution theory in the psychology of personality, contingency learning in experimental psychology, and cognitive theory in clinical psychology.

The term "helplessness" implies that nothing a person does will matter, or that the outcome of an event is beyond a person's control. The person makes no voluntary response to control the outcome. The probability of the outcome is perceived to stay the same whether or not a given response occurs. The outcome, then, is independent of any response

the person's repertoire. That is, when this condition exists for every controlling response the individual is capable of performing, the outcome is uncontrollable.

Seligman (1975) defines helplessness as a psychological state that frequently results when events are uncontrollable. The result of this uncontrollability produces problems for persons who learn or perceive that they are helpless. In laboratory experiments, helplessness has caused motivation to diminish, the ability to perceive success to be undermined, and emotions of depression and anxiety to escalate.

The study of Seligman's learned helplessness experiments also provides a model for examining and explaining the reactions and behavior of persons who perceive themselves to be in a helpless situation. The perception of helplessness does not imply that the situation is truly uncontrollable. A person may assume that a situation is helpless at times because of similarities between the event and previous events which were uncontrollable. In the new situation, this assumption may prove to be inappropriate. Though irrational, it creates obstacles for the person. It lowers motivation to respond, causing the individual to persevere less in learning a new task. If the person does succeed and produces the correct response, he or she tends to attribute the success to luck rather than to ability or effort. This attribution minimizes the reinforcement of the success, and the correct response is less likely to be repeated. Instead, the person tends to reproduce previous performance difficulties.

The implication of this model is that students who could be characterized as inappropriately helpless would benefit more from a different instructional design than that which would be most effective for students who respond to contingent reinforcement. In this study, an attempt is made to compare two forms of instructional design in terms of their effectiveness in improving mathematical performance of college freshman students who have been classified as inappropriately helpless. The first form (Treatment I) consists of a cognitive restructuring model aimed at

changing inappropriate attributions of helplessness. The second form (Treatment II) consists of a contingency-based model aimed at reinforcing appropriate responses. A control group is incorporated in the design as Treatment III. Outcome measures include final examination scores in a freshman mathematics course and scores on the Fennema-Sherman Mathematics Attitude Scales (Appendix A). Subjects are blocked on sex, based on the research showing an interaction between achievement motivation and sexual differences.

The purpose of this study, then, is to compare the effectiveness of a cognitive restructuring model of instructional design with that of a contingency-based model on the alleviation of learned helplessness factors and on the improvement of math performance in college freshmen.

Definitions

Throughout the study, the ideas of helplessness, learned helplessness, and inappropriate helplessness are interwoven. To aid in clarification, definitions of each concept for this study will follow.

Helplessness

The term "helplessness" is used here to imply the perception that the outcome of an event is beyond a person's control and is independent of any learnable responses in a person's repertoire.

Learned Helplessness

The term "learned helplessness" is used to describe the stimulus generalization of helplessness cognitions to

experiences which resemble the uncontrollable conditions under which the cognitions were acquired.

Inappropriate Helplessness

The term "inappropriate helplessness" is used to extend the idea that the stimulus generalization of learned helplessness may be irrational and inappropriate in some cases. It is the assumption of the existence of inappropriate helplessness that underlies the attempt in this study to examine the effectiveness of various forms of instruction on the alleviation of learned helplessness behavior.

Review of the Literature

This review of the literature covers research in three areas: learned helplessness, attribution theory as it applies to learned helplessness, and achievement motivation. A synthesis and overview of the research in these areas, with implications for this study, is then presented. The review covers relevant research published through September of 1979, with an emphasis on the 12-year period immediately preceding.

Learned Helplessness

The concept of learned helplessness is an extension of Mowrer's (1960) idea of hopelessness. This concept was first studied experimentally by Seligman and Maier (1967) and Overmier and Seligman (1967). The researchers used the term "learned helplessness" to denote that helplessness is produced through learning that the presentation and/or withdrawal of an aversive event is independent of one's

behavior. Seligman, Maier, and Geer (1968) found that dogs pretreated with unavoidable and inescapable shock later failed to avoid and escape shock in another situation in which shock was avoidable and escapable. Replication of this phenomenon of learned helplessness has been shown with dogs (Maier, 1970); with rats (Weiss, 1968, 1971; Maier, Albin, & Testa, 1973; Maier & Testa, 1975; Seligman & Beagley, 1975); with cats (Masserman, 1971; Thomas & Dewald, 1977); and with fish (Padilla, 1973).

Similar effects have been demonstrated in humans. Hiroto (1974) duplicated the phenomenon of learned helplessness with humans by assigning college students to three groups. The first group received a loud noise but could turn it off by pushing a button. The second group heard the same noise but could make no response that would turn off the sound. The third group was a control and received no noise. Each person was then placed in a room with a hand-shuttle box. To turn off the noise, the subjects had only to move a lever from one side of the box to the other. Both the first and third groups learned how to control the aversive sound. The second group, which had previously experienced the uncontrollable noise, sat passively and accepted the aversive noise. Similar laboratory effects of learned helplessness in humans have also been shown by using an escape-avoidance task in the testing procedure (Fosco & Geer, 1971; Thornton & Jacobs, 1971; Klein & Seligman, 1976). In other studies, an anagram-solution task has been employed in place of the escape-avoidance

procedure by providing the subjects with a series of anagrams with the same solution order. Subjects had to solve anagrams after experiencing escapable noise, inescapable noise, or no noise. Those subjects receiving inescapable noise prior to the anagrams had greater difficulty in determining the solution order (Hiroto & Seligman, 1975; Benson & Kennelly, 1976).

As a result of this research, Seligman (1975) suggests that learning the uncontrollability of an outcome has major consequences in terms of motivation, cognition, and emotion. He states:

Laboratory evidence shows that when an organism has experienced trauma it cannot control, its motivation to respond in the face of later trauma wanes. Moreover, even if it does respond, and the response succeeds in producing relief, it has trouble learning, perceiving, and believing that the response worked. Finally, its emotional balance is disturbed: depression and anxiety, measured in various ways, predominate (pp. 22-23).

In measuring these consequences, a variety of dependent measures have been employed. In both escape-avoidance and anagram tasks, three measures are commonly used: the number of trials to escape or solve an anagram, the number of failures to escape or solve an anagram, and the average time needed to escape or solve an anagram. Miller and Seligman (1975) argue that the problem with these solution criteria is that motivational and cognitive components are not separated in response speed. In an attempt to isolate cognitive deficits, these researchers employed Rotter, Liverant, and Crowne's (1961) measure of expectancy change following success or failure. Each subject was given a

chance or a skill task. Reinforcement for successful completion of the task was then manipulated by the experimenter. The dependent measure was the expectancy change reported after success or failure. The problem with this measure is the assumption that expectancy is a function of a response-outcome contingency (Phares, 1957; Rotter et al., 1961). Its usefulness in measuring learned helplessness then becomes questionable in view of the basic premise of response-outcome independence within learned helplessness theory.

In other studies, researchers have tried to isolate cognitive deficits by using problem-solving tasks. These tasks consisted of intelligence tests (Thornton & Jacobs, 1971), block designs (Dweck & Repucci, 1973), discrimination learning (Eisenberger, Park, & Frank, 1976), and concept-formation problems (Roth & Kubal, 1975). According to Miller and Norman (1979), none of these studies has adequately separated the cognitive from the motivational components of learned helplessness. It is therefore difficult to distinguish between deficits shown in the two components based on previous research.

The third component of learned helplessness is the emotional aspect of the phenomenon. Emotional deficits have been measured mainly through self-report measures of anxiety and depression. Miller and Seligman (1975) and Gatchel, Paulus, and Maples (1975) used the Multiple Affect Adjective Check List developed by Zuckerman, Lubin, and Robins (1965). Griffith (1977) employed the Paired Anxiety

and Depression Scale (Mould, 1975) as a pretest and post-test measure. Roth and Kubal (1975) used self-made questionnaires to reflect emotional changes due to learned helplessness factors. Following noncontingent failure, subjects reported increased levels of anxiety on all of the measures.

Physiological measures of the emotional aspects of learned helplessness have also been employed. Gatchel and Proctor (1976) and Krantz, Glass, and Snyder (1974) measured these aspects of learned helplessness through a physiological response, electrodermal activity. Subjects placed in learned helplessness conditions produced lower levels of electrodermal activity than subjects in a control group. Malmo (1965) suggests that lower electrodermal activity may reflect a lower motivational state which McCarron (1973) correlates with clinical depression.

The employment of physiological measures in the study of learned helplessness is a major result of research done by Weiss, Stone, and Harrell (1970) and Weiss, Glazer, and Pohorecky (1974), who have shown neurochemical changes associated with learned helplessness. These researchers suggest that learned helplessness performance deficits are not caused by cognition, but by norepinephrine (NE) depletion. These deficits in turn have produced failure to escape and lower levels of activity when rats are placed in escapable conditions. Weiss, et al. (1970) conclude that NE depletion is necessary and sufficient to produce learned helplessness behaviors, but that a cognition of learned helplessness may not be sufficient within itself.

Thomas and Balter (in press) extended this research by suggesting that helplessness may be caused by stimulating the septum. Such stimulation would inhibit the median forebrain bundle (MFB), an adrenergic whose primary transmitter substance is NE. To test this hypothesis, learned helplessness was produced in cats by the use of inescapable shock. Once learned helplessness had been established, half the cats were injected with atropine (a cholinergic blocking agent that shuts off the activity in the septum). The cats injected with atropine no longer showed signs of learned helplessness in a shuttle box. The cats not receiving atropine continued to exhibit helpless behavior. It was concluded that helplessness can be explained by the cholinergic action of the septum.

The catecholamine hypothesis may also be applied to learned helplessness. This hypothesis suggests that depression is caused by a deficiency in catecholamines at certain receptor sites in the brain. Catecholamines are known to be released by the sympathetic-adrenomedullary system under conditions of high arousal or anxiety (Cox, 1978). The implication of this hypothesis is that physiological states produce psychological conditions.

Baldessarini (1975), however, would consider this view an oversimplification of the problem. The relationship between physiology and cognition in learned helplessness may be shown to have causality in both dimensions. Thus, self-report and physiological data both support Seligman's (1975) predictions of emotional deficits and

increased depression and anxiety following exposure to learned helplessness conditions. Associated with this support, self-report measures also imply an increase in hostility and aggression (Roth & Kubal, 1975; Krantz et al., 1974) not suggested by Seligman.

Performance deficits, therefore, may be shown to have a cognitive, a motivational, a physiological, or an emotional basis within the learned helplessness environment. Such deficits may also be the result of an impairment of all four processes. To focus on any one of the processes may lead to limited predictions and generalizations (Mischel, 1977). Learned helplessness, then, is viewed in this study as a wholistic response determined by many interacting variables, both within the person and in the environment. Alleviation of any performance deficit caused by inappropriate helplessness is considered a function of an individual's perception of the causality of his or her helplessness, based on attribution theory.

Attribution Theory as Applied to Learned Helplessness

Attribution theory is applied to learned helplessness in terms of causal attribution (Kelley, 1967). This theory is concerned with the way a person forms causal explanations for events and how these explanations affect future behavior. The cognitive model of motivation generally applied is described by Weiner, Frieze, Kukla, Reed, Rest, and Rosebaum (1971). In this model, it is assumed that beliefs about the causes of events offer a way of understanding reasons that

persons offer for perseverance and for responsibility for outcomes. In formulating these beliefs the model suggests that:

Individuals utilize four elements of ascription both to postdict (interpret) and predict the outcome (O) of an achievement-related event. The four causal elements are ability (A), effort (E), task difficulty (T), and luck (L):

$$O = f(A, E, T, L)$$

That is, in attempting to explain the prior outcome (success or failure) of an achievement-related event, the individual assesses his own or the performer's ability level, the amount of effort that was expended, the difficulty of the task, and the magnitude and direction of the experienced luck... (Weiner et al., 1971, p. 2).

When applied to learned helplessness, the important variable is not the aversive event, but the perception of the independence of the event and one's own behavior. Weiner et al. (1971) suggest that the person's attribution concerning the noncontingency of the outcome affects both expectations and performance on future tasks. In five studies (Dweck, 1975; Dweck & Repucci, 1973; Klein, Fencil-Morse, & Seligman, 1976; Tennen & Eller, 1977; Wortman, Panciera, Shusterman, & Hibscher, 1976) the effects of attribution on the development of learned helplessness have been examined.

In one of the first studies linking learned helplessness to attributions of outcomes, Dweck and Repucci (1973) found that, following failure, a certain group of children did not perform a task required to succeed even though they were motivated to and were capable of doing so. These children tended to attribute the outcomes of their behaviors to ability rather than to effort. They believed they had

little ability to perform the task, and therefore, regardless of effort, expected to fail. The more persevering children attributed their success to their efforts, and therefore tended to put forth more effort until they succeeded.

Klein et al. (1976) directly manipulated attributions by providing subjects with information on other subjects and their ability to perform a task. Two experimental conditions were established to produce internal and external attributions regarding performance. In the internal-attribution condition, subjects were told that 55 percent of the previous subjects had solved the problem correctly. In the external-attribution condition, subjects were told that 90 percent of the previous subjects had failed every problem. Following this information, depressed and non-depressed subjects were given the problems to solve and were randomly reinforced for success. Subjects were then asked to complete an anagram task, which served as the dependent measure. The results showed that non-depressed subjects were not affected by the information. Depressed subjects, however, were alleviated of learned helplessness factors through the external-attribution condition. Klein et al. (1976) suggest that helplessness and depression may be due to both failure and the attribution of that failure to the lack of personal ability.

This attribution was not included in Seligman's (1975) theory of learned helplessness. To rectify this omission, two forms of helplessness were introduced in the reformulation of Seligman's theory presented by Abramson, Seligman,

and Teasdale (1978). The first form is called universal helplessness. In this situation the individual believes that the outcome of a situation is independent of all of his or her responses, as well as the responses of other persons. The second form is called personal helplessness. In this situation the individual believes that the outcome of a situation is independent of all of his or her responses, but may be controlled by the responses of others.

The crucial factor in this reformulation of Seligman's theory is the involvement of attribution theory in the formation of learned helplessness. The events leading to the development of learned helplessness become an interaction between the individual and the environment. First, the person must perceive that all responses are noncontingent with a desired outcome. Second, the person makes an attribution concerning the perceived noncontingency of his or her actions and the outcomes. This attribution leads to an expectation of noncontingency between future behaviors and the outcome for the individual. The consequences of this expectation become the symptoms of learned helplessness. The person expects his or her future responses to be futile.

According to Miller and Norman (1979):

In contrast with the single expectancy term of Seligman's model, attribution theory suggests that analysis of the individual's ascriptions of causality of environmental events will lead to more accurate representations of cognitive processing and to better predictions of future behavior (p. 108).

This statement implies that an interaction of outcome and

situational variables with individual differences produces an attribution, which explains future helplessness responses based on expectation.

Weiner (1974) characterizes this attribution along two dimensions: locus of control (internal versus external) and stability or relative permanence of the attribution (stable versus variable). Two additional dimensions with particular relevance to learned helplessness are presented by Miller and Norman (1979). These are specificity of task situations (specific versus general) and perceived importance of task situations (important versus unimportant). The interactions among these four dimensions comprise the strength of the attribution applied in the helplessness situation and the effect of the attribution on future responses and expectations.

For example, attributions were characterized as stable (ability) or unstable (effort) to test the expectation of sex-appropriate behaviors on a specific task (Etaugh & Brown, 1975). The researchers showed that a hypothetical male's success in a mechanics class was attributed to ability by subjects. His failure was attributed to lack of effort. If the hypothetical person was female, the attribution was reversed. Her success was attributed to her effort or her uniqueness as an individual, and her failure to lack of ability.

The implication of this research for education is the suggestion that persons carry expectations for success and failure that are related to factors beyond the particular

task and behavior. Such expectations may conflict with reality. This discrepancy extends achievement motivation concerns beyond the use of reinforcement principles for persons who wish to educate all individuals to their fullest potential.

Achievement Motivation

What is lacking in achievement motivation research begins to be explained with the application of attribution theory to learned helplessness. Maehr (1974) suggests that achievement motivation research shows a lack of attention to the influence of contextual conditions of achievement. He stresses the behavioral patterns of motivation, or routines. Learned helplessness offers an example of a particular behavioral pattern of motivation. The significance of learned helplessness as a contextual condition of achievement motivation can be supported by research on attributional processes. Crandall (1969) discusses the importance of an "illusion" of control as a factor in achievement motivation. Maehr's own research shows that freedom from external controls in learning encourages continuing interest in difficult tasks.

Particularly relevant to the present study is the research on the contextual condition of learned helplessness in achievement motivation. The effect of this condition is examined as a function of sexual differences. The result of this examination is directly applied to performance in mathematics.

Studies on sex differences in learned helplessness behaviors indicate that males tend to attribute their successes to their ability and their failures to lack of effort. Females, in turn, attribute their successes to effort or luck, and their failures to lack of ability (Dweck & Repucci, 1973; Nicholls, 1975). These findings suggest that males and females do not respond in the same way to similar environments, nor do adults react toward males and females in identical patterns. Dweck and Goetz (1977) showed that adults tend to give negative feedback to males for a variety of reasons (e.g., behavior, dress, lack of effort) and to females for a specific reason (e.g., quality of work). Thus, males begin to disregard negative feedback, since it is so generalized, whereas females begin to incorporate the effects of negative feedback as a stable part of their personality.

The conclusions of this research on achievement motivation are that males tend to persist in spite of negative feedback and past failures, whereas females tend to give up sooner at the indication of negative feedback. Females tend to concentrate on failure and behave as if it were a valid indication of their abilities. Complex patterns of reinforcement from parents, models, and media begin to establish norms which tend to separate males and females in achievement areas. These reinforcement patterns, coupled with persistence differences, ultimately affect the rate of academic success in schools and the extent of achievement motivation in the world of work.

Mathematics aptitude may be applied closely to this model of learned helplessness within achievement motivation (Mark, 1978). Math skills involve conceptualizing information in order to progress into more specific areas (e.g., algebra, geometry, and trigonometry). At each new level, a degree of persistence is necessary to master the material. This persistence is much more likely to occur in males than in females. Males, therefore, are more likely to perform well in mathematics.

The application of achievement motivation research to mathematics is divided into three areas of concern for this study. The first area of concern is the relationship between attitudes toward mathematics and achievement in mathematics. The second area of concern is whether attitude, ability, avoidance, and anxiety are linked to mathematical achievement. The third area of concern is the relationship between lack of background in mathematics and the possible constriction of the range of vocational choices available to students.

The assessment of attitudes toward mathematics is a concern because attitudes have been shown to affect performance. Evidence from a variety of studies utilizing different test instruments and different populations has shown a positive correlation between self-reported attitude toward mathematics and standardized test scores (Aiken, 1970, 1976; Neale, 1969). This evidence implies that attitude affects achievement and, in turn, achievement affects attitude.

Researchers argue that sex differences in mathematical skills may be caused by either social or biological

differences. Biological differences include differences in brain structure, genetic factors, and hormonal factors (McGuire, Ryan, & Omenn, 1975; Maccoby & Jacklin, 1974).

The social reasons for sex differences in mathematical ability have been researched by many authors. Maccoby and Jacklin (1974) discuss the major role imitation plays in the development of sexually stereotyped attitudes toward mathematics. Imitation may be seen as a means of learning the "appropriate" response to gain social support. Social support offered by peers, parents, and teachers for math achievement has been shown to have a strong positive correlation with the taking of advanced mathematics courses on the high school level (Sells, 1973). Two consistent myths, according to Donady and Tobias (1977), underlie the extent to which males and females receive social support for involvement in mathematics. The first myth says that males are naturally better at math than females, and the second myth holds that males like math better than females do. As a result of these myths, fewer women enroll in and succeed in mathematics courses.

Sells (1973) reports that, in a random sample of freshmen at the University of California at Berkeley, 57 percent of the males met a requirement for freshman calculus of three and one-half years of high school math. However, only 8 percent of the females met the same requirement. Seventy-five percent of the curriculum requires freshman calculus in order to continue in departmental majors. Therefore, a lack of background in mathematics serves to disqualify students for many occupations.

Synthesis and Overview

For this study, application of the attribution model of learned helplessness to poor performance in mathematics was employed in three steps. The first step was the identification of a population of college freshmen who saw themselves as personally helpless in regard to mathematics. The second step was the determination of the inappropriateness of the learned helplessness in the identified sample in regard to the level of mathematics required. The third step was the presentation of experimental treatments aimed at improving math performance in college freshmen who could be characterized as "math-helpless."

According to Keller (1975), helplessness in humans results more from the attributions that follow upon failure than from an aversive stimulus (such as electric shock, as often used in the experimental laboratory). Behavior in persons who fail or perceive themselves as failing may be identical to the learned helplessness behavior of animals, but the controlling variable is not the same. The controlling variable in humans is the attribution of that failure to the lack of personal ability (Klein et al., 1976).

The first step in this study was to identify a population of college freshmen who had experienced failure in mathematics and who lacked confidence in their ability to perform mathematics. Subjects were identified as personally helpless in mathematics by a combination of both failure and attitude. Failure was defined as not passing the arithmetic entrance examination required by Michigan State University. An

attitude of lack of confidence was indicated by scoring less than a mean of 3 on the Confidence in Learning Mathematics Scale (in Appendix A), which was developed by Fennema and Sherman for the National Science Foundation.

The second step was to determine the appropriateness or inappropriateness of the personal helplessness in regard to mathematics for the identified sample. Two areas were considered: the potential ability of the subjects and the level of mathematical performance expected in this study. The acceptance of the subjects into Michigan State University based on high school grade-point average and Scholastic Aptitude Test (SAT) qualification scores was seen as indicative of potential ability to do basic arithmetic and mathematics on the ninth grade level. Therefore, attributions of personal helplessness in mathematics were seen as inappropriate for the low level of mathematics expected in this study.

The third step in the application was the presentation of experimental treatments aimed at alleviating inappropriate helplessness and improving mathematical performance. The first treatment was a cognitive restructuring model based on Goldfried, Decenteneo, and Weinberg's (1974) systematic rational restructuring model. The purpose of this treatment was the alleviation of inappropriate attributions of personal helplessness in mathematics. The second treatment was a contingency-based model developed from Ferster and Skinner's (1957) behavioral theory of reinforcement. In the experimental design of the study, the effects of these treatments and those of a control group were compared.

CHAPTER II

PROCEDURES

Population

Subjects for this study were selected from a population of 120 first-term college freshmen at Michigan State University. This population is a subset of the entire freshman class by virtue of its enrollment in Mathematics 082, a non-credit remedial math course. Math 082 is not an elective, but a requirement of the University for establishing a minimal level of acceptable mathematics performance in freshmen. The population is mainly 18 or 19 years old and consists of both sexes. It includes persons from a variety of cultures and races. All persons in the population have failed the Arithmetic Placement Entrance Examination at orientation into the University.

Sample

All of the subjects in the sample were enrolled in their first term of college and in Math 082. Math 082 is a non-credit course offered by the Department of Mathematics for students who have failed to meet an acceptable level of performance (a score of less than 6 out of 30) on the Michigan State University Arithmetic Placement Examination. This course is a self-moduled program of study. Each subject was placed in the appropriate module based on

individual performance as measured by a diagnostic pretest. Therefore, subjects were considered independent even though they took the same final examination in the course.

Seventy-one volunteers from the Math 082 classes were pretested by using the Fennema-Sherman Confidence in Learning Mathematics Scale (in Appendix A). This scale is intended to measure confidence in one's ability to learn and to perform well on mathematical tasks. The dimensions range from a distinct lack of confidence to definite confidence on a five-point Likert-type scale. The Confidence Scale is correlated at the .89 level with the Fennema-Sherman Anxiety Scale. Therefore, Fennema and Sherman (1976) no longer suggest the use of the Anxiety Scale in educational research.

Thirty-four students scoring an average of 3.0 or below on the Confidence Scale met the characteristics of personal helplessness in mathematics as defined in this study. These subjects were blocked on sex. Twenty-four of these subjects, 12 males and 12 females, were randomly assigned to one of the three treatment groups. This procedure generated a Randomized Level Design as defined by Porter and Chibucos (1973).

Thirty-seven students scoring higher than a 3.0 average on the scale were not used as research subjects, since they did not meet the characteristics of personal helplessness in mathematics as defined in this study. Although further research data were not collected on those students, a weekly help session of one hour was made available to them for volunteering.

Instrumentation

In this study, two dependent measures were used to evaluate the effectiveness of treatment on improving mathematics performance and alleviating inappropriate attributions of helplessness. The measures used were scores on the Fennema-Sherman Mathematics Attitude Scales and scores on the final examination in Math 082. All standardized instruments used may be found in Appendix A. Descriptions of each dependent measure are summarized in the following paragraphs.

Fennema-Sherman Mathematics Attitude Scales

These scales consist of nine specific Likert-type scales measuring attitudes related to learning mathematics. They were developed under a grant from the National Science Foundation in 1976. The scales can be used as a total inventory to assess a variety of attitudes or as individual scales to assess specific attitudes. Dimensions covered by the scales include (a) confidence in mathematics; (b) perceived attitudes of one's father, mother, and teacher toward one as a learner of mathematics; (c) motivation in mathematics; (d) attitude toward success in mathematics; (e) mathematics as a male domain; (f) usefulness of mathematics; and (g) mathematics anxiety. Because of the importance of causal attributes in this study, a total inventory of all nine scales was used as the dependent measure. The individual scales were

also analyzed to determine specific attitude differences among groups.

Scale statistics reported by Fennema and Sherman (1976) were obtained by testing two high school populations with a combined N of 1600. The twelfth grade norms would appear to provide an appropriate standardization sample for the subjects in this study. Split-half reliabilities are shown in Table 2.1. The manual for the scales does not state whether these reliabilities were corrected for length.

Table 2.1.—Split-Half Reliabilities of the Fennema-Sherman Mathematics Attitude Scales

Scale	Reliability
Attitude toward Success in Mathematics (<u>AS</u>)	.87
Mathematics as a Male Domain (<u>MD</u>)	.87
Confidence in Learning Mathematics (<u>C</u>)	.93
Effectance Motivation in Mathematics (<u>E</u>)	.87
Usefulness of Mathematics (<u>U</u>)	.88
Father (<u>F</u>)	.91
Mother (<u>M</u>)	.86
Teacher (<u>T</u>)	.88
Mathematics Anxiety (<u>A</u>)	.89

Each scale consists of six positively stated and six negatively stated items. The reader is asked to indicate the extent of his or her agreement or disagreement with each item, using a Likert scale from 1 to 5, where 1 denotes "strongly agree" and 5, "strongly disagree." A

weight of 1 is given to the response that is hypothesized to have the most positive effect on the learning of mathematics. Conversely, a weight of 5 is given to the response that is hypothesized to have the least positive effect on the learning of mathematics. This weighting procedure thus requires the reversal of scale values for the negatively stated items. The person's score on each of these scales is the cumulative total, and the lower the score, the more positive the attitude toward mathematics.

Final Examination in Math 082

This examination was given on December 5, 1979 from 10 a.m. to noon. It included a random sample of the material covered in Modules I, II, III, IV, and V of the Series in Mathematics Modules developed by Albon, Blackman, Giangrasso, and Siner (1976) and Modules VI, VII, and VIII of the same series, written by Butts and Phillips (1979). The combination of the eight modules is equivalent to a year and a half of elementary algebra. The eight modules are: (I) Operations on Numbers; (II) Operations on Polynomials; (III) Linear Equations and Lines; (IV) Factoring and Operations on Algebraic Fractions; (V) Quadratic Equations and Curves; (VI) Linear Inequalities and Absolute Values; (VII) Exponents and Radicals; and (VIII) Functions. The total score obtained on the final examination was the dependent measure collected on each subject. Means for treatment groups were analyzed.

TreatmentOverview

This study incorporated an experimental design which measured the effectiveness of two instructional formats on mathematics performance and on the alleviation of inappropriate attributions of helplessness in mathematics. Three experimental groups were compared: two treatment groups and a control group. The first group received a cognitive restructuring model as treatment. The second group received a contingency-based model as treatment. The third group received no treatment and served as a control group.

Treatment consisted of two sessions weekly with each subject for five weeks. Each session was 45 minutes in length. Subjects were asked to bring their mathematics homework to each session.

Treatment was administered by two graduate students enrolled in the Department of Counseling and Educational Psychology. Both students had bachelor's degrees in mathematics. The study, the treatment, and the Math 082 course were explained to them during an afternoon training session. Copies of the material taught and role plays of treatment situations were utilized in the training.

Cognitive Restructuring Model

The cognitive restructuring model was aimed at alleviating inappropriate attributions of helplessness in mathematics. It incorporated two forms of self-management behavior therapy. The two forms were systematic rational restructuring (Goldfried, Decenteneo, & Weinberg, 1974) and stress inoculation training (Meichenbaum, 1975).

Goldfried et al. (1974) have attempted to fit Ellis' (1962) Rational-Emotive Therapy (RET) within a learning theory model. They have provided guidelines for implementing a relearning process. These guidelines consist of four procedures: (1) presentation of rationale underlying rational restructuring, (2) overview of irrational assumptions or self-defeating statements representing unreasonable beliefs, (3) analysis of the client's own unreasonable beliefs, and (4) teaching the client to modify his or her internal sentences.

Meichenbaum's (1975) stress inoculation training provided the overall framework for the cognitive restructuring treatment. It consists of three phases: an educational phase, a rehearsal phase, and an application phase. This treatment was aimed at substituting positive coping statements for self-defeating statements of the subject. The following outline consists of procedures incorporated in this framework:

Week I - Educational Phase

- A. Explain the relationship between cognition and performance.

Week I (continued)

- B. Apply the relationship to mathematical performance.
- C. Identify self-defeating statements related to attributions concerning ability to do mathematics.
- D. Generate contradicting positive self-statements in regard to mathematics.

Week II - Educational/Rehearsal Phase

- A. Continue generating positive and negative self-statements.
- B. Develop individual cards containing positive self-statements.
- C. Contradict negative self-statements with positive self-statements aloud as subject and trainer work through mathematics homework to identify negative cognitions.
- D. Give homework. Review cards once before doing mathematics and at every difficult problem.

Weeks III and IV - Rehearsal/Application Phase

- A. Review cards aloud.
- B. Identify difficult mathematics problems.
- C. Work problems aloud, including the use of overtly spoken cognitions concerning mathematical ability.
- D. Continue homework.

Week V - Application Phase

- A. Review cards aloud.
- B. Evaluate application of positive self-statements concerning mathematical performance without trainer present.
- C. Work on mathematics homework.
- D. Discuss the way positive self-statements can be used in other stressful situations.

The educational phase incorporated the first three procedures of the systematic rational restructuring. An

explanation of the relationship between cognition and behavior, and how this relationship affects performance in mathematics was provided. A list of negative or self-defeating statements related to attributions concerning ability to do mathematics was given to the subjects (Appendix B). Individual subjects then developed a list of their own self-defeating statements concerning their mathematical ability. Finally, a list of contradicting positive self-statements was generated.

The rehearsal phase was intended to provide coping techniques. The subject, with the assistance of the trainer, worked on mathematical homework problems related to the module level of the subject. As the problems were taught, the subject and trainer identified and assessed the reality of any stress involved in mathematical performance. Negative self-attributions concerning ability were contradicted aloud by verbally stating positive self-statements generated in the first phase. Stress was slowly increased by the continued rise in difficulty of the math problems in each module.

In the application phase, subjects were asked to implement the substitution of positive self-statements in actual stressful situations without the trainer present. To help with the implementation, cards were generated of positive self-statements used in the rehearsal stage. Subjects were asked to practice while working on mathematics homework, in mathematics class, and in any mathematics-related stressful situations. Ways in which these coping skills

could be transferred to other tasks and settings were covered during the last session.

Contingency-Based Model

The second treatment was aimed at changing the behavioral performance of the subjects by actively increasing the reinforcement of success in mathematics. This treatment was based on Ferster and Skinner's (1957) model of behavioral reinforcement schedules. An explanation of reinforcement theory and a reinforcement menu were also given to each subject (Appendix C). Additional reinforcers were generated with the individual. Each subject brought mathematical problems to the treatment sessions, and tutoring help was given. Subjects were encouraged to reward themselves extrinsically for success in mathematics. The following outline consists of procedures employed in this treatment:

Week I

- A. Explain reinforcement theory.
- B. Discuss reinforcer menu.
- C. Generate individual reinforcers.
- D. Determine reinforcement schedule for remainder of term.
- E. Work-through homework, with verbal reinforcement by trainer for successful problem-solving.

Weeks II, III, and IV

- A. Work-through homework, with verbal reinforcement by trainer for successful problem-solving.
- B. Encourage extrinsic reinforcement, contingent upon mathematical success.

Week V

- A. Work-through homework, with verbal reinforcement by trainer for successful problem-solving.
- B. Evaluate and discuss the usefulness of reinforcement for helping with mathematical performance and for learning new behaviors.

Control Group

This group received no systematic treatment. The procedure consisted of two sessions a week for 45 minutes each. These sessions were conducted with subjects individually. The subjects were asked to bring their mathematics homework to each session. The trainers answered questions concerning the homework, but did not otherwise help the subjects with their work. Moreover, the trainers did not invite questions concerning the subjects' homework.

Design

The design employed in this study was a Randomized Level Design (Porter & Chibucos, 1973). Subjects were blocked on sex. The use of sex as a blocking variable in this design was based on the research which highly correlates sex differences with differences in learned helplessness and achievement motivation (Dweck, 1975; Nicholls, 1975; Dweck & Goetz, 1977). Blocking on sex also provided an increase in statistical power. The gain in precision obtained correlated directly with the degree of covariance between the blocking variable and the dependent measures.

To assure a lack of initial bias among treatment groups, subjects were randomly assigned from the levels of

the blocking variable (sex) to the three treatment groups. Thus, the study incorporated a 3 x 2 factorial design. The first independent variable (treatment) consisted of three levels: cognitive restructuring, contingency-based learning, and control. The second independent variable (sex) consisted of two levels: male and female. The use of a factorial design provided a test for main effects within the independent variables. It also allowed the researcher to test for interactions between the two variables on the dependent measures.

The overall design of the study is shown in Table 2.2. The number of subjects (n) in each cell was four. A total of 24 subjects was used in the design.

Table 2.2--Randomized Level Design Used to Test Hypotheses

Sex	TREATMENT I COGNITIVE	TREATMENT II CONTINGENCY	TREATMENT III CONTROL
Males	n = 4	n = 4	n = 4
Females	n = 4	n = 4	n = 4

Hypotheses

This study provided an examination of the following null hypotheses for each dependent measure:

1. Linear Combination of Dependent Measures

- H₁: There is no difference among the means of the three treatment groups on the linear combination of dependent measures.
- H₂: There is no difference between the means of males and females on the linear combination of dependent measures.
- H₃: There is no difference among the means of the interactions between treatment and sex on the linear combination of dependent measures.
- H₄: There is no difference among the variances within the cells on the linear combination of the dependent measures.

2. Final Examination in Math 082

- H₅: There is no difference among the means of the three treatment groups on the final examination given in Math 082.
- H₆: There is no difference between the means of males and females on the final examination given in Math 082.
- H₇: There is no difference among the means of the interactions between treatment and sex on the final examination given in Math 082.
- H₈: There is no difference among the variances within the cells on the final examination given in Math 082.

3. Fennema-Sherman Mathematics Attitude Scale

- H₉: There is no difference among the means of the three treatment groups on the Fennema-Sherman Mathematics Attitude Scales.
- H₁₀: There is no difference between the means of males and females on the Fennema-Sherman Mathematics Attitude Scales.

- H_{11} : There is no difference among the means of the interactions between treatment and sex on the Fennema-Sherman Mathematics Attitude Scales.
- H_{12} : There is no difference among the variances within the cells on the Fennema-Sherman Mathematics Attitude Scales.

Data Analysis

The alpha level was set at .05 in the analysis of data for each hypothesis. Using the Confidence in Learning Mathematics Scale and the module diagnostic pretest as covariates, the data were analyzed by two multivariate analyses of covariance (MANCOVA). By reducing each subject's scores on the two dependent variables to a linear combination, this procedure provided an overall test of the differences among the levels within each variable (treatment and sex) and a determination of any interaction between the independent variables (Harris, 1975). The MANCOVA also provided data on the relationship between the scores on the Math 082 final examination and the total Fennema-Sherman Mathematics Attitude Scale in regard to their effects on the variance of independent variables. The covariates were used to increase the precision of the design, in view of the possible existence of error not controlled by random assignment with a small sample size.

An analysis of covariance (ANCOVA) for each individual subscale within the Fennema-Sherman Mathematics Attitude Scales was also used to determine

treatment differences. Covariates employed in the MANCOVA were used for each ANCOVA. Pearson product-moment correlations between scores on each subscale and scores on the Math 082 final examination were also included to determine the relationship between dependent variables. These correlations were examined to provide further information about the effect of inappropriate helplessness, as reflected in attitudes and performance on mathematical problem solving.

Since a MANCOVA and an ANCOVA do not provide tests for directionality with more than two treatments, directional hypotheses of interest to the research were analyzed by post hoc tests in cases where significance was found in the overall analysis. According to Harris (1975), the appropriate follow-up to a statistically significant MANCOVA is to perform univariate analyses of variance (ANOVA) on each dependent measure. ANOVAs were therefore performed with each covariate used in the original procedure. Post hoc t-tests were used to analyze the directional hypotheses of any significant univariate ANOVAs.

The results of the analysis are presented in Chapter III.

CHAPTER III

ANALYSIS OF RESULTS

This chapter contains the analysis of the results generated by the study in three areas: hypothesis testing, correlational comparisons, and trend analysis. The first area includes the formal testing of the hypotheses that were examined in the study. The second area includes a summary of the Pearson product-moment correlations between each of the Fennema-Sherman Mathematics Attitude Subscales and mathematical performance. The third area contains explorational studies of the data to determine the existence of systematic trends within the results. Following the analysis, a summary of the results is presented.

Hypothesis Testing

Multivariate Analyses of Covariance

The alpha level was set at .05 for the analysis of the data for each hypothesis. The data were analyzed by two multivariate analyses of covariance (MANCOVA) based on a linear combination of the two dependent measures (scores on the Math 082 final examination and scores on the total Fennema-Sherman Mathematics Attitude Scale). The degrees of freedom, the calculated F values, and their probabilities of occurrence for the first MANCOVA, using the Confidence in Learning Mathematics Scale as the covariate, are presented in Table 3.1.

Table 3.1.--Summary of Multivariate Analysis of Variance with
Confidence in Learning Mathematics Scale as a Covariate

Source of Variation	Degrees of Freedom	F-Value	p
Treatment	(4,32)	1.90345	.13397
Sex	(2,16)	1.76634	.20270
Interaction	(4,32)	.46620	.76002
Within-Cell Variance	(2,16)	.94803	.40823

Results of the tests of the first four null hypotheses stated in Chapter II are shown in this table. These hypotheses are:

Hypothesis 1: There is no difference among the means of the three treatment groups on the linear combination of dependent measures.

Hypothesis 2: There is no difference between the means of males and females on the linear combination of dependent measures.

Hypothesis 3: There is no difference among the means of the interactions between treatment and sex on the linear combination of dependent measures.

Hypothesis 4: There is no difference among the variances within the cells on the linear combination of the dependent measures.

As indicated in Table 3.1, Null Hypotheses 1 and 2 of no differences among treatment groups and between sexes cannot be rejected. Likewise, Hypotheses 3 and 4 cannot be rejected. The results of the overall MANCOVA with the Confidence in Learning Mathematics Scale employed as a covariate, therefore, show no significant sources of variation within the design factors.

For the purpose of exploration, Wilks' lambda statistic (1932) was used to reduce the MANCOVA into two univariate ANCOVAs based on statistical approximations from the linear combination for each dependent measure. The degrees of freedom, F-values, and probabilities of occurrence for the ANCOVA using the performance on the Math 082 final examination as the dependent variable are reported in Table 3.2.

Results of the tests of Null Hypotheses 5, 6, 7, and 8 stated in Chapter II using the Confidence in Learning Mathematics Scale as a covariate are also shown in Table 3.2. These hypotheses are:

Hypothesis 5: There is no difference among the means of the three treatment groups on the final examination given in Math 082.

Hypothesis 6: There is no difference between the means of males and females on the final examination given in Math 082.

Table 3.2.--Summary of Analysis of Variance for Performance on Math 082 Final Examination with Confidence in Learning Mathematics Scale as a Covariate

Source of Variation	Degrees of Freedom	F-Value	p
Treatment	(2,17)	1.66541	.21852
Sex	(1,17)	3.25799	.08882
Interaction	(2,17)	.89401	.42739
Within-Cell Variance	(1,17)	1.30591	.26898

Hypothesis 7: There is no difference among the means of the interactions between treatment and sex on the final examination given in Math 082.

Hypothesis 8: There is no difference among the variances within the cells on the final examination given in Math 082.

As indicated in Table 3.2, the null hypotheses of no difference among treatment groups, sex, and treatment-by-sex interactions cannot be rejected as analyzed by the univariate ANCOVA on the scores of the final examination given in Math 082. The results also indicate no significant within-cell variance in the analysis procedure.

Results of tests of the last four null hypotheses stated in Chapter II using the Confidence in Learning Mathematics Scale as a covariate are provided in Table 3.3. The hypotheses reflected in this table are:

Table 3.3.--Summary of Analysis of Variance for Fennema-Sherman Mathematics Attitude Scale with Confidence in Learning Mathematics Scale as a Covariate

Source of Variation	Degrees of Freedom	F-Value	p
Treatment	(2,17)	3.33432	.06003
Sex	(1,17)	.01462	.90517
Interaction	(2,17)	.05625	.94548
Within-Cell Variance	(1,17)	1.32200	.26615

Hypothesis 9: There is no difference among the means of the three treatment groups on the Fennema-Sherman Mathematics Attitude Scale.

Hypothesis 10: There is no difference between the means of males and females on the Fennema-Sherman Mathematics Attitude Scale.

Hypothesis 11: There is no difference among the means of the interaction between treatment and sex on the Fennema-Sherman Mathematics Attitude Scale.

Hypothesis 12: There is no difference among the variances within the cells on the Fennema-Sherman Mathematics Attitude Scale.

As indicated in Table 3.3, Null Hypotheses 9, 10, 11, and 12 cannot be rejected through the analysis of the data provided by the approximate ANCOVA using the Fennema-Sherman Mathematics Attitude Scale as a dependent measure.

Hypothesis 9--stating no difference among treatment means on the Fennema-Sherman Mathematics Attitude Scale--though not rejected, had a probability level of .06.

As a result of the general theme throughout the study of interpreting attitude and performance interactions, it was of interest to the researcher to re-run the analysis with a mathematics performance covariate. The module diagnostic pretest, used for module placement in Math 082, was selected as the covariate for the second multivariate analysis. The F-values, probabilities of occurrence, and degrees of freedom which resulted from this analysis are reported in Table 3.4.

As indicated in Table 3.4, the change in covariate to a performance measure did not affect the results of the MANCOVA on the independent variable of sex, the interaction of the two independent variables, or the within-cell variance. Null Hypotheses 2, 3, and 4 are not rejected in this case. The use of the diagnostic pretest as a covariate did, however, produce significant differences in treatment means on the linear combination of dependent measures used in the multivariate analysis procedure. The result of this significance is the rejection of Null Hypothesis 1 of no difference among treatment for this dependent variable.

The F-values, probabilities of occurrence, and degrees of freedom for the two estimated univariate ANCOVAs with the diagnostic module pretest as a covariate are reported in Table 3.5 and Table 3.6.

Table 3.4.—Summary of Multivariate Analysis of Variance with Module Diagnostic Pretest as a Covariate

Source of Variation	Degrees of Freedom	F-Value	p
Treatment	(4,32)	2.72937	.04627*
Sex	(2,16)	1.69535	.21489
Interaction	(4,32)	.29694	.87776
Within-Cell Variance	(2,16)	.61404	.55343

*
p < .05

The results shown in Table 3.5 and Table 3.6 are consistent with those found in the previous univariate ANCOVAs reported in Table 3.2 and Table 3.3. Null Hypotheses 5, 6, 7, and 8--stating no differences among treatments, between sexes, among treatment-by-sex interactions, and among within-cell variances as measured by performance on the 082 Math final examination--cannot be rejected. Hypotheses 10, 11, and 12--stating no difference between sexes, among treatment-by-sex interactions, and among within-cell variances as measured by the Fennema-Sherman Mathematics Attitude Scale--again cannot be rejected. Null Hypothesis 9, however, stating no differences in the means of treatment groups as measured by the Fennema-Sherman Mathematics Attitude Scale, can be rejected, showing differences among treatment means at the .01313 level of significance.

Table 3.5.--Summary of Analysis of Variance for Performance on Math 082 Final Examination with Module Diagnostic Pretest as a Covariate

Source of Variation	Degrees of Freedom	F-Value	p
Treatment	(2,17)	1.94849	.17302
Sex	(1,17)	2.40191	.13960
Interaction	(2,17)	.48214	.62565
Within-Cell Variance	(1,17)	.00327	.95510

Table 3.6.--Summary of Analysis of Variance for Fennema-Sherman Mathematics Attitude Scale with Module Diagnostic Pretest as a Covariate

Source of Variation	Degrees of Freedom	F-Value	p
Treatment	(2,17)	5.65169	.01313*
Sex	(1,17)	.21053	.65216
Interaction	(2,17)	.10492	.90098
Within-Cell Variance	(1,17)	1.17476	.29356

*
p < .05

Analysis of Variance of Subscales

Since the scores on the total Fennema-Sherman Mathematics Attitude Scale reflected significant treatment differences in the previous analysis procedures, individual

analyses of variance were run on each of the nine subscale components of the total attitude scale. The Confidence in Learning Mathematics Scale and the module diagnostic pretest were used as covariates. The purpose of these analyses was to determine possible significant components within the Fennema-Sherman Mathematics Attitude Scale.

The results of the individual subscale analyses of variance using the Confidence in Learning Mathematics Scale as a covariate are summarized in Tables 3.7 through 3.15.

Table 3.7.—Analysis of Variance on Mother Scale (M) with Confidence in Learning Mathematics Scale as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	.771	2	1.940	.174
Sex	.015	1	.037	.850
Interaction	.001	2	.001	.999
Error	.398	17		

Table 3.8.—Analysis of Variance on Effectance Motivation in Mathematics Scale (E) with Confidence in Learning Mathematics Scale as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	.120	2	.287	.754
Sex	.008	1	.019	.892
Interaction	.021	2	.051	.951
Error	.420	17		

Table 3.9.--Analysis of Variance on Usefulness of Mathematics Scale (U) with Confidence in Learning Mathematics Scale as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	2.251	2	4.236	.032*
Sex	.021	1	.040	.844
Interaction	.285	2	.537	.594
Error	.531	17		

*
p < .05

Table 3.10.--Analysis of Variance on Mathematics Anxiety Scale (A) with Confidence in Learning Mathematics Scale as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	.217	2	.501	.614
Sex	.671	1	1.552	.230
Interaction	.147	2	.340	.716
Error	.432	17		

Table 3.11.—Analysis of Variance on Father Scale (F) with
Confidence in Learning Mathematics Scale as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	.561	2	1.855	.187
Sex	.169	1	.560	.464
Interaction	.182	2	.602	.559
Error	.302	17		

Table 3.12.—Analysis of Variance on Attitude toward Success in
Mathematics Scale (AS) with Confidence in Learning
Mathematics Scale as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	.588	2	1.825	.191
Sex	.740	1	2.297	.148
Interaction	.595	2	1.848	.188
Error	.322	17		

Table 3.13.--Analysis of Variance on Teacher Scale (T) with
Confidence in Learning Mathematics Scale as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	.066	2	.158	.855
Sex	.071	1	.169	.686
Interaction	.121	2	.291	.751
Error	.417	17		

Table 3.14.--Analysis of Variance on Mathematics as a Male Domain
Scale (MD) with Confidence in Learning Mathematics Scale
as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	2.049	2	8.951	.002*
Sex	.689	1	3.008	.101
Interaction	.124	2	.542	.591
Error	.229	17		

* $p < .05$

Table 3.15.--Analysis of Variance on Confidence in Learning Mathematics Scale (C) with Confidence in Learning Mathematics as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	.268	2	1.512	.249
Sex	.330	1	1.862	.190
Interaction	.131	2	.742	.491
Error	.177	17		

As reported in Table 3.7 through Table 3.15, the analyses of variance showed no significant differences in the means of the subscales for sex and treatment-by-sex interactions. Significant p-values (probabilities of occurrence) were found for treatment differences with the Usefulness of Mathematics Scale and the Mathematics as a Male Domain Scale.

The results of the individual subscale analyses of variance using the module diagnostic pretest as the covariate are summarized in Table 3.16 through Table 3.24. F-values, probabilities of occurrence, and degrees of freedom are reported.

Table 3.16.--Analysis of Variance on Mother Scale (M) with Module Diagnostic Pretest as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	1.031	2	2.959	.079
Sex	.046	1	.132	.721
Interaction	.051	2	.147	.864
Error	.416	17		

Table 3.17.--Analysis of Variance on Effectance Motivation in Mathematics Scale (E) with Module Diagnostic Pretest as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	.333	2	.745	.490
Sex	.001	1	.002	.961
Interaction	.178	2	.399	.677
Error	.447	17		

Table 3.18.—Analysis of Variance on Usefulness of Mathematics Scale
(U) with Module Diagnostic Pretest as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	1.844	2	3.537	.052
Sex	.078	1	.150	.703
Interaction	.197	2	.378	.691
Error	.521	17		

Table 3.19.—Analysis of Variance on Mathematics Anxiety Scale (A)
with Module Diagnostic Pretest as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	.455	2	1.169	.334
Sex	.311	1	.799	.384
Interaction	.135	2	.347	.712
Error	.389	17		

Table 3.20.--Analysis of Variance on Father Scale (F) with Module Diagnostic Pretest as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	1.124	2	4.187	.033*
Sex	.362	1	1.347	.262
Interaction	.099	2	.370	.696
Error	.268	17		

* p < .05

Table 3.21.--Analysis of Variance on Attitude toward Success in Mathematics Scale (AS) with Module Diagnostic Pretest as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	.505	2	1.593	.232
Sex	.656	1	2.070	.168
Interaction	.599	2	1.891	.181
Error	.317	17		

Table 3.22.—Analysis of Variance on Teacher Scale (T) with Module Diagnostic Pretest as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	.005	2	.010	.990
Sex	.010	1	.020	.888
Interaction	.019	2	.041	.960
Error	.479	17		

Table 3.23.—Analysis of Variance on Mathematics as a Male Domain Scale (MD) with Module Diagnostic Pretest as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	1.912	2	7.680	.004*
Sex	.593	1	2.380	.141
Interaction	.113	2	.452	.644
Error	.249	17		

* $p < .05$

Table 3.24.--Analysis of Variance on Confidence in Learning Mathematics Scale (C) with Module Diagnostic Pretest as a Covariate

Source of Variation	Mean Square	Degrees of Freedom	F-Value	p
Treatment	1.623	2	5.506	.014*
Sex	.002	1	.008	.929
Interaction	.528	2	1.791	.197
Error	.295	17		

*p < .05

No significant differences between sexes and no significant interactions between treatment and sex were found, as shown in Tables 3.16 through 3.24. The subscales of Mathematics as a Male Domain ($p = .004$) and Usefulness of Mathematics ($p = .052$) provide consistent components which may reflect the significant difference found in treatment means on the total Fennema-Sherman Mathematics Attitude Scale. In addition, the use of the module diagnostic pretest as a covariate resulted in significant treatment differences on two other subscales, the Father Scale ($p = .033$) and the Confidence in Learning Mathematics Scale ($p = .014$).

Post Hoc t-Tests

Since the directionality of the results cannot be determined by the previous analysis procedures, a series of post hoc t-tests was performed on the significant

treatment differences. A summary of the differences between Treatment I (cognitive restructuring) and Treatment II (contingency-based learning) on the significant dependent measures is presented in Table 3.25.

Dunn's procedure (Hays, 1973), involving orthogonal comparisons, was used to control for inflation of error. Accordingly, alpha was set at .017, derived by dividing the alpha of .05 by 3 for the three comparisons (T_1 with T_2 , T_1 with T_3 , and T_2 with T_3).

Table 3.25.—Post Hoc t-tests between Treatment I and Treatment II on Significant Dependent Measures

Dependent Measure	Mean	Degrees of Freedom	t-Value	p
Total Math Attitude				
Treatment I	2.1031	14	-4.91	.000**
Treatment II	2.5961			
Usefulness				
Treatment I	1.5312	14	-3.24	.006**
Treatment II	2.5729			
Male Domain				
Treatment I	1.0417	14	-4.81	.002**
Treatment II	2.000			
Father				
Treatment I	1.9271	14	-2.61	.020
Treatment II	2.4896			
Confidence				
Treatment I	2.4062	14	-2.89	.012**
Treatment II	3.0625			

**
p < .017

Significant differences between Treatment I and Treatment II exist across all measures indicated in Table 3.25 except for the Father Scale. Treatment II, the contingency-based learning format, has the greater mean in each dependent measure. Since the smaller numerical score on the Fennema-Sherman Mathematics Attitude Scale implies a more positive attitude toward mathematics, the analysis indicates that Treatment I produced significantly more positive attitudes on all dependent measures tested, except for the Father Scale, when compared with Treatment II.

The means, t-values, probabilities of occurrence, and degrees of freedom used in determining the differences between Treatment I (cognitive restructuring) and Treatment III (control) on significant dependent measures are summarized in Table 3.26.

Significant differences between Treatment I and Treatment III were not found in the analysis of the significant dependent measures presented in Table 3.26. This result implies that the means for Treatment I and Treatment III are statistically equal for each dependent measure tested. The conclusion, therefore, is that Treatment I and Treatment III cannot be considered significantly different for these measures.

A summary of the post hoc analysis procedures comparing Treatment II (contingency-based learning) and

Table 3.26.—Post Hoc t-Tests between Treatment I and Treatment III
on Significant Dependent Measures

Dependent Measure	Mean	Degrees of Freedom	t-Value	p
Total Math Attitude				
Treatment I	2.1031	14	- .31	.767
Treatment III	2.1586			
Usefulness				
Treatment I	1.5312	14	-1.04	.315
Treatment III	1.9167			
Male Domain				
Treatment I	1.0417	14	-2.22	.062
Treatment III	1.5521			
Father Domain				
Treatment I	1.9271	14	0	1.000
Treatment III	1.9271			
Confidence				
Treatment I	2.4062	14	- .09	.929
Treatment III	2.4375			

Treatment III (control) is presented in Table 3.27. Means, degrees of freedom, t-values, and probabilities of occurrence are reported on each significant dependent measure. The results indicate that Treatment II and Treatment III may not be considered statistically different for all dependent measures reported in the table.

Table 3.27.—Post Hoc t-Tests between Treatment II and Treatment III
on Significant Dependent Measures

Dependent Measure	Mean	Degrees of Freedom	t-Value	p
Total Math Attitude				
Treatment II	2.5961	14	2.35	.034
Treatment III	2.1586			
Usefulness				
Treatment II	2.5729	14	1.99	.066
Treatment III	1.9167			
Male Domain				
Treatment II	2.000	14	1.48	.160
Treatment III	1.5521			
Father				
Treatment II	2.4896	14	2.00	.065
Treatment III	1.9271			
Confidence				
Treatment II	3.0625	14	1.74	.104
Treatment III	2.4375			

Correlational Comparisons

To examine the relationship among dependent measures, correlational comparisons were computed. In these comparisons, scores on the Fennema-Sherman Mathematics Attitude Scale were correlated with scores on the Fennema-Sherman Mathematics Attitude Subscales. Performance scores on the Math 082 final examination were also correlated with all scales.

In order to compare different subsets of the sample, correlational comparisons were computed four times.

In the first comparison, the relationship between scores on dependent measures for all subjects was determined. In the second, third, and fourth comparisons, the relationship between scores on dependent measures for subjects in each of the three treatment groups, respectively, was examined. Because of the interval nature of all dependent measures, Pearson product-moment correlations were used for all comparisons.

Correlational Comparisons for All Subjects

The results of the Pearson product-moment correlations computed on the scores of the dependent measures for all subjects are shown in Table 3.28. Abbreviations for dependent measures used in this table and in similar tables on subsequent pages are defined as follows:

M	=	Mother Scale
E	=	Effectance Motivation in Mathematics Scale
U	=	Usefulness of Mathematics Scale
A	=	Mathematics Anxiety Scale
F	=	Father Scale
AS	=	Attitude toward Success in Mathematics Scale
T	=	Teacher Scale
MD	=	Mathematics as a Male Domain Scale
C	=	Confidence in Learning Mathematics Scale
Total	=	Combined Fennema-Sherman Mathematics Attitude Scale
Perf	=	Performance on Math 082 Final Examination

Table 3.28.---Summary of Pearson Product-Moment Correlations for All Subjects (N = 24)

Dependent Measure	M	E	U	A	F	AS	T	MD	C	TOTAL	PERF
M	1.00	.25	.62	.11	.68	.37	.09	.49	.41	.75	-.33
E		1.00	.27	.52	.25	-.12	.21	-.12	.54	.52	-.07
U			1.00	.05	.63	.38	.04	.52	.24	.72	-.51
A				1.00	.29	-.25	.11	-.23	.47	.39	-.15
F					1.00	.42	.13	.45	.50	.81	-.17
AS						1.00	.10	.52	.11	.47	-.16
T							1.00	.14	.43	.40	-.10
MD								1.00	.22	.56	-.24
C									1.00	.73	-.39
TOTAL										1.00	-.42
PERF											1.00

Negative correlations are shown between the scores on all of the Fennema-Sherman Mathematics Attitude Scales and the scores on the Math 082 final examination in Table 3.28. The negative sign reflects the inverse relationship between (a) the smaller numerical scores, indicating a more positive attitude toward mathematics on the attitude scales, and (b) the higher numerical scores, indicating a better performance on the Math 082 final examination. The scores on the Usefulness in Mathematics Scale and the total or combined scores of all the Fennema-Sherman Mathematics Attitude Scales are shown to have the strongest correlations with the scores on the Math 082 final examination. Correlations reported are $r = -.51$ and $r = -.42$, respectively.

Correlational Comparisons for Subjects in Cognitive Restructuring Treatment

The correlational comparisons for scores of the subjects in the cognitive restructuring treatment (Treatment I) are reported in Table 3.29.

The lack of consistent negative correlations is shown in Table 3.29. The scores on the Father Scale were shown to have a strong positive correlation ($r = .60$) with the performance scores on the Math 082 final examination. This correlation implies that the less positive the fathers of subjects in the cognitive restructuring group viewed their children's abilities to do mathematics, the higher their performance scores on the Math 082 final examination.

TABLE 3.29.--Summary of Pearson Product-Moment Correlations for Subjects in
Cognitive Restructuring Treatment (N = 8)

Dependent Measure	M	E	U	A	F	AS	T	MD	C	TOTAL	PERF
M	1.00	.26	.23	.41	.12	.23	-.006	.58	.15	.71	.20
E		1.00	-.08	.69	.02	-.15	.07	.34	-.03	.48	.24
U			1.00	.06	.39	.30	-.36	-.20	-.48	.42	-.23
A				1.00	-.17	-.08	-.21	.07	-.17	.38	-.26
F					1.00	-.08	-.07	.31	.19	.46	.60
AS						1.00	-.41	.29	.36	.35	-.37
T							1.00	-.19	.35	.12	.21
MD								1.00	.46	.45	.22
C									1.00	.34	.22
TOTAL										1.00	.20
PERF											1.00

Correlations between scores on all other dependent measures and performance scores were relatively small for these subjects.

Correlational Comparisons for Subjects in Contingency-Based Treatment

The correlational comparisons for the scores of the subjects in the contingency-based treatment (Treatment II) are presented in Table 3.30. A shift to positive correlation between all dependent attitude measures except the Usefulness in Mathematics Scale and performance scores on the Math 082 final examination is shown. The Mother Scale ($r = .54$), Effectance Motivation in Mathematics Scale ($r = .41$), and the total or combined Fennema-Sherman Mathematics Attitude Scale ($r = .59$) are correlated the strongest with the performance scores on the Math 082 final examination. These correlations indicate that in each of these three scales, the less positive the attitude reported in the scale the higher the predicted performance score on the Math 082 final examination.

Correlational Comparisons for Subjects in Control Group

The correlational comparisons for scores of the subjects in the control group are shown in Table 3.31. All dependent measures are correlated inversely with performance scores on the Math 082 final examination. An increase in the strength of the correlations with

Table 3.30.---Summary of Pearson Product-Moment Correlations for Subjects in Contingency-
Based Treatment (N = 8)

Dependent Measure	M	E	U	A	F	AS	T	MD	C	TOTAL	PERF
M	1.00	.25	.14	-.17	.68	.43	-.24	.29	-.52	.21	.54
E		1.00	.07	.70	.07	-.53	.15	-.56	.83	.59	.41
U			1.00	.26	.45	-.09	-.11	.02	-.12	.44	-.20
A				1.00	.30	-.57	-.21	-.59	.32	.46	.15
F					1.00	.41	-.44	.08	-.25	.58	.29
AS						1.00	-.03	.80	-.30	.16	.15
T							1.00	.42	.39	.28	.32
MD								1.00	-.26	.20	.23
C									1.00	.47	.30
TOTAL										1.00	.59
PERF											1.00

Table 3.31.---Summary of Pearson Product-Moment Correlations for Subjects in Control Group (N = 8)

[illegible]

performance scores in all dependent measures except the Attitude toward Success in Mathematics Scale and the Mathematics as a Male Domain Scale is also indicated.

Exploratory Analysis

Exploratory t-Tests

Although the formal hypothesis testing revealed no significant differences on the means of the dependent measures discussed in this section, exploratory t-tests were computed. The purpose of these analysis procedures was to determine any systematic differences related to treatment and to gain further information to aid in the analysis of treatment results.

A summary of the differences between Treatment I (cognitive restructuring) and Treatment II (contingency-based) is shown in Table 3.32 for the six nonsignificant dependent measures: the Mother Scale, the Effectance Motivation in Mathematics Scale, the Anxiety Scale, the Attitude toward Success in Mathematics Scale, the Teacher Scale, and Performance on the Math 082 final examination. The means, t-values, probabilities of occurrence, and degrees of freedom are reported in the table.

The results in Table 3.32 indicate that although the overall analysis procedure did not produce significant data differences among the three treatments for these dependent measures, a significant difference does exist between the cognitive restructuring treatment and the

Table 3.32.—t-Tests between Treatment I and Treatment II on
Nonsignificant Dependent Measures

Dependent Measure	Mean	Degrees of Freedom	t-Value	p
Mother				
Treatment I	1.9479	14	-3.16	.007*
Treatment II	2.5833			
Effectance Motivation				
Treatment I	2.7822	14	- .82	.427
Treatment II	3.0521			
Anxiety				
Treatment I	3.0417	14	.34	.739
Treatment II	2.9375			
Attitude toward Success				
Treatment I	1.7292	14	-1.35	.197
Treatment II	2.1146			
Teacher				
Treatment I	2.5208	14	- .11	.912
Treatment II	2.5521			
Performance on Final				
Treatment I	128.8750	14	2.05	.059
Treatment II	106.5000			

*
p < .017

contingency-based treatment on the Mother Scale. Performance scores on the Math 082 final examination also showed differences between Treatment I and Treatment II at the $p = .059$ level.

The results of the comparison between Treatment I (cognitive restructuring) and Treatment III (control) are reported in Table 3.33. The means, degrees of freedom,

Table 3.33.—t-Tests between Treatment I and Treatment III on
Nonsignificant Dependent Measures

Dependent Measure	Mean	Degrees of Freedom	t-Value	p
Mother				
Treatment I	1.9479	14	- .74	.474
Treatment III	2.1875			
Effectance Motivation				
Treatment I	2.7822	14	.67	.514
Treatment III	2.6146			
Anxiety				
Treatment I	3.0417	14	1.35	.198
Treatment III	2.6563			
Attitude toward Success				
Treatment I	1.7292	14	.55	.590
Treatment III	1.5729			
Teacher				
Treatment I	2.5208	14	-1.12	.905
Treatment III	2.5625			
Performance on Final				
Treatment I	128.8750	14	1.11	.287
Treatment III	115.7500			

t-values, and probabilities of occurrence are indicated for the nonsignificant dependent measures.

No significant differences are shown in Table 3.33. This result implies that the cognitive restructuring treatment group and the control group may be considered statistically equal on all nonsignificant dependent measures.

The results of the comparison between Treatment II (contingency-based) and Treatment III (control) are shown

in Table 3.34. The means, degrees of freedom, t-values, and probabilities of occurrence are reported for each nonsignificant dependent measure.

Table 3.34--t-Tests between Treatment II and Treatment III on Nonsignificant Dependent Measures

Dependent Measure	Mean	Degrees of Freedom	t-Value	p
Mother				
Treatment II	2.5833	14	1.28	.221
Treatment III	2.1875			
Effectance Motivation				
Treatment II	3.0521	14	1.30	.216
Treatment III	2.6146			
Anxiety				
Treatment II	2.9375	14	.75	.464
Treatment III	2.6563			
Attitude toward Success				
Treatment II	2.1146	14	1.69	.114
Treatment III	1.5729			
Teacher				
Treatment II	2.5521	14	- .03	.974
Treatment III	2.5625			
Performance on Final				
Treatment II	106.5000	14	- .88	.395
Treatment III	115.7500			

The results indicated in Table 3.34 show no significant differences between the contingency-based treatment group and the control group. A visual inspection of the means, however, shows a smaller numerical value for the control group on all attitude scales except the Teacher Scale when compared with the contingency-based treatment.

Moreover, the control group scored higher on the final examination for Math 082 than the contingency-based treatment group. These results imply a more positive attitude toward mathematics and a better performance on the final examination for the control group than for the contingency-based treatment group.

Descriptive Statistics of Treatment-by-Sex

Further studies were done by exploring the descriptive statistics of the three treatments for differences between males and females on the Fennema-Sherman Mathematics Attitude Scale and performance on the Math 082 final examination. The purpose of this exploration was to determine the existence of any systematic trends within the independent variable of sex on the dependent measures.

The means and standard deviations for treatment-by-sex on the Fennema-Sherman Mathematics Attitude Scale are indicated in Table 3.35. For the cognitive restructuring treatment and the contingency-based treatment, female subjects are shown in Table 3.35 to have a smaller mean score than male subjects on the attitude scale. The reverse is true for the subjects in the control group. Subjects in the contingency-based treatment group also are shown to have larger numerical scores for males and females than those of subjects in the cognitive restructuring treatment or control group. Standard deviations for the cognitive restructuring treatment and the contingency-based

Table 3.35.—Descriptive Statistics of Treatment-by-Sex on Fennema-Sherman Mathematics Attitude Scale

Treatment-by-Sex	Mean	Standard Deviation
Cognitive Restructuring		
Males	2.14836	.19913
Females	2.05787	.18166
Contingency-based		
Males	2.67593	.23302
Females	2.51620	.19691
Control		
Males	2.10185	.53990
Females	2.21528	.48646

treatment are numerically smaller than those of the control group for both males and females.

The descriptive statistics for treatment-by-sex are indicated in Table 3.36 for the performance scores on the Math 082 final examination. Means and standard deviations are reported.

The results indicated in Table 3.36 show that male subjects performed consistently better than female subjects on the final examination. This finding was true for all three treatment groups. Both males and females in the cognitive restructuring treatment had higher means on the final examination than those in the contingency-based treatment or the control group. Females in the control group had the greatest variability (s.d. = 31.60564).

Table 3.36.--Descriptive Statistics of Treatment-by-Sex on
Performance on Math 082 Final Examination

Treatment-by-Sex	Mean	Standard Deviation
Cognitive Restructuring		
Males	142.50000	19.27866
Females	115.25000	22.77974
Contingency-based		
Males	110.00000	22.10581
Females	103.00000	17.68238
Control		
Males	120.25000	13.52467
Females	111.25000	31.60564

Summary of Results

The following list consists of a summary of the results previously presented in the analysis of the data:

1. The results of the overall MANCOVA with the Confidence in Learning Mathematics Scale used as the covariate showed no significant sources of variation within the design factors.

2. The results of the overall MANCOVA with the module diagnostic pretest used as the covariate indicated the presence of significant treatment differences.

3. The results of the univariate ANCOVA with the module diagnostic pretest used as the covariate showed no significant sources of variation within the design factors for performance scores on the Math 082 final examination.

4. The results of the univariate ANCOVA with the module diagnostic pretest used as the covariate showed significant treatment differences for scores on the Fennema-Sherman Mathematics Attitude Scale.

5. The results of the ANCOVAs showed no significant differences in the means of the Fennema-Sherman Mathematics Attitude Subscales for sex and treatment-by-sex interactions.

6. The results of the ANCOVAs with the Confidence in Learning Mathematics used as a covariate showed significant treatment differences on the means of the Usefulness of Mathematics Scale and the Mathematics as a Male Domain Scale.

7. The results of the ANCOVAs with the module diagnostic pretest used as a covariate showed significant treatment differences on the means of the Usefulness of Mathematics Scale, the Mathematics as a Male Domain Scale, the Father Scale, and the Confidence in Learning Mathematics Scale.

8. The results of the post hoc t-tests showed the cognitive restructuring treatment group to have significantly more positive attitudes toward mathematics than the contingency-based treatment group on the total or combined Fennema-Sherman Mathematics Attitude Scale, the Mathematics as a Male Domain Scale, and the Confidence in Learning Mathematics Scale.

9. The results of the post hoc t-tests showed no significant differences between the cognitive restructuring treatment group and the control group.

10. The results of the post hoc t-tests showed no significant differences between the contingency-based treatment group and the control group.

11. The results of the correlational comparisons of dependent measures implied a change in direction and in strength of the relationship between scores on the attitude scales and performance scores on the Math 082 final examination with a change in treatment group. The cognitive restructuring treatment subjects' results reflected small correlations between attitude scales and performance except on the Father Scale. The results of the contingency-based treatment showed moderately high positive correlations between attitude scales and performance. The control group subjects' results implied a strong inverse relationship between attitude scales and performance.

12. The results of t-tests on nonsignificant dependent measures showed significant differences between means in one case--comparing the cognitive restructuring treatment with the contingency-based treatment on the Mother Scale.

13. The results of exploratory studies on descriptive statistics for treatment-by-sex differences showed no significant differences on the Fennema-Sherman

Mathematics Attitude Scale for sex, although a larger standard deviation was reported for both sexes in the control group.

14. The results of the exploratory study on the descriptive statistics for performance on the Math 082 final examination showed males scoring higher in each treatment group and the cognitive restructuring treatment group scoring the highest for both sexes.

Implications of these results are discussed in the next chapter.

CHAPTER IV

Discussion

Summary

The purpose of this study was to compare the effectiveness of a cognitive restructuring model of instructional design with that of a contingency-based model of instructional design on the alleviation of inappropriate learned helplessness factors and the improvement of math performance in college freshmen.

The organization of the study was developed in three steps. The first step was to identify a population of college freshmen who saw themselves as personally helpless in regard to mathematics. Criteria for this population were a recent failure experience in mathematics and a lack of personal confidence in ability to perform mathematics. Failure was defined as not passing the arithmetic entrance examination at Michigan State University and thereby being enrolled in Math 082. Volunteers for the study were students from Math 082 classes who were interested in participating in research at the University. The type of research was not initially explained to the subjects, as a means of controlling motivation differences between volunteers and the rest of the population. The volunteers were

then pretested to determine a lack of personal confidence in mathematical ability, using the Fennema-Sherman Confidence in Learning Mathematics Scale (in Appendix A). Those students whose scores indicated a lack of confidence in their ability to do mathematics served as the population for the study and were identified as personally helpless in regard to mathematics.

The second step in the study was to determine the appropriateness of this personal helplessness in regard to the level of mathematics required. Potential ability of the population and the level of mathematical performance expected were considered. The acceptance of the population into Michigan State University and the ninth grade level of mathematics expected on the arithmetic entrance examination were seen as indicative of the population's potential ability to succeed in passing the examination. Not passing the arithmetic entrance examination, coupled with a lack of confidence in ability to do the level of mathematics required, was deemed inappropriate for persons entering Michigan State University. Therefore, the identified population was considered inappropriately helpless in regard to the level of mathematics required.

These subjects were blocked on sex. Twelve males and twelve females were then randomly assigned to one of three treatment groups. This procedure resulted in a 3×2 randomized level design as defined by Porter and Chibucos (1973), with treatment and sex employed as

independent variables. The remaining individuals and those volunteers whose scores indicated confidence in their ability to do mathematics on the Fennema-Sherman Confidence in Learning Mathematics Scale were provided an available weekly help session.

The third step consisted of the actual experimental procedures aimed at alleviating inappropriate helplessness and improving mathematical performance. Three treatment groups were employed. The first treatment was a cognitive-restructuring model based on Goldfried, Decenteneo, and Weinberg's (1974) systematic rational restructuring. The second treatment was a contingency-based model developed from Ferster and Skinner's (1957) behavioral theory of reinforcement. The third treatment, which involved a placebo-control group, offered individual tutoring for the subjects.

The results of the treatment were analyzed with data collected on two dependent measures, the Fennema-Sherman Mathematics Attitude Scale and the final examination in Math 082. A multivariate analysis of variance was the predominant statistical procedure used in the analysis, with the Confidence in Learning Mathematics Scale and the diagnostic module pretest used as covariates.

As suggested by Harris (1975), post hoc univariate analyses of variance were calculated for each dependent measure and the subscales of the Fennema-Sherman Mathematics Attitude Scale. To determine the directionality of significant differences between treatments, post hoc t-tests were

used to evaluate all pairwise comparisons. Inflation of alpha was controlled using Dunn's procedure (Hays,1973).

The research hypotheses were supported in varying degrees. Relationships between scores on the dependent measures and levels of two sources of variation, sex and treatment-by-sex, were not statistically significant for the total analysis procedures. Significant treatment differences were, however, found in the overall multivariate analysis of variance with the diagnostic module pretest used as a covariate and in the univariate analyses of variance of the scores on the Fennema-Sherman Mathematics Attitude Scale, the Mathematics as a Male Domain Scale, the Usefulness of Mathematics Scale, and the Confidence in Learning Mathematics Scale. In addition, the results of post hoc t-tests indicated that the directionality of the differences between scores on the dependent measures was the result of the significant differences found in the comparison between the cognitive restructuring treatment and the contingency-based treatment. No significant treatment differences were found in the comparisons of the two treatment groups with the control group.

Pearson product-moment correlations were calculated for all pairwise comparisons of scores on the dependent measures for each treatment group. The purpose of these correlations was to determine the relationship between scores on the Fennema-Sherman Mathematics Attitude Scale and performance scores on the Math 082 final examination,

and to explore the differences in the correlations computed on these measures across treatment groups. The results of these supplementary analyses revealed a change in the relationship between scores on the dependent measures with a change of treatment group.

Exploratory analyses were used to determine the existence of potential sources of variation not previously interpreted. The results of t-tests on nonsignificant dependent measures showed significant differences between means in one instance--comparing the cognitive restructuring treatment with the contingency-based treatment on the Mother Scale. Exploratory studies of descriptive statistics on differences in performance scores on the Math 082 final examination indicated that males scored higher than females in each treatment group. Males and females in the cognitive restructuring treatment did better than males and females, respectively, in the other two treatment groups on the Math 082 final examination.

These results should be interpreted cautiously, however, in view of the existence of confounding variables in the study. These limitations are discussed in the next section.

Limitations

Four areas of limitation appear relevant to this research. These areas include the sample, the instrumentation, the design, and the methodology. The limitations of each area are explored in this section.

Sample

There were two limitations to the sample utilized in this study--the small sample size and the restricted generalizability of the sample.

The small sample size must be considered a major limitation. However, a trade-off point between practical considerations and statistical power lies in the convenience of small samples versus the representativeness of large samples. According to Isaac and Michael (1977), small sample sizes are more appropriate for techniques of eliciting or evaluating behaviors such as counseling or interviewing procedures. Nevertheless, it remains true that the larger the sample, the smaller the sampling error. To minimize the sampling error which might result from the small sample size used, the study was blocked on sex and the analysis procedures incorporated covariates to control for possible confounding. These procedures helped to minimize error and increased the statistical power of the research.

The restricted generalizability of the sample constitutes a second limitation. Subjects in this study were freshman college students in Math 082. It was not possible to obtain a random sample from this population because of the selection procedure employed in determining inappropriate helplessness. The use of a non-laboratory helpless population in the study required a generalization of behaviors which had produced helplessness in laboratory experiments (Seligman, 1973). To aid in this generalization, two criteria were combined as a selection procedure for the sample:

a recent failure experience associated with performance, and a lack of confidence in the individual's perception of his/her ability to perform the task required. The employment of this selection procedure made random sampling an impossibility. The generalizability of the resulting sample to a non-laboratory helpless population is only as good as the validity of the procedure in actually reflecting helplessness--a procedure which is questionable at this point.

The use of volunteers further limits the generalizability of the sample. A true random sample is one in which each individual in the population (in this case, students in Math 082) has an equal and independent chance of being selected. Therefore, the voluntary nature of the sample in this study constitutes a systematic bias. The pitfall is the likelihood that volunteers differ from non-volunteers, a factor which confounds the interpretation of the results (Isaac & Michael, 1977). Borg and Gall (1976) imply that volunteers can rarely be used as an unbiased sample of a population containing volunteers and non-volunteers. Therefore, samples of volunteers are assumed to be biased, and the generalization of results is limited to volunteers from the same population.

However, the presence of such sampling bias in this study seems unlikely in view of the criteria employed in determining those volunteers used in the sample. First, all subjects in the sample and in the population had experienced recent failure in the arithmetic entrance examination at Michigan State University. Second, approximately equal

numbers of volunteers met ($n = 34$) and did not meet ($n = 37$) the second criterion of lacking confidence in their ability to perform mathematics.

Therefore, the Cornfield-Tukey Bridge Argument (Cornfield & Tukey, 1956) may be applied to this study. This argument implies that the results of the study may be generalized to populations having characteristics similar to the sample. One of the assumptions is that the characteristics of the present population would not be different from the characteristics of future populations to which the results might be generalized.

Instrumentation

Instrumentation is the process of selecting or developing measuring devices appropriate to a given evaluation problem. Instruments used in this study to evaluate the effectiveness of treatment on improving mathematics performance and on alleviating inappropriate attributions of helplessness were the final examination in Math 082 and the Fennema-Sherman Mathematics Attitude Scale. Two principal questions may be raised about both instruments:

1. Are they consistent and stable measuring instruments (are they reliable)?
2. Are they accurate measuring instruments (are they valid)?

The final examination in Math 082 includes a random sample of the material covered in the module texts used in the course. It therefore possesses content validity. It may be questioned, of course, whether the Math 082 final examination, a teacher-made achievement test, can measure

improved mathematics performance with one administration. The use of a control group in this study, however, provides standards against which the performance of the treatment groups can be compared.

The reliability of the final examination is not known. Since an item analysis or an accumulation of data on past Math 082 final examination administrations has not been performed, the reliability coefficients for internal consistency and for alternate forms of the final examination are not known. Therefore, the stability and consistency of the final examination as a measure of mathematics performance constitute limitations to this research.

The Fennema-Sherman Mathematics Attitude Scale is a self-report instrument which consists of nine specific Likert-type scales measuring attitudes related to the learning of mathematics. Split-half reliabilities, as reported in Chapter II, show high correlation coefficients (from $r = .86$ to $r = .93$), indicating a measure of consistency with regard to the content sampled in each scale. Test-retest reliability coefficients are not reported in the test manual.

The major limitation of the Fennema-Sherman Mathematics Attitude Scale is in regard to construct validity. According to Mehrens and Lehmann (1973), attitude scales are highly susceptible to faking, which makes their interpretation dubious. Further, the wording of some items may reflect an extreme attitude: for example, "I'd be proud

to be the outstanding student in math." Agreement with such an extreme may reflect an unrealistic attitude for this population or merely a socially acceptable response, while disagreement with the item may not reflect helplessness. Thus, a question of construct validity exists in the interpretation of attributions of helplessness to persons whose scores reflect a poor attitude on the Fennema-Sherman Mathematics Attitude Scale.

The validity and reliability of the instruments used in this study, therefore, may be legitimately questioned. To the extent that subjects responded to the items in an honest manner, the content validity of the data collected is upheld. The construct validity based on the relationship between helplessness and poor attitude remains a theoretical issue (Miller & Norman, 1979). Implications for the relationship as a result of this study are discussed later in the chapter.

Design

A 3 x 2 factorial posttest-only control group design was employed in this study. Two limitations of this design are (a) the lack of a pretest and (b) possible sources of external invalidity which resulted from an interaction of treatment and selection or from the reactive arrangements of experimental procedures.

Campbell and Stanley (1966) state that while the concept of a pretest is deeply embedded in the thinking of educational researchers, it is not essential to true experimental design. They suggest, furthermore, that in educational research we must frequently experiment with methods for the introduction of new subject matter, for which pretests in the ordinary sense of the word are impossible. Accordingly, since the subjects in this research were learning new mathematical skills, a pretest of mathematical performance was considered unrealistic.

A second limitation is based on the criticisms of Campbell and Stanley (1966) in regard to the basic design of the study. Although an interaction of treatment and selection is controlled by the use of experimental and control groups within the design, there remains a possibility that the effects demonstrated hold only for that unique population from which subjects were randomly selected. It is important, then, that generalizations from this study be limited to subjects with characteristics similar to those of the sample used.

It should also be noted that reactive arrangements are produced by the use of volunteers who know they are participating in an experiment. The

"guinea-pig" effect may generate data unrepresentative of nonexperimental settings. The more obvious the connection between the experimental treatment and the posttest content, the more likely this effect becomes. In this study, the use of a placebo-control group receiving tutorial help in mathematical performance might have produced this reactive arrangements effect. Thus, representativeness of the control group in regard to the nonexperimental helpless population without tutorial assistance may be questionable.

Methodology

The fourth area of possible limitation within this study is methodology. Two general aspects of the experimental methodology are discussed in this section. These aspects are treatment and analysis.

The major limitation in regard to treatment is that problem which is implicit in all self-management research--whether the subjects actually employed the experimental procedures outside the treatment sessions. The four basic components of Bandura's (1969) self-management are (a) self-monitoring; (b) self-measurement, (c) self-mediation, and (d) self-maintenance (Kahn, 1976). The purpose of this paradigm is to place the individual in the role of being his or her own change agent. Research by Wahler (1969)

suggests that when an external change agent is responsible for initiating and maintaining the strategy, the individual fails to acquire the skills or the control necessary to adapt the new behaviors to similar conditions, or fails to maintain the contingencies once the treatment is terminated. Hence, the control exercised by a well-intentioned person may maintain or even strengthen the dysfunctional behavior of another person.

It was necessary, therefore, to balance the increased maintenance of the new behavior in self-management with the increased consistency of external change agents in applying treatment. Consequently, a system was developed that simplified and systematized the reporting process through two 45-minute sessions per week with a trainer. This system was used to improve the consistency with which each treatment was applied. However, the implementation of treatment outside these sessions in the application phase of the cognitive restructuring treatment and in the application of extrinsic rewards in the contingency-based treatment was evaluated through self-report, which constitutes a limitation of the treatment.

A second aspect of the methodology which may be questioned consists of the analysis procedures employed.

The use of covariates to increase precision in the analysis necessarily involves a loss in degrees of freedom. With the small sample size employed in the study, this loss might have resulted in a statistical test that was overly conservative. The result of such an analysis procedure was to sacrifice meaningful differences for the sake of statistical precision. The same observation may be made about the use of Dunn's procedure to control the inflation of alpha in post hoc t-tests. To examine the possible loss of meaningful differences, exploratory t-tests on nonsignificant dependent measures as well as descriptive statistics on nonsignificant independent sources of variation were computed and reported in the study. The results of these analyses are discussed in the following section.

Discussion of Results

Hypothesis Testing

The primary purpose of the study was to compare the effectiveness of a cognitive restructuring model of instruction (Treatment I) with that of a contingency-based model of instruction (Treatment II) on the alleviation of inappropriate learned helplessness factors and on the improvement of mathematical performance in college freshmen.

The significance of the results of the analysis changed with the change of covariate from the Fennema-Sherman Confidence in Learning Mathematics Scale to the module diagnostic pretest in the analysis procedures. This change in the level of significance was to be expected because of the role of a covariate in the procedures. The use of a covariate is intended to correct for initial differences in the data--differences which are the result of inequalities on the covariate prior to treatment. If not corrected, these initial differences may serve as sources of confounding in the interpretation of the results. In each analysis procedure, the correction of initial differences was based on the particular covariate used. Therefore, the data analyzed in the overall procedure differed from covariate to covariate.

The results of the study revealed significant treatment differences in the overall multivariate analysis. The multivariate procedure took into account the correlations between the two dependent measures (scores on the Fennema-Sherman Mathematics Attitude Scale and performance scores on the final examination in Math 082). Statistics were computed to reject or not reject the hypotheses applicable to the two dependent measures simultaneously. Therefore, the significance of the differences between the treatment groups was calculated as a simultaneous analysis

involving both dependent measures. The results of the study failed to show significant differences between males and females and in treatment-by-sex interactions in the multivariate analysis.

To facilitate the interpretation of the overall significance of the multivariate analysis, univariate analyses of variance were performed on each dependent measure. Again the analysis procedures failed to produce significant differences on sex and treatment-by-sex sources of variation for either dependent variable. Treatment differences were found to be significant on one dependent measure, the Fennema-Sherman Mathematics Attitude Scale. This result implies that the overall significance of the treatment differences in the multivariate procedure was based on the significant differences among treatments on the scores of the Fennema-Sherman Mathematics Attitude Scale ($p = .013$). Performance scores on the final examination in Math 082 were not significantly different among treatments.

Further results showed that the overall significance of treatment mean differences on the combined Fennema-Sherman Mathematics Scale (Total) was due to significant differences on the scores of four subscales: the Mathematics as a Male Domain Scale (MD), the Usefulness of Mathematics Scale (U), the Father Scale (F), and the Confidence in Learning Mathematics Scale (C). The Usefulness of Mathematics Scale and the Confidence in Learning Mathematics

Scale may reflect a more accurate picture of this attitudinal difference because of difficulties in the interpretation of results involving the other two scales. The significance of the differences on the Mathematics as a Male Domain Scale may be the result of the use of female trainers in the cognitive restructuring treatment. Also questionable is the effect of the Father Scale on treatment differences, since no significant differences were found on the post hoc analysis procedures for this measure. A graphic representation of the mean differences is shown in Figure 4.1 on these significant dependent measures for all treatments. Abbreviations for dependent measures used in this figure are defined as follows:

Total = Combined Fennema-Sherman Mathematics
Attitude Scale

U = Usefulness of Mathematics Scale

MD = Mathematics as a Male Domain

F = Father Scale

C = Confidence in Learning Mathematics
Scale

Significant differences between the means of the contingency-based treatment and the cognitive restructuring treatment were found for all the significant dependent measures except one, the Father Scale. Also, in every case the cognitive restructuring treatment group scored a lower numerical value than the contingency-based treatment group, which implies a more positive attitude toward mathematics on each significant dependent measure.

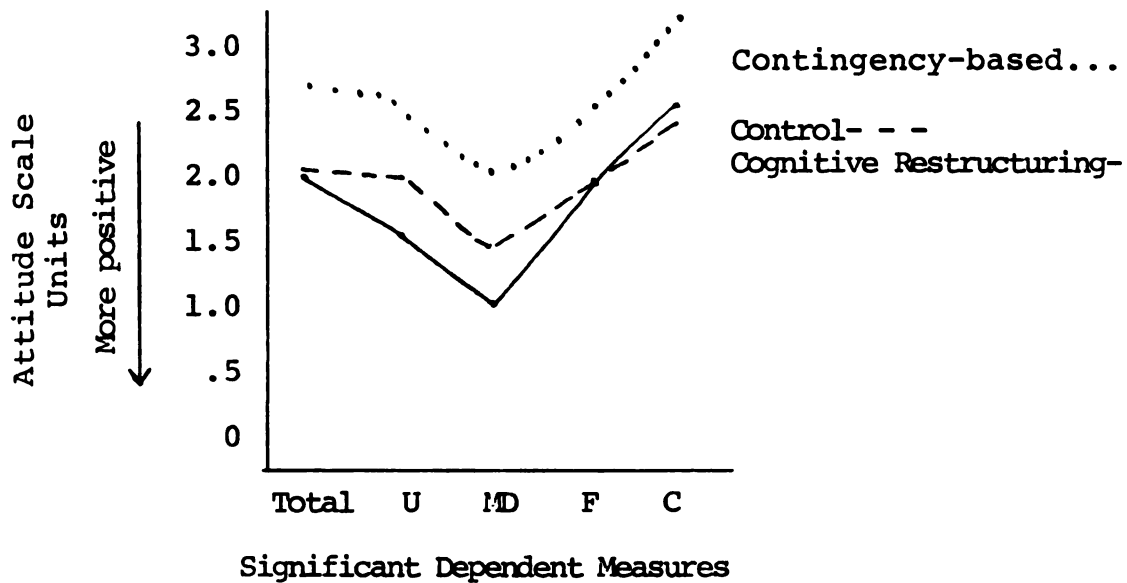


Figure 4.1. Comparison of Significant Dependent Measures Across Treatments

Neither the contingency-based treatment group nor the cognitive restructuring group had significantly different means from those of the control group on the dependent measures. The failure to find significant differences between the treatment groups and the control group may be the result of the two theories--consistency theory and attribution theory--being confounded in the treatments, as well as the reactivity of the placebo-control with the dependent measures, as previously discussed.

As shown in Figure 4.1, the cognitive restructuring treatment group had more positive attitudes on the significant dependent measure than did the control group for all but one measure, the Father Scale. However, the lack of significance in these differences may be understandable. Shrauger (1975) has stated that the effectiveness of evaluation data is dependent upon the initial

self-perception of the person. This statement implies that evaluative feedback which is inconsistent with self-perception is not assimilated as quickly as feedback which is consistent with self-perception. In this case, consistency theory (Festinger, 1957) would imply that the population experiencing cognitions of helplessness would show little positive change on self-perception measures. Since any positive cognitive feedback given as part of the treatment would be inconsistent with their self-perception, the positive attitude expressed in the scores of the subjects in the cognitive restructuring treatment may represent a meaningful, although not significant, difference in comparison to the control group when the short length of treatment and the implications of consistency theory are considered. The correlations between attitude measures and performance on the Math 082 final examination, however, were relatively small for the cognitive restructuring treatment group.

The contingency-based treatment group, as shown in Figure 4.1, had the least positive attitude on the significant dependent measures of all the treatment groups. Though not significantly different from the control group, the negative trend of the contingency-based treatment group may have implications for the application of reinforcement theory principles to persons who see themselves as helpless. In this case, attribution theory (Weiner, 1974) would imply that a population experiencing conditions of learned

helplessness would show little positive change because of the minimizing of reinforcement contingencies through self-defeating cognitions. The negative trend shown in the analysis of the results for this group may suggest new theoretical questions in the area of learned helplessness. For example, attempting to increase the level of performance through the use of extrinsic rewards may increase attributions of helplessness and thereby minimize the chance of successful performance. Implications of this possibility in classrooms for reluctant learners and in clinical settings for depressed or helpless clients are considerable.

The condition of inappropriate helplessness may, therefore, contain three components: the maximizing of the value of the performance, the minimizing of the reinforcement contingent on successful performance, and causal attributions of personal lack of ability. The use of contingency-based treatment may actually intensify the helpless condition of individuals rather than alleviate it.

Although the study failed to produce significant results on the independent variable of sex and on treatment-by-sex interactions, general areas of inquiry were explored in the analysis procedures for these variables. Interest in these areas, especially in regard to improved performance, was based on studies of achievement motivation. The results of the study are not consistent with this research and are

explored in the next section to determine the existence of any systematic trends.

Exploratory Analysis

The exploratory t-tests on the nonsignificant dependent measures were computed to determine any significant differences between treatments not reported in the previous analysis procedures. A significant difference between the means of the cognitive restructuring treatment group and the contingency-based treatment group was found on the Mother Scale of the Fennema-Sherman Mathematics Attitude Scale. The subjects in the cognitive restructuring treatment group reported more positive self-perceptions of their mothers' views of their ability to do mathematics. This finding was consistent with the previous results which showed that the cognitive restructuring treatment group had more positive attitudes toward mathematics than did the contingency-based treatment group. Again, the control group was found to be statistically equivalent to the two other treatment groups.

The lack of significance found in differences in the means of the dependent measures for sex and treatment-by-sex interactions seemed at first inconsistent with the previous research on achievement motivation. The results of further exploration of the means and standard deviations of treatment-by-sex indicated systematic trends, however, which support earlier research.

The performance scores on the Math 082 final examination, when compared to attitude expressed on significant dependent measures, are consistent with Aiken's (1970, 1976) findings indicating a positive correlation between test scores and self-reported attitude toward mathematics. The cognitive restructuring treatment group had the most positive attitude toward mathematics on the significant dependent measures and scored highest on the Math 082 final examination for both males and females. The reversal of the trend is also shown by the results of the contingency-based treatment group, which expressed the least positive attitude toward mathematics on the significant dependent measures and scored lowest on the Math 082 final examination for both sexes.

In comparing differences on the dependent measures by sex, no systematic trend was found in the scores on the Fennema-Sherman Mathematics Attitude Scale. However, performance scores indicated a trend of females scoring lower than males on the Math 082 final examination in all treatment groups. This finding is consistent with the research of Kaminski (1976) and Macoby and Jacklin (1974), who stated that females are programmed by both their parents and themselves for lower performance in mathematics than males and consequently behave according to their self-perceptions.

Implications

The results of the present study suggest implications for the theory and treatment of inappropriate learned helplessness. The data supported the alternative hypothesis that overall treatment differences existed at the $\alpha = .05$ level. A cognitive restructuring model was shown to be significantly more effective than a contingency-based model of instruction in the alleviation of attributions and attitudes of learned helplessness as well as in the improvement of mathematical performance in college freshmen. Thus, by directly confronting self-defeating statements concerning ability to do mathematics, the condition of learned helplessness seems to lessen.

However, few clear implications can be drawn from this study in regard to comparisons between the treatment groups and the control group. A general trend of a more positive attitude on the significant dependent measures and a higher performance score on the final examination in Math 082 was reported for the cognitive restructuring treatment group when compared to the control group. The contingency-based treatment group, in turn, had the least positive attitude scores and the lowest performance scores on the final examination. The nonsignificant differences between the treatment groups and the control group prohibit definitive conclusions regarding the advisability of using either treatment as opposed to the placebo-control procedure of tutoring.

Since no significant differences were found among treatment-by-sex interactions, treatment implications can be interpreted as being applicable for both sexes. Therefore, the alleviation of learned helplessness factors is apparently not confounded by sex differences, although Dweck and Goetz (1977) suggest a higher incidence of learned helplessness in females than males.

Seligman (1975) suggests that learned helplessness provides a model for understanding depression. To the extent that learned helplessness is a cognitive phenomenon, and to the extent that learned helplessness is equivalent to depression, a cognitive restructuring treatment may be effective in alleviating symptoms of depression. The implications for this treatment, then, may possibly be generalized to similar helpless or depressed individuals in a variety of environmental settings, as suggested by Beck (1976).

Implications for Future Research

The results of the research in the area of learned helplessness are at best tentative when applied outside the laboratory setting. The exact nature of learned helplessness is far from being defined, let alone completely researched. While the previous discussion has implied many areas for further research, several additional areas should also be mentioned:

1. The focus of research on learned helplessness should be expanded. Research on the prevention and

remediation of helplessness factors in the field should be extended from the typical practice of creating helpless situations through insoluble anagrams and tasks, to identifying helpless environmental situations and determining their causation.

2. The greatest need is for the development of instruments which can assess helplessness factors. The extension of laboratory helplessness to helpless environmental situations requires measuring devices relevant to the construct of learned helplessness as well as to the particular performance problem. With an improvement in instrumentation, more conclusive results could be reached to aid in the alleviation of helplessness factors.

3. Closely related to the problem of construct validity is the need for alleviation studies to be done in settings outside the classroom or laboratory. Research utilizing counseling settings might minimize the time constraints and artificiality of experimental procedures and make it possible to examine the effectiveness of alleviation procedures in a more generalizable setting.

4. Research employing a variety of independent variables such as age, type of performance expected, locus of control, and stability of attribution is needed to explore the role of these variables on helplessness and its alleviation.

5. A larger sample size and the use of non-volunteer subjects would also be helpful in interpreting

the effects of learned helplessness, since motivation is so closely intertwined throughout this construct.

This research, then, may be seen as one stepping stone to a much wider base of knowledge encompassing achievement motivation and self-defeating personality disorders. Conjecture concerning implications for these constructs would seem presumptuous at this time. However, it is hoped that this research provides an impetus for the application of learned helplessness theory in the field and a beginning at research on the alleviation of helplessness factors within a nonlaboratory, environmental setting.

APPENDICES

APPENDIX A

FENNEMA-SHERMAN MATHEMATICS ATTITUDE SCALES

DIRECTIONS
FENNEMA-SHERMAN MATHEMATICS ATTITUDE SCALES

Elizabeth Fennema - Julia A. Sherman
University of Wisconsin-Madison

On the following pages is a series of statements. There are no correct answers for these statements. They have been set up in a way which permits you to indicate the extent to which you agree or disagree with the ideas expressed. Suppose the statement is:

Example 1. I like mathematics.

As you read the statement, you will know whether you agree or disagree. If you strongly agree, circle number "1." If you agree but with reservations, that is, you do not strongly agree, circle "2." If you disagree with the idea, indicate the extent to which you disagree by circling "4" for disagree or circling "5" if you strongly disagree. But if you neither agree nor disagree, that is, you are not certain, circle "3" for undecided. Also, if you cannot answer a question, circle "3."

- 1 - strongly agree
- 2 - agree
- 3 - uncertain
- 4 - disagree
- 5 - strongly disagree

Do not spend much time with any statement, but be sure to answer every statement. Work fast but carefully.

There are no "right" or "wrong" answers. The only correct responses are those that are true for you. Whenever possible, let the things that have happened to you help you make a choice.

THIS INVENTORY IS BEING USED FOR RESEARCH PURPOSES ONLY AND NO ONE WILL KNOW WHAT YOUR RESPONSES ARE.

Developed under a grant from the National Science Foundation.
Directions have been slightly modified for use in this research.

Mother Scale (M)

	<u>Weight</u>				
1. My mother thinks I'm the kind of person who could do well in mathematics.	1	2	3	4	5
2. My mother thinks I could be good in math.	1	2	3	4	5
3. My mother has always been interested in my progress in mathematics.	1	2	3	4	5
4. My mother has strongly encouraged me to do well in mathematics.	1	2	3	4	5
5. My mother thinks that mathematics is one of the most important subjects I have studied.	1	2	3	4	5
6. My mother thinks I'll need mathematics for what I want to do after I graduate from high school.	1	2	3	4	5
7. My mother thinks advanced math is a waste of time for me.	1	2	3	4	5
8. As long as I have passed, my mother hasn't cared how I have done in math.	1	2	3	4	5
9. My mother wouldn't encourage me to plan a career which involves math.	1	2	3	4	5
10. My mother has shown no interest in whether or not I take more math classes.	1	2	3	4	5
11. My mother thinks I need to know just a minimum amount of math.	1	2	3	4	5
12. My mother hates to do math.	1	2	3	4	5

**Effectance Motivation in Mathematics
Scale (E)**

	<u>Weight</u>				
1. I like math puzzles.	1	2	3	4	5
2. Mathematics is enjoyable and stimulating to me.	1	2	3	4	5
3. When a math problem arises that I can't immediately solve, I stick with it until I have the solution.	1	2	3	4	5
4. Once I start trying to work on a math puzzle, I find it hard to stop.	1	2	3	4	5
5. When a question is left unanswered in math class, I continue to think about it afterward.	1	2	3	4	5
6. I am challenged by math problems I can't understand immediately.	1	2	3	4	5
7. Figuring out mathematics problems does not appeal to me.	1	2	3	4	5
8. The challenge of math problems does not appeal to me.	1	2	3	4	5
9. Math puzzles are boring.	1	2	3	4	5
10. I don't understand how some people can spend so much time on math and seem to enjoy it.	1	2	3	4	5
11. I would rather have someone give me the solution to a difficult math problem than to have to work it out for myself.	1	2	3	4	5
12. I do as little work in math as possible.	1	2	3	4	5

Usefulness of Mathematics Scale (U)

	<u>Weight</u>				
1. I'll need mathematics for my future work.	1	2	3	4	5
2. I study mathematics because I know how useful it is.	1	2	3	4	5
3. Knowing mathematics will help me earn a living.	1	2	3	4	5
4. Mathematics is a worthwhile and necessary subject.	1	2	3	4	5
5. I'll need a firm mastery of mathematics for my future work.	1	2	3	4	5
6. I will use mathematics in many ways as an adult.	1	2	3	4	5
7. Mathematics is of no relevance to my life.	1	2	3	4	5
8. Mathematics will not be important to me in my life's work.	1	2	3	4	5
9. I see mathematics as a subject I will rarely use in my daily life as an adult.	1	2	3	4	5
10. Taking mathematics is a waste of time.	1	2	3	4	5
11. In terms of my adult life it is not important for me to do well in mathematics in high school.	1	2	3	4	5
12. I expect to have little use for mathematics when I get out of school.	1	2	3	4	5

Mathematics Anxiety Scale (A)

	<u>Weight</u>				
1. Math doesn't scare me at all.	1	2	3	4	5
2. It wouldn't bother me at all to take more math courses.	1	2	3	4	5
3. I haven't usually worried about being able to solve math problems.	1	2	3	4	5
4. I almost never have gotten shook up during a math test.	1	2	3	4	5
5. I usually have been at ease during math tests.	1	2	3	4	5
6. I usually have been at ease in math classes.	1	2	3	4	5
7. Mathematics usually makes me feel uncomfortable and nervous.	1	2	3	4	5
8. Mathematics makes me feel uncomfortable, restless, irritable, and impatient.	1	2	3	4	5
9. I get a sinking feeling when I think of trying hard math problems.	1	2	3	4	5
10. My mind goes blank and I am unable to think clearly when working mathematics.	1	2	3	4	5
11. A math test would scare me.	1	2	3	4	5
12. Mathematics makes me feel uneasy and confused.	1	2	3	4	5

Father Scale (F)

		<u>Weight</u>				
1.	My father thinks that mathematics is one of the most important subjects I have studied.	1	2	3	4	5
2.	My father has strongly encouraged me to do well in mathematics.	1	2	3	4	5
3.	My father has always been interested in my progress in mathematics.	1	2	3	4	5
4.	My father thinks I'll need mathematics for what I want to do after I graduate from high school.	1	2	3	4	5
5.	My father thinks I'm the kind of person who could do well in mathematics.	1	2	3	4	5
6.	My father thinks I could be good in math.	1	2	3	4	5
7.	My father wouldn't encourage me to plan a career in mathematics.	1	2	3	4	5
8.	My father hates to do math.	1	2	3	4	5
9.	As long as I have passed, my father hasn't cared how I have done in math.	1	2	3	4	5
10.	My father thinks advanced math is a waste of time for me.	1	2	3	4	5
11.	My father thinks I need to know just a minimum amount of math.	1	2	3	4	5
12.	My father has shown no interest in whether or not I take more math courses.	1	2	3	4	5

Attitude toward Success in Mathematics Scale (AS)

	<u>Weight</u>				
1. It would make me happy to be recognized as an excellent student in mathematics.	1	2	3	4	5
2. I'd be proud to be the outstanding student in math.	1	2	3	4	5
3. I'd be happy to get top grades in mathematics.	1	2	3	4	5
4. It would be really great to win a prize in mathematics.	1	2	3	4	5
5. Being first in mathematics competition would make me pleased.	1	2	3	4	5
6. Being regarded as smart in mathematics would be a great thing.	1	2	3	4	5
7. Winning a prize in mathematics would make me feel unpleasantly conspicuous.	1	2	3	4	5
8. People would think I was some kind of a grind if I got A's in math.	1	2	3	4	5
9. If I had good grades in math, I would try to hide it.	1	2	3	4	5
10. If I got the highest grade in math I'd prefer no one knew.	1	2	3	4	5
11. It would make people like me less if I were a really good math student.	1	2	3	4	5
12. I don't like people to think I'm smart in math.	1	2	3	4	5

Teacher Scale (T)

	<u>Weight</u>				
1. My teachers have encouraged me to study more mathematics.	1	2	3	4	5
2. My teachers think I'm the kind of person who could do well in mathematics.	1	2	3	4	5
3. Math teachers have made me feel I have the ability to go on mathematics.	1	2	3	4	5
4. My math teachers would encourage me to take all the math I can.	1	2	3	4	5
5. My math teachers have been interested in my progress in mathematics.	1	2	3	4	5
6. I would talk to my math teachers about a career which uses math.	1	2	3	4	5
7. When it comes to anything serious I have felt ignored when talking to math teachers.	1	2	3	4	5
8. I have found it hard to win the respect of math teachers.	1	2	3	4	5
9. My teachers think advanced math is a waste of time for me.	1	2	3	4	5
10. Getting a mathematics teacher to take me seriously has usually been a problem.	1	2	3	4	5
11. My teachers would think I wasn't serious if I told them I was interested in a career in science and mathematics.	1	2	3	4	5
12. I have had a hard time getting teachers to talk seriously with me about mathematics.	1	2	3	4	5

Mathematics as a Male Domain (MD)

	<u>Weight</u>				
1. Females are as good as males in geometry.	1	2	3	4	5
2. Studying mathematics is just as appropriate for women as for men.	1	2	3	4	5
3. I would trust a woman just as much as I would trust a man to figure out important calculations.	1	2	3	4	5
4. Girls can do just as well as boys in mathematics.	1	2	3	4	5
5. Males are not naturally better than females in mathematics.	1	2	3	4	5
6. Women certainly are logical enough to do well in mathematics.	1	2	3	4	5
7. It's hard to believe a female could be a genius in mathematics.	1	2	3	4	5
8. When a woman has to solve a math problem, it is feminine to ask a man for help.	1	2	3	4	5
9. I would have more faith in the answer for a math problem solved by a man than a woman.	1	2	3	4	5
10. Girls who enjoy studying math are a bit peculiar.	1	2	3	4	5
11. Mathematics is for men; arithmetic is for women.	1	2	3	4	5
12. I would expect a woman mathematician to be a masculine type of person.	1	2	3	4	5

Confidence in Learning Mathematics
Scale (C)

	<u>Weight</u>				
1. Generally I have felt secure about attempting mathematics.	1	2	3	4	5
2. I am sure I could do advanced work in mathematics.	1	2	3	4	5
3. I am sure that I can learn mathematics.	1	2	3	4	5
4. I think I could handle more difficult mathematics.	1	2	3	4	5
5. I can get good grades in mathematics.	1	2	3	4	5
6. I have a lot of self-confidence when it comes to math.	1	2	3	4	5
7. I'm no good in math.	1	2	3	4	5
8. I don't think I could do advanced mathematics.	1	2	3	4	5
9. I'm not the type to do well in math.	1	2	3	4	5
10. For some reason even though I study, math seems unusually hard for me.	1	2	3	4	5
11. Most subjects I can handle O.K., but I have a knack for flubbing up math.	1	2	3	4	5
12. Math has been my worst subject.	1	2	3	4	5

APPENDIX B

NEGATIVE SELF-STATEMENTS IN REGARD
TO MATHEMATICS PERFORMANCE

**Negative Self-Statements in Regard to Mathematics
Performance**

1. Mathematics usually makes me feel uncomfortable and nervous.
2. Mathematics makes me feel uncomfortable, restless, irritable, and impatient.
3. I get a sinking feeling when I think of trying hard math problems.
4. My mind goes blank and I am unable to think clearly when working mathematics.
5. A math test would scare me.
6. Mathematics makes me feel uneasy and confused.
7. I'm no good in math.
8. I don't think I could do advanced mathematics.
9. I'm not the type to do well in math.
10. For some reason even though I study, math seems unusually hard for me.
11. Most subjects I can handle O.K., but I have a knack for flubbing up math.
12. Math has been my worst subject.

APPENDIX C
REINFORCEMENT MENU

REINFORCEMENT MENU

Indicate which of the following you would find rewarding.
Be sure to list some ideas of your own at the bottom.

- | | |
|---|--|
| ☐ money | ☐ bouquet of fresh flowers |
| ☐ going to a movie or play | ☐ getting to sleep-in late |
| ☐ spending "extra" time at a favorite hobby | ☐ going skiing |
| ☐ buying a favorite record album | ☐ going on a trip somewhere |
| ☐ playing certain sports | ☐ night out with the boys or girls |
| ☐ spending extra time with a friend | ☐ buying a poster or painting |
| ☐ reading or buying a desired book | ☐ obtaining or caring for pets |
| ☐ going to a party | (Use the space below to list some other rewards that you can think of) |
| ☐ goofing-off time | 1. |
| ☐ watching certain TV programs, or not watching them | 2. |
| ☐ going out on the town (certain restaurant, show, dance, sport, etc.) | 3. |
| ☐ making a special purchase (clothes, tools, an appliance) | 4. |
| ☐ taking lessons in something (music, crafts, sports, etc.) | 5. |
| ☐ going on a picnic | 6. |
| ☐ box of stationery | 7. |
| | 8. |
| | 9. |
| | 10. |

APPENDIX D
INFORMED CONSENT AGREEMENT

INFORMED CONSENT AGREEMENT

I, _____ have had the purpose of this project explained to me. I understand that the general purpose of the study is to improve mathematical performance.

I understand that the personal information collected during the course of this study is essential to the research. This information is confidential and will not be released to anyone without my written permission. I give Claudia Sowa permission to obtain any necessary information from my file and records. In any research report prepared subsequent to this project, I will not be identified by name, and any identifying information will be changed so as to protect my identity. I understand I can stop participating in the study at any time. This consent agreement will terminate March 1, 1980, but confidentiality will be extended indefinitely.

I certify that I have read this document, or had it read to me, prior to signing it.

Signed _____

Date _____

REFERENCES

REFERENCES

- Abramson, L. Y., Seligman, M. E. P., & Teasdale, J. D. Learned helplessness in humans: Critique and reformulation. Journal of Abnormal Psychology, 1978, 87, 49-74.
- Aiken, L. R. Attitudes toward mathematics. Review of Educational Research, 1970, 40, 551-561.
- Aiken, L. R. Update on attitudes and other affective variables in learning mathematics. Review of Educational Research, 1976, 46, 293-311.
- Albon, L. J., Blackman, S., Giangrasso, A. P., & Siner, H. G. Series in Mathematics Modules. Menlo Park, Calif.: Cummings, 1976.
- Baldessarini, R. J. The basis of amine hypotheses in affective disorders: A critical evaluation. Archives of General Psychiatry, 1975, 32, 1087-1093.
- Bandura, A. Principles of behavior modification. New York: Holt, Rinehart, & Winston, 1969.
- Beck, A. T. Cognitive therapy and the emotional disorders. New York: Signet, 1976.
- Benson, J. S., & Kennelly, K. J. Learned helplessness: The result of uncontrollable reinforcements or uncontrollable aversive stimuli? Journal of Personality and Social Psychology, 1976, 34, 138-145.
- Borg, W. R., & Gall, M. D. Educational research. New York: David McKay, 1976.
- Butts, T., & Phillips, E. Modules VI, VII, VIII and study guides for Math 081-103 and Math 082-104. Unpublished manuscript, 1979. Available from Department of Mathematics, Michigan State University, East Lansing.
- Campbell, D. T., & Stanley, J. C. Experimental and quasi-experimental designs for research. Chicago: Rand McNally, 1966.
- Cornfield, J., & Tukey, J. W. Average value of mean squares in factorial. Annals of Mathematical Statistics, 1956, 27, 907-949.

- Cox, T. Stress. Baltimore: University Park Press, 1978.
- Crandall, V. C. Sex differences in expectancy of intellectual and academic reinforcement. In C. P. Smith (Ed.), Achievement-related motives in children. New York: Russell Sage, 1969.
- Donady, B., & Tobias, S. Math anxiety. Teacher Magazine, November 1977, 17, 71-74.
- Dweck, C. S. The role of expectations and attributions in the alleviation of learned helplessness. Journal of Personality and Social Psychology, 1975, 31, 674-685.
- Dweck, C. S., & Goetz, T. E. Attributions and learned helplessness. In J. D. Harvey, S. Ickes, & L. R. Kidd, (Eds.), New directions in attribution research, Vol. 2. Hillsdale, N. J.: Lawrence Erlbaum Associates, 1977.
- Dweck, C. S., & Repucci, N. D. Learned helplessness and reinforcement responsibility in children. Journal of Personality and Social Psychology, 1973, 25, 109-116.
- Eisenberger, R., Park, D. C., & Frank, M. Learned industriousness and social reinforcement. Journal of Personality and Social Psychology, 1976, 33, 227-232.
- Ellis, A. Reason and emotion in psychotherapy. New York: Lyle Stuart, 1962.
- Etaugh, C., & Brown, B. Perceiving the causes of success and failure of male and female performers. Developmental Psychology, 1975, 11, 103.
- Fennema, E., & Sherman, J. A. Fennema-Sherman Mathematics Attitude Scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. JSAS Catalogue of Selected Documents in Psychology, 1976, 6, 31.
- Ferster, C. B., & Skinner, B. F. Schedules of reinforcement. Englewood Cliffs, N. J.: Prentice-Hall, 1957.
- Festinger, L. A theory of cognitive dissonance. Evanston, Ill.: Row, Peterson, 1957.
- Fosco, F., & Geer, J. H. Effects of gaining control over aversive stimuli after differing amounts of no control. Psychological Reports, 1971, 29, 1153-1154.

- Gatchel, R. J., Paulus, P. B., & Maples, C. W. Learned helplessness and self-reported affect. Journal of Abnormal Psychology, 1975, 84, 732-734.
- Gatchel, R. J., & Proctor, J. D. Physiological correlates of learned helplessness in man. Journal of Abnormal Psychology, 1976, 85, 27-34.
- Goldfried, M. R., Decenteneo, E. T., & Weinberg, L. Systematic rational restructuring as a self-control technique. Behavior Therapy, 1974, 5, 247-254.
- Griffith, M. Effects of noncontingent success and failure on mood and performance. Journal of Personality, 1977, 45, 442-457.
- Harris, R. J. A primer of multivariate statistics. New York: Academic Press, 1975.
- Hays, W. L. Statistics for the social sciences. New York: Holt, Rinehart, & Winston, 1973.
- Hiroto, D. S. Locus of control and learned helplessness. Journal of Experimental Psychology, 1974, 102, 187-193.
- Hiroto, D. S., & Seligman, M. E. P. Generality of learned helplessness in man. Journal of Personality and Social Psychology, 1975, 31, 311-327.
- Isaac, S., & Michael, W. B. Handbook in research and evaluation. San Diego: Edits, 1977.
- Kahn, W. J. Self-management: Learning to be our own counselor. Personnel and Guidance Journal, 1976, 55, 176-180.
- Kaminski, D. M. Why females don't like mathematics: The effect of parental expectations. Paper presented at the annual meeting of the American Sociological Association, New York, August 1976.
- Keller, J. M. Determinants of learned helplessness in problem solving. Syracuse University, 1975, (ERIC Document Reproduction Service No. ED 102 937).
- Kelley, H. H. Attribution theory in social psychology. In D. Levine (Ed.), Nebraska symposium on motivation (Vol. 15). Lincoln: University of Nebraska Press, 1967.

- Klein, D. C., Fencil-Morse, E., & Seligman, M. E. P. Learned helplessness, depression, and the attribution of failure. Journal of Personality and Social Psychology, 1976, 33, 508-516.
- Klein, D. C., & Seligman, M. E. P. Reversal of performance deficits in learned helplessness and depression. Journal of Abnormal Psychology, 1976, 85, 11-26.
- Krantz, D. S., Glass, D. C., & Snyder, M. L. Helplessness, stress level, and the coronary-prone behavior pattern. Journal of Experimental Social Psychology, 1974, 10, 284-300.
- Maccoby, E. E., & Jacklin, C. N. The psychology of sex differences. Stanford, Calif.: Stanford University Press, 1974.
- Maehr, M. L. Culture and achievement motivation. American Psychologist, 1974, 29, 887-896.
- Maier, S. F. Failure to escape traumatic shock: Incompatible skeletal motor responses or learned helplessness? Learning and Motivation, 1970, 1, 157-170.
- Maier, S. F., Albin, R. W., & Testa, T. J. Failure to learn to escape in rats previously exposed to inescapable shock depends on nature of escape response. Journal of Comparative and Physiological Psychology, 1973, 85, 581-592.
- Maier, S. F., & Testa, T. J. Failure to learn to escape by rats previously exposed to inescapable shock is partly produced by associative interference. Journal of Comparative and Physiological Psychology, 1975, 88, 554-564.
- Malmö, R. B. Finger sweat prints in differentiation of low and high incentive. Psychophysiology, 1965, 1, 231-240.
- Mark, S. F. To succeed or not to succeed: Is that the only question in learned helplessness? A critical analysis of theoretical and methodological issues. Genesee Community College, New York (ERIC document ED 158 808, August 1978).
- Masserman, J. H. The principle of uncertainty in neurogenesis. In H. D. Kimmel (Ed.), Experimental psychopathology. New York: Academic Press, 1971.

- McCarron, L. T. Psychophysiological discrimination of reactive depression. Psychophysiology, 1973, 10, 223-230.
- McGuire, L. S., Ryan, K. O., & Omenn, G. S. Congenital adrenal hyperplasia, II: Cognitive and behavioral studies. Behavior Genetics, 1975, 5, 175-188.
- Mehrens, W., & Lehmann, I. Measurement and evaluation in education and psychology. New York: Holt, Rinehart, & Winston, 1973.
- Meichenbaum, D. H. A self-instructional approach to stress management: A proposal for stress inoculation training. In C. Speiberger & I. Sarason (Eds.). Stress and anxiety in modern life. New York: Winston & Sons, 1975.
- Miller, I. W., & Norman, W. H. Learned helplessness in humans: A review and attribution-theory model. Psychological Bulletin, 1979, 86, 93-118.
- Miller, W. R., & Seligman, M. E. P. Depression and learned helplessness in man. Journal of Abnormal Psychology, 1975, 84, 228-238.
- Mischel, W. On the future of personality measurement. American Psychologist, 1977, 32, 246-254.
- Mould, D. E. Differentiation between depression and anxiety: A new scale. Journal of Consulting and Clinical Psychology, 1975, 43, 592.
- Mowrer, O. H. Learning theory and behavior. New York: Wiley, 1960.
- Neale, D. C. The role of attitudes in learning mathematics The Arithmetic Teacher, December 1969, 16, 631-640.
- Nicholls, J. G. Causal attributions and other achievement-related cognitions: Effects of task outcome, attainment value and sex. Journal of Personality and Social Psychology, 1975, 31, 379-389.
- Overmeier, J. B., & Seligman, M. E. P. Effects of inescapable shock upon subsequent escape and avoidance learning. Journal of Comparative and Physiological Psychology, 1967, 63, 23-33.
- Padilla, A. M. Effects of prior and interpolated shock exposures on subsequent avoidance learning by goldfish. Psychological Reports, 1973, 32, 451-456.

- Phares, E. J. Expectancy change in chance and skill situations. Journal of Abnormal and Social Psychology, 1957, 54, 339-342.
- Porter, A. C., & Chibucos, T. R. Analysis issues in summative evaluation. In G. Borich (Ed.), Evaluating educational programs and products. Englewood Cliffs, N. J.: Educational Technology Publications, 1973.
- Roth, S., & Kubal, L. Effects of noncontingent reinforcement on tasks of differing importance: Facilitation and learned helplessness. Journal of Personality and Social Psychology, 1975, 32, 680-691.
- Rotter, J. B., Liverant, S., & Crowne, D. P. The growth and extinction of expectancies in chance controlled and skilled tasks. Journal of Psychology, 1961, 52, 161-177.
- Seligman, M. E. P. Fall into helplessness. Psychology Today, June 1973, 43-48.
- Seligman, M. E. P. Helplessness: On depression, development and death. San Francisco: Freeman, 1975.
- Seligman, M. E. P., & Beagley, G. Learned helplessness in the rat. Journal of Comparative and Physiological Psychology, 1975, 88, 534-541.
- Seligman, M. E. P., & Maier, S. F. Failure to escape traumatic shock. Journal of Experimental Psychology, 1967, 74, 1-9.
- Seligman, M. E. P., Maier, S. F., & Geer, J. H. The alleviation of learned helplessness in the dog. Journal of Abnormal Psychology, 1968, 73, 256-262.
- Sells, L. W. High school mathematics as the critical filter in the job market. Unpublished manuscript, 1973. (Available from Department of Sociology, University of California, Berkeley).
- Shrauger, J. S. Responses to evaluation as a function of initial self-perception. Psychological Bulletin, 1975, 82 (4), 581-596.
- Tennen, H., & Eller, S. J. Attributional components of learned helplessness and facilitation. Journal of Personality and Social Psychology, 1977, 35, 265-271.
- Thomas, E., & Balter, A. Learned helplessness: Amelioration of symptoms by cholinergic blockage of the septum. *Science*, "in press," listed in Seligman (1975),

- Thomas, E., & Dewald, L. Experimental neurosis: Neuropsychological analysis. In J. D. Maser & M. E. P. Seligman (Eds.), Psychopathology: Experimental models. San Francisco: Freeman, 1977.
- Thornton, J. W., & Jacobs, P. D. Learned helplessness in human subjects. Journal of Experimental Psychology, 1971, 87, 369-372.
- Wahler, R. G. Setting generality: Some specific general effects of child behavior therapy. Journal of Applied Behavior Analysis, 1969, 2, 239-246.
- Weiner, B. (Ed.) Achievement motivation and attribution theory. Morristown, N. J.: General Learning Press, 1974.
- Weiner, B., Frieze, I., Kukla, A., Reed, L., Rest, S., & Rosenbaum, R. M. Perceiving the causes of success and failure. Morristown, N. J.: General Learning Press, 1971.
- Weiss, J. M. Effects of coping response on stress. Journal of Comparative and Physiological Psychology, 1968, 68, 597-603.
- Weiss, J. M. Effects of coping behavior in different warning signal conditions on stress pathology in rats. Journal of Comparative and Physiological Psychology, 1971, 77, 1-13.
- Weiss, J. M., Glazer, H., & Pohorecky, L. Coping behavior and neurochemical changes in rats. Paper presented at the Kittay Scientific Foundation Conference, New York, March, 1974.
- Weiss, J. M., Stone, E. A., & Harrell, N. Coping behavior and brain norepinephrine in rats. Journal of Comparative and Physiological Psychology, 1970, 72, 153-160.
- Wortman, C. B., Panciera, L., Shusterman, L., & Hibscher, J. Attributions of causality and reactions to uncontrollable outcomes. Journal of Experimental Social Psychology, 1976, 12, 301-316.
- Zuckerman, M., Lubin, B., & Robins, S. Validation of the Multiple Affect Adjective Check List in clinical situations. Journal of Consulting Psychology, 1965, 29, 594.