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The Relationship of Anxiety to Achievement in Community College Remedial Algebra Classes with Differing Levels of Student Participation

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THE RELATIONSHIP OF ANXIETY TO ACHIEVEMENT IN COMMUNITY COLLEGE REMEDIAL ALGEBRA CLASSES WITH DIFFERING LEVELS OF STUDENT PARTICIPATION

by

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ABSTRACT

THE RELATIONSHIP OF ANXIETY TO ACHIEVEMENT IN COMMUNITY COLLEGE REMEDIAL ALGEBRA CLASSES WITH DIFFERING LEVELS OF STUDENT PARTICIPATION

Jean P. Stark

This study investigated the relationship of anxiety to mathematics achievement in remedial algebra students in one community college. The experimental treatments were differentiated by the amount of student involvement in the instruction (high student participation vs. low student participation). This study extended the "flow of research" which began with a pilot study of mathematics attitudes, success and attrition. A second study investigated a wide band of aptitudes in remedial algebra students in 14 community colleges in Illinois.

Four major research questions guided this investigation: (1) Does specific mathematics anxiety relate to the achievement of remedial algebra students? (2) Is the effect of anxiety on achievement related to sex, age, or intelligence of the students? (3) Does specific mathematics self-concept relate to the specific mathematics anxiety of the students? (4) Does the level of student participation in the classroom instruction relate to the achievement of the subjects differentially by sex, age, intelligence, prior achievement, or self-concept?

Multiple regression analysis and partial correlation techniques were used to evaluate the effects and the magnitudes of the effects of the independent variables (facilitating mathematics anxiety, debilitating mathematics anxiety, actual mathematics self-concept, ideal mathematics self-concept, prior achievement, intelligence, sex and age) on one dependent variable (Mathematics achievement) with two levels of an intervening variable (high student participation vs. low student participation).

Student performance was measured at the beginning and end of the summer semester with the Wide Range Achievement Test. Anxiety and self-concept were measured with items from the National Longitudinal Study of Mathematics Abilities of SMSG; intelligence was measured with the Quick Word Test. High student participation was defined by the author as: students give the review of the previous days lesson; students signal the transition to the next lesson; and students summarize the important points of the lesson. Low student participation delegated the same tasks to the instructor.

The two classes of remedial algebra were taught by the same instructor in two modes of participation. The high student participation class was the experimental group; the low student participation class was the control group. Twenty-eight of the 574 students in the study completed just prior to this investigation made up a random control group.

Differences among the groups were eliminated when initial standing on the pretest and IQ were accounted for.

No variables accounted for achievement differences once Pre-test and IQ were controlled for. The over-powering effects of prior achievement and intelligence all but obliterated the effects of all the other variables including anxiety and student participation. The level of participation does not appear to change achievement. Students learn as well with high participation as they do with low participation.

The results indicated a need to control for initial differences in the variables and groups. To replicate this study, a change in achievement measure is recommended. The choice of instrument must not underestimate achievement. With that change suggested, future research should identify the specific behaviors associated with failures and repeated failures among adult remedial mathematics students. Specific attention should be given to the interaction between anxiety and selected processing variables. Further work is needed in determining the effects of student participation in learning.

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CHAPTER I

INTRODUCTION

Anxiety is an experience common to people in a variety of experiences and as a result of a variety of situations and events. It is the product of both simple experiences (e.g., waiting for a friend, keeping a dental appointment) and complex experiences (e.g., learning, memory). Anxiety, as a term which is used to describe a product or a process which represents such varied experiences and applications, carries with it some conceptual confusion. A clarification is briefly presented in a conceptual overview of anxiety. This is followed by the purposes of the chapter, background of the study, and organization of the dissertation.

Conceptual Overview of Anxiety

Since it appears that there are two general areas of confusion about anxiety, this section will present a continuum of anxiety and a discussion of the terms 'anxiety' and 'fear'. The former deals with the "goodness" and "badness" of anxiety; the latter, the presence and absence of a spatial object in defining the terms.

An Anxiety Continuum

Anxiety appears to run on a continuum from low to

high. Figure 1 illustrates the continuum.

Debilitating Facilitating Debilitating

Low High

Figure 1. An Anxiety Continuum

A normal level of anxiety is one which is not disproportionate to the experience, i.e., not too little or too much, either of which would be debilitating. A curvilinear relationship, commonly known as the Yerkes-Dodson Law, illustrates this effect.

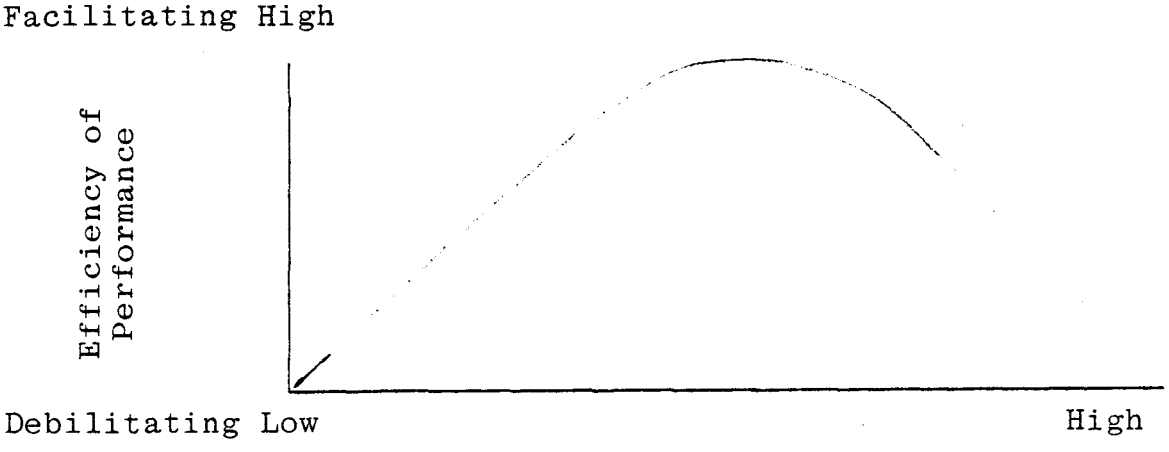

Figure 2. A curvilinear relationship of anxiety and performance

Human beings vary in their capacity for handling anxiety. There are some persons who never seem to get "excited" or anxious about anything; there are others who seem to be perpetually anxious; and there are still others who are temporarily or spontaneously anxious.

Normal anxiety is associated with a temporary arousal of feeling related to some value. (Sartre, 1956) This value could be a family relationship, a friendship, a good acting performance, or a good grade on a mathematics test. It would seem normal to "be anxious" when a friend or family member is late arriving at a destination, or to have "butterflies in the stomach" before a mathematics test, or even "the jitters" before an opening curtain. These feelings are not disproportionate to the values of family, friendship, achievement or profession as long as the individual is able to move through the anxiety-provoking experience.

It is not only the quantity but also the intensity of anxiety that separates the good or helpful from the bad or harmful anxiety. There are persons who seem to be anxious all the time, as if it were a trait in their personality. Such individuals become paralyzed by their anxiety and are sometimes unable to function adequately. On the other hand, the individual with an inadequate level of anxiety also functions poorly.

In summary, it might be said that the individual with

normal or healthy anxiety moves ahead through anxiety-provoking experiences, and the anxiety acts as a facilitator of his development. On the other hand, individuals at either extreme are prevented from actualizing their possibilities: too much anxiety is constricting (neurotic); too little anxiety prevents the individual from engaging in conflict. Thus, for the purposes of this study, anxiety can be viewed as a pleasant arousal of feeling if it is facilitating or as an unpleasant feeling if it is debilitating.

Fear and Anxiety

Without anxiety and fear man may never have survived his primitive beginnings. Today, the threats of the sabre-tooth tiger and mastodon are gone, but in their place is the danger of losing out in the competitive struggle in a highly technological world. Such a loss could result in damage to self-esteem (LeKarczyk and Hill, 1969; May, 1977).

Anxiety, though, is different from fear which has an external object, one that can be located spatially, such as a tiger or a fire. Sartre (1956) defines anxiety as a fear of failure to meet some internal standard or value. Confusion abounds because the terms are used interchangeably in everyday usage, among researchers (e.g., Izard and Tomkins) as well as in defining anxiety (e.g., Sartre). The distinction, however, is clearly stated by Anna Freud (1977):

> We have always distinguished between 'fear' and 'anxiety', using the former exclusively for the attitudes toward real danger threatening from external sources and the latter exclusively for reactions to threats located within the mind, due to clashes between drives and internal opposing forces (p. 86).

The conceptual overview has presented the confusion found in the use of the term "anxious". The next sections present the purpose, background, and organization of the dissertation.

Purpose of the Study

It is the purpose of this study to investigate the relationship of anxiety to mathematics achievement in a sample of remedial algebra students in one community college. The instructional treatments were differentiated by the amount of student involvement in the instruction (high student participation vs. low student participation). Also, it was the purpose of this study to extend the "flow of research" which began with a pilot study of mathematics attitudes, success and attrition (Stark, 1979). That initial research was followed by a study of a wide band of aptitudes in a random sample of remedial algebra students in 14 community colleges in Illinois. The two studies are briefly discussed in the background section of this chapter as well as throughout the dissertation whereever the findings are applicable.

Four major research questions guide this investiga-

tion: (1) Does specific mathematics anxiety relate to the achievement of remedial algebra students? (2) Is the effect of anxiety on achievement related to the sex, age, or intelligence of the students? (3) Does specific mathematics self-concept relate to the specific mathematics anxiety of the students? (4) Does the level of student participation in the classroom instruction relate to the achievement of the subjects differentially by sex, age, intelligence, prior achievement, or self-concept?

Multiple regression analysis and partial correlation techniques were used to evaluate the effects and the magnitudes of the effects of the independent variables (facilitating anxiety, debilitating anxiety, actual mathematics self-concept, ideal mathematics self-concept, prior achievement, intelligence, sex, age) on one dependent variable (mathematics achievement) with two levels of an intervening variable (high student participation versus low student participation). The principles of correlation and regression are discussed in Chapter III.

Background of the Study

The research and expository literature regarding the adult in remedial mathematics is not only sparse but also limited generally to demographic surveys of the students. Nevertheless, it was the reports (Archer, 1978; Fey, 1976)

of the startling failure rates among the adult remedial mathematics students that prompted the two earlier studies, Phases I and II, and the subsequent research reported in this dissertation. Phases I and II were completed by this researcher to provide background and baseline data for the present investigation. A brief description of the first phases is summarized in the following section.

Phase One

The subjects in the first phase were 68 remedial algebra students in four classes taught by two instructors during the fall term of 1978 at Oakton Community College. The independent variables were the eight sub-scales of the Math Inventory of the National Longitudinal Study of Mathematics Achievement (Wilson, Cahen, and Begle, 1968). The aptitudes measured in a pre- and posttest were: promath, easy vs. hard, math vs. nonmath, fun vs. dull, actual math self-concept, ideal math self-concept, facilitating anxiety, debilitating anxiety. The criterion variable was successful completion of the course enabling the student to go to the next course. Treatment was defined by the structure of the class i.e., high structure (regular lectures, regular quizzes, homework, a textbook, final examination) vs. low structure (no regular lectures, no regular quizzes, no required homework, no textbook, a final examination). The results indicated a low but positive trend toward significance between high struc-

ture and success. Also, the downward curve of facilitating anxiety, reported as beginning in early adolescence (NLSMA, Report No. 20), continued its downward curve among the remedial algebra students. Likewise, the upward curve of debilitating anxiety begun in the junior high schools (NLSMA, Report No. 20) continued an upward curve in the Phase I study. Of the eight aptitudes measured, ideal mathematics and self-concept showed the greatest variance in the pre- and posttests although the posttest variance was less than the pretest. This, it was concluded, might indicate that students with low ability in mathematics wish the hardest to be "good" at mathematics and that the over 40 percent failure or withdrawal from class removed some of the poorest students from the posttesting. Actual mathematics self-concept appeared to correlate positively with high or successful achievement. Since no standardized test of achievement was used to measure "success" or achievement, it was recommended future research use such measures. Additionally, it was suggested that a test of intelligence be used to control for intellectual differences among the students. (See Appendix E for descriptive statistics.)

Phase Two

In the second phase of research on the aptitudes and achievement of adults in remedial algebra, the subjects were

575 community college students in 14 community colleges in Illinois during the summer session, 1979. A wide band of aptitudes was measured: the two anxiety scales, the two self-concept scales used in Phase I; locus-of-control; field-dependence field-independence; spatial orientation and spatial visualization; prior achievement and verbal intelligence. The criterion variable was a standardized achievement test (Wide Range Achievement Test, Jastak and Jastak, 1978). Treatment was defined as traditional or self-paced as declared by the college presidents in a questionnaire completed prior to data collection. The researcher's classroom visitations in ten of the different classes indicated that only the student's decision concerning when to come to the laboratory and when to take quizzes appeared to differentiate the treatments. This, in the researcher's opinion, constituted a nonevent (Charters and Jones, 1973) and, thus, was minimized in the statistical analyses.

The results of a multiple regression analysis on achievement indicated that intelligence and prior achievement accounted for more than half of the variance in achievement. Also, statistics indicated that intelligence and achievement were probably measuring the same thing. No significant differences were found by age or sex. Since the data represents a large number of students, the data is used for comparative purposes in the present research. (See Appendix D for descriptive statistics.)

In summary, the first phase was a pilot study which helped establish the needed controls in subsequent research. Phase two gave needed direction to the definition of treatment. This research, as presented in the third chapter, uses the guidance provided by the results of the first two phases.

Organization of the Dissertation

In the following chapter, Review of Related Literature, anxiety will be discussed theoretically and operationally. The measurement of anxiety will be discussed. The interrelationships of anxiety and the other variables (self-concept, prior achievement, intelligence, sex, age, participation in instruction) will be generally reviewed. In the third chapter, Procedures, the subjects, setting, testing procedures, treatment and statistical design will be presented. Subsequent chapters will present the results of the research and, finally, the conclusions and uses of this research in continuing the "flow of research" begun in Phase One.

CHAPTER II

REVIEW OF RELATED LITERATURE

This chapter presents a brief theoretical overview of anxiety, the definitions of anxiety, the measurement of anxiety and the inter-relationships of anxiety and each of the variables in this study. The research questions are restated in the last section.

Theoretical Overview of Anxiety

Many disciplines have contributed to an emerging integrated theory of anxiety. Among these disciplines are: philosophy; biology; psychology; psychoanalytic theory. Education, on the other hand, appears to have engaged in applied research of the concept. Each of the disciplines is briefly presented with representative contributions from each.

Philosophy

The compartmentalization of sciences and theories in the early nineteenth century may explain how the disunity of mind and body and the tendency to repress undesirable impulses provoked feelings of anxiety. This disunity was rejected by Kierkegaard (1944) who stressed the unity

of the individual in feeling, thinking and acting. He regarded anxiety as a companion of human freedom, i.e., a capacity for new experiences, to "take new roads". The combination of possibility (e.g., seeking after adventure) and responsibility (confronting conflicts and crises) moves the individual toward unity and individuation in his personality development (Kierkegaard, 1944, 38-40). The way, however, is not without threats of isolation and powerlessness and subsequent anxiety (Kierkegaard, 1944, p. iii).

Anxiety, said Kierkegaard (1944), "... is a desire for what one dreads, a sympathetic antipathy ... an alien power which lays hold of an individual ..." (p. xii). It is this antipathy which apparently moves the individual down roads not previously taken in a desire to actualize potentialities. Additionally, according to Kierkegaard, self-awareness and the social environment are closely related to anxiety.

Since Kierkegaard there have been other existentialists who have described anxiety in an atomic age. Among these is Jean-Paul Sartre (1956) who links anxiety to the basic concept of freedom which is the "only foundation of values" (Sartre, 1956, p. 76). Man is the being through whom all values come into being, and this is by free choice. This creates anxiety since values cannot be established without being put in doubt. Further, the hierarchy of one's

values may be overthrown and replaced with another at any time (Sartre, 1956, pp. 28-29). This freedom to choose is described as a jump into limitlessness and gives the feeling of anxiety:

> I have not and cannot have recourse to any value when I am confronted with the fact that it is I who maintain the values in being: nothing can protect me against myself - cut from the world and from my essence by the nothingness I am, I have to achieve the sense of the world and of my essence: I make the decision concerning that sense, alone, unjustifiable and without excuse (Sartre, 1956, p. 77).

Existentialism is humanistic. It has taught that in so far as man has reached an age of reason, he has to recognize that he stands alone in this world and can rely only on himself. In Existentialism there is the idea of man here and now, man who is the sole legislator of values, man whose knowing mind is second only to existence. Man is responsible for his value choices and the anxiety that arises from it.

Biology

If a loud gunshot or a whistle is suddenly sounded in one's ears, the individual will jerk his head, probably blink his eyes. He exhibits the startle reaction. This startle pattern is innate and involuntary and precedes both fear and anxiety. An individual startles before he knows what startles him (Landis and Hunt, 1939). The development and importance of startle is stated by Kubie (1941):

> ... the fetus cannot experience startle ... the infant and the startle pattern are born at the same moment. Thereafter, there exists a 'distance' between the individual and his environment. The infant experiences waiting, postponement and frustration. Anxiety and the thought processes both arise out of this situation ... Anxiety preceding the development of thought ... stands as a bridge between the startle pattern and the dawn of all processes of thought (pp. 78-85).

In recent years, the thrust of anxiety research among biologists and biochemists has been on anxiety-reducing drugs - their uses and side effects. Many of these drugs have become household words (e.g., tranquilizers) and common drug jargon (e.g., "downers"). Information in this area is so extensive it is included in all required health courses in both elementary and secondary schools. The need to regulate the amount of anxiety for an individual's capacity and occasion cannot be denied, but the need to control this regulation by professionals is an issue of concern. The effects of drugs is of such widespread interest that the general populace is apprised of new findings through radio, television and print media.

Psychology

In early experiments using laboratory rats, investigations of anxiety-like reactions were later termed "vigilance" by Liddell (1950). Vigilance refers to a generalized alertness to or suspiciousness of the environment, and animals do not show anxiety. It was Liddell who reported that

anxiety and intelligence are so closely associated that anxiety is like intellect's shadow. Also, both are associated with and depend on the social environment.

Three current areas of research in psychology which contribute to the understanding of anxiety are: (1) cognitive psychology; (2) state-trait anxiety theory; and (3) learning theory. Brief representative contributions are presented in each area.

Cognitive psychology. The cognitive theorists (e.g., Epstein, 1976; Lazzrus and Averill, 1976) emphasize man-as-a-perceiver, i.e., there are cognitive mediators between the emotionality and the response. Going beyond this distance between the stimulus and the response, Epstein stresses a relationship between self-esteem and anxiety, which begins with the dependency of the child on others in which it is important to receive approval and avoid disappointing significant others. The child adopts the value system of the significant adults, and, through "punishment" learns to control his behavior. By internalizaing the values of the significant others, the child reduces his main source of anxiety, disapproval. However, says Epstein, in so doing, the child acquires a new source of anxiety -- self-disapproval. From this point on, "... the maintenance of self-esteem is apt to become the single most important source" of anxious feelings for the individual (p. 223).

State-trait theory. Speilberger (1976) differentiates between "state", a temporary anxiety condition, and "trait", a proneness to be frequently anxious over long periods of time. The difference has been termed one of normal and neurotic anxiety. The research on the etiology of trait anxiety is similar to the Freudian theory presented in the psychotherapy section. Parent-child difficulties, particularly maternal rejection, is cited as the origins of trait anxiety.

Learning theory. Mowrer's (1950) research on anxiety originated in early stimulus-response investigations with rats and guinea pigs. The tension and organic pain he observed in the organism's conditioned response to anticipated danger, he labeled "anxiety". Mowrer says anxiety is a motivator and the anxious symptoms are learned behavior. In Mowrer's later research, he stressed the importance of the intellect, how man's capacity to reason sets him apart from the animals. Mowrer's contribution to anxiety theory brings "time" into learning. Future consequences can be weighed against the immediate anxiety which stems from the "emotionally charged" symbols one imagines. The response involves the individual's values for himself and his social set. Over the years, Mowrer's viewpoint changed from the notion that anxiety is a conditioned pain to anxiety is a constructive positive product:

> There is a common tendency in our day, both in the part of professional psychologists and laymen, to look upon anxiety as a negative, destructive, 'abnormal' experience, one which must be fought and if possible annihilated ... Anxiety is ... not the cause of personal disorganization; rather is it the outcome or expression of such a state ... psychotherapy must involve acceptance of the essential friendliness and helpfulness of anxiety (pp. 61-62).

Another contributor to a learning theory of anxiety is Taylor (1951) who interpreted anxiety as a drive which Farber (1954) says has never been denied. As a drive, it is a general anxiety state descriptor. There may, says Taylor, be many other "characteristics other than drive level on which anxious and nonanxious Ss differ" (1956, p. 303).

In recent years, Gagné (1970) has indicated that learning theory is moving from a connectionist point of view to an information processing view of learning. He found little evidence, other than the spaced review, to support learning by repetition (p. 170). The newer theory views learning as a "complex of processes" taking place inside the learner. Some of these processes are cognitive, but others are affective. Self-confrontation is one such process which produces anxiety. Schmuck and Schmuck (1974) state that "when a person is confronted with discrepancies between his actual and ideal states he usually experiences discomfort..." (p. 295). This discomfort, they say is anxiety, one of the three most important factors affecting a learner's responses

(p. 298).

Animal studies support the hypothesis that abnormal behavior is learned in the same way that normal behavior is learned (e.g., desensitization experiments). However, is experimentally induced behavior disturbances in animals a valid analogue of human behavior? If wrong responses which lead to negative reinforcement should die out, why do the symptoms of debilitating anxiety persist? To what extent is genetics (nature) responsible for maladaptive behavior patterns? To what extent does the manipulation of the environment (nurture) facilitate the learning of a wide array of individuals with differences in innate capacities to learn? Research on motivation, attention, task complexity, stress, cue utilization are all currently searching for the parts of a complex theory of learning that has application generally.

Psychoanalytic Theory

Freud, whose contributions to anxiety theory development is acknowledged by theorists who have followed him, changed his view of anxiety in the course of his writings. At first, Freud (1964) thought that anxiety was repressed libido, i.e., that repressed sexual excitiation was transformed into anxiety. Later, he stated that it is the ego which must reduce anxiety which in turn causes repression.

His theory suggests that repressed affect becomes anxiety, that in neurotic (paralyzing) anxiety, the ego takes "flight" from the demands of the libido. In other words, the person treats his inner concern or threat as if it were an external danger. External dangers (fear), he distinguished from internal anxieties which disregard the external object.

In summary, many disciplines have contributed to a theory of anxiety, but at this time, there is no one theory of anxiety. Overall, it can be seen that the theoretical contributions from each field developed as the need for explanations arose. There appears to be a consistent relationship between the intellect, social environment and anxiety. Anxiety and fear are not the same; there are both constructive and destructive effects of anxiety; self-esteem is important in evaluating anxiety. The next section will present the definitions of anxiety.

Definitions of Anxiety

Just as there is no one theory of anxiety, there is no one definition of anxiety. The definitions are divided into two categories: general anxiety and specific anxiety. The distinctions are presented in this section, but the operational definitions are delayed until the next chapter wherein they are included with operational definitions for all the variables.

General Anxiety

Another name for general anxiety is manifest anxiety (Taylor, 1950). Inter-individual differences on a global dimension are defined by differences on a pencil and paper response to 50 items from the Minnesota Multiphasic Personality Inventory. Global anxiety had previously been defined by responses to electric shock or stressful instructions. An adjective checklist of descriptors of life situations also defined global anxiety. All of these have been used to define a general anxiety, even though each measures something different from the others. For example, the items from the MMPI define a drive and motivation characteristic of anxiety, the stressful instructions probably define the role of stress with anxiety, the adjective checklist appears to define the reflective aspect of anxiety. Although each of these is undifferentiated from "general" anxiety, it seems clear that each is a separate characteristic of anxiety.

The general theoretical thrust of the literature defines general anxiety as a global dimension which considers anxiety as a composite: "a desire for what one dreads" (Kirkegaard, 1944); "a jump into limitlessness" (Sartre, 1956); the bridge between startle and thought (Kubie, 1941); self-disapproval (Epstein, 1976); either a temporary or long-term condition (Speilberger, 1976); tension, organic pain, the weighing of future consequences (Mowrer, 1950); drive

(Taylor, 1951) or repressed affect (Freud, 1964). Each of these contributes to a "feeling of anxiety" which may be able to be measured by propriocentric devices. They do not necessarily preclude a self-awareness by the individual.

Specific Anxiety

The need for more specific definitions of anxiety arose when intra-individual differences in anxiety were investigated. Mandler and Sarason (1952) were among the first to consider such differences. Their concern for test and achievement anxiety is voiced by Sarason, Mandler and Craighill (1952):

> When a stimulus situation contains elements which specifically arouse test or achievement anxiety, this increase in anxiety drive will lead to poorer performance in individuals who have test-irrelevant anxiety responses in their response repertory. For individuals without such self-response tendencies, these stimulus elements will raise their general drive level and result in improved performance (p. 561).

Later, Alpert and Haber (1960) extended the definition and measurement of specific anxiety. They separated anxiety into facilitating and debilitating effects. The former leads to improved performance; the latter interferes with performance.

Still later in the 1960's, the Mathematics Study Group (MSG) further refined the definition of specific anxiety as subject-related. In so doing, they found that there were certain feelings of arousal regarding learning math-

ematics which were beneficial. These they labeled facilitating anxiety. Other feelings regarding learning of mathematics were unpleasant and hindered the progress of learning the subject. Responses to feelings such as taking math tests, being called on in class, and working math problems determine whether the feelings are helpful arousal (facilitating) or harmful (debilitating).

For the purpose of this study specific anxiety is defined as facilitating mathematics anxiety and debilitating mathematics anxiety. The former is the degree to which mathematics performance is facilitated by stressful conditions; the latter the extent to which achievement is harmed by such conditions.

In summary, there are two categories of definitions of anxiety. One is general anxiety, the other is specific anxiety. The former appears to define inter-individual differences on a global dimension; the latter defines intra-individual differences on specific anxieties.

The Measurement of Anxiety

Anxiety does not lend itself to direct observation and measurement. Cattell (1966) reported conflicting findings on anxiety and school achievement which were partly explained by contaminated anxiety measures. At best, anxiety is measured indirectly by self-report forms (Maccoby and Jacklin, 1974).

The Manifest Anxiety Scale was the first pencil and paper measure of anxiety and is still used today (Taylor, 1953). Taylor drew 50 items from the Minnesota Multiphasic Personality Inventory (MMPI) for the Manifest Anxiety Scale (MAS). One of the assumptions of the MAS is:

> that the intensity of this anxiety could be ascertained by a paper and pencil test consisting of items describing what have been called overt or manifest symptoms of this state. (p. 285)

That the MAS could measure adequately the effects of anxiety in any situation was questioned by Alpert and Haber (1960), among others. Mandler and Sarason, (1952), concerned about the effects of test anxiety, developed the Test Anxiety Scale (TAS). The implication of such a scale, say Alpert and Haber, is that "... increased situational specificity of its item content will allow for a more sensitive measurement of anxiety and its effect in the academic achievement ..." (p. 208).

Such specificity is found in Alpert and Haber's Achievement Anxiety Test (AAT, 1960). This test was designed to measure the facilitating and debilitating aspects of anxiety.

In the early 1960's the Mathematics Study Group (MSG) felt a need to define anxiety specifically for the National Longitudinal Study of Mathematical Achievement (NLSMA). Teams of mathematicians, mathematics educators, psychologists and statisticians developed the NLSMA scales

for measuring mathematics attitudes in elementary, junior high and high school populations. The scales were pilot studied and revised before being administered to the three populations. In the high school population the attitude scales were evaluated by previous achievement, i.e., the students had or had not had geometry. Thus, the NLSMA provided a standard of reference for measures in mathematics (Dessart and Fransden, 1973, p. 1190).

The NLSMA desired not only the specificity of anxiety in its helpful and harmful aspects but the specificity that comes from subject specification. The Math Inventory is such an instrument. It is a Likert scale which asks the individual to respond to a series of statements by indicating whether he strongly agrees, agrees, disagrees, or strongly disagrees with the statement. A point value for positive statements of 4, 3, 2, 1 is assigned to the responses. For negative responses the values are reversed, i.e., 1, 2, 3, 4.

Two years were spent developing the NLSMA Math Inventory for the longitudinal study which ran from 1962 to 1967. With each revision, three criteria were used for the items: (1) face validity; (2) group statistics, i.e., variation approximating a normal distribution; (3) internal consistency (Crosswhite, 1968, p. 29). Additionally, significant correlations were found with grades, achievement, I.Q.,

and other personality variables. "The attitude scales appeared to be valid indicators of a student's behavioral reaction to mathematics" (Crosswhite, 1968, p. 29). Reliabilities for the anxiety scales are in the .80's (Wilson, Cahen, and Begle, 1968, pp. 162-165). In selecting aptitude measures for specific mathematics anxiety there were no measures which equaled the Math Inventory for specificity, reliability and validity.

In summary, general and specific anxiety scales measure something different from one another. The choice of measure depends upon the purpose of the study.

The Interrelationships of Anxiety and Other Variables

This section will discuss the research and expository literature related to anxiety and each of the variables in this study. The operational definitions of these variables will not be presented until the next chapter, Procedures. The variables are divided into cognitive, affective and demographic variables.

Cognitive Variables

The two cognitive variables in this study are intelligence and prior achievement. Neither was included in Phase I, but both were included in Phase II for control of individual differences in cognition. Liddell (1949) has stated that anxiety accompanies the intellect as its shadow.

Since the turn of the century, intelligence has been considered the "universal cognitive entry behavior" in pre-college years as well as later (Bloom, 1976, p. 5). It is also accepted that mathematical achievement and intelligence correlate highly (e.g., Logue, 1977). As suggested in Phase II, they may correlate so highly that they are actually measuring the same thing. Aiken's (1971) historical review of mathematics ability includes the belief that there is a "math-type", i.e., those high in mathematics are high in general intelligence. In Rappaport's (1977) investigation of the effects of cognitive style among 490 community college subjects randomly assigned to computer-based versus lecture classes in beginning algebra, the discriminant analyses revealed that prior achievement and intelligence were the most important variables in achievement and course completion in either mode of instruction.

The relationship of intelligence to anxiety, however, does not appear to hold so consistently. Kerrick (1955) found that anxiety scores correlated significantly and negatively with all measures of intelligence or aptitude administered to anxious subjects. He reported that "... it is virtually impossible to select extreme subjects on the Taylor scale who are equated in intelligence" (p. 77). Two possible interpretations were offered; (a) persons of lower intelligence are more prone to anxiety, or (b) anxiety may de-

press scores on intelligence. The latter was considered more plausible. McKeachie and Linn (1968) found an inverse relationship between intelligence and anxiety. Likewise, Speilberger (1966) reported that achievement evaluations (grades) among the very bright students were higher for those with high anxiety than the very bright with low anxiety. In an earlier study, Speilberger (1958), tested the relationship of manifest anxiety and intelligence with college freshmen and reported the relationship of manifest anxiety to intelligence was not significantly different from zero. When Speilberger and Katzenmeyer (1959) separated intelligence into high, average and low ability, they found that college grades varied inversely with the anxiety level for average intelligence and that high ability students received good grades irrespective of their anxiety level. However, college work appeared to be too difficult for low ability subjects whose poor grades were unrelated to their anxiety scores (p. 425). Still later, Harleston (1963), in a study of intelligence, anxiety, and task difficulty found that the relationships between anxiety level and ability level did not receive support. From these studies it would seem apparent that there is variability in the relationship of anxiety to intelligence from group to group.

Prior achievement in this study is used as a standardized measure for a base line for each student. In Phase II,

the range of prior achievement was eight full grades, third grade sixth month to eleventh grade sixth month as measured by the Wide Range Achievement Test (Jastak and Jastak, 1978).

These figures are astounding when one considers that individuals are generally thought to reach the stage of formal operations (a capability for abstract thought and reasoning) by ages 11 to 15. This stage, however, may neither be attained nor maintained by all individuals. Thibodeau (1980) hypothesizes that the majority of adults operate at the concrete level. Although Piaget has maintained that the sequence of stages of cognitive growth is fixed, the rate may vary from one individual to another. It was in 1972 that Piaget raised the upper limit for the development of formal operations to age 20. Further, he said, all normal individuals can reach formal operations by age 20, but they may reach it in different content areas which are consistent with their individual aptitudes and specializations (1972, p. 11). Flavell, (1977), agrees with Piaget that the specifics of a content area are likely to contribute significantly to the adult's cognitive performance.

Early cognitive achievement in school has a powerful effect on subsequent achievement (Bloom, 1964, p. 41). In a longitudinal study, Bracht and Hopkins (1972) found that 81 percent of grade eleven achievement is predictable from grade seven achievement. Also, Bloom (1976) states that by grade

three at least 50 percent of the general achievement pattern at grade twelve has been developed. When one considers that five and one-half percent of the first graders may begin school with an arithmetic disability (Poteet, 1970; Webster, 1977) it is not surprising to find an eight-year range of achievement in adult remedial mathematics (Stark, 1979; Tarnopol and Tarnopol, 1979). This range of achievement and the powerful predictability of early achievement lends credence to Rappaport's (1977) recommendation for control of prior achievement as well as intelligence in affective research

Affective Variables

Self-concept is measured by the two NLSMA scales of actual mathematics self-concept and ideal mathematics self-concept. Actual mathematics self-concept (ASC) is a measure of how the student sees himself in relationship to mathematics; ideal mathematics self-concept (ISC) is a measure of how the student wishes he were in relationship to mathematics.

Attitude is the most important predictor of achievement (Aiken, 1976; Webb, 1972). Usually, low but significant correlations among measures of mathematics attitudes and mathematics achievement have been reported in elementary, secondary and college studies (e.g., Crosswhite, 1968; Edwards, 1972; White, 1972; Wilson, 1973). According to Bloom

(1976) affect may contribute 20 percent of the variance in achievement and subject-related affect may account for a much greater amount (p. 85). The long-term effects of attitude on mathematics has been reported by Begle:

> ... attitudes towards mathematics seem to be rather favorable at the beginning of fourth grade and improve slightly during the remainder of elementary school. However, at the beginning of junior high school, student attitudes towards mathematics begin a slow but steady drop that continues to the end of high school (1973, pp. 212-213).

Stark (1979), later, reported that the drop continues in a remedial algebra sample in an Illinois community college.

The linkage between anxiety and self-concept is a most interesting finding (Epstein, 1976, p. 185).

> Holding all other factors constant, some people are more apt to face the implications of threatening stimuli than others because of direct training and development of a value system which regards facing challenges from within and without as desirable (p. 193).

Further:

> Increases in self-esteem produce increases in feelings of happiness, integration, energy, availability, freedom and expansiveness. Decreases in self-esteem produce increases in ... anxiety (p. 208).

And also:

> The most prevalent sources of both positive and negative changes in self-esteem for both males and females were experiences in which competence or acceptance were involved with the two being of about equal importance for the combined group (p. 208).

Additionally, mathematics attitude (as measured by the Mathematics Attitude Survey by Aiken and Dreger) has been reported

independent of developmental mathematics course completion; however, the higher the self-concept, the more likely the student is to complete the course (Kimes, 1973).

The fact that the emotional factor "... that includes low self-esteem [and] anxiety ... has not previously been observed is that the appropriate variables were not included" (Epstein, 1976, p. 222). Four studies (NLSMA, Phase I, Phase II, and Lekarczyk and Hill, 1969) have investigated both self-concept and anxiety which in a combined affect is termed "school anxiety" by Phillips (1978). In his factorial analysis of 74 items constituting school anxiety, four factors emerged as significant indicators: (1) fear of assertiveness and self-expression; (2) test anxiety; (3) lack of confidence in meeting expectations of others; (4) physiologic reactivity associated with tolerance of stress (p. 28). These factors are consistent, for example, with Sartre's definition of anxiety as the fear of failure to meet some internalized value or standard, with Kierkegaard's desire for what one dreads and Epstein's note that anxiety is related to disappointing significant others.

Demographic Variables

Since sex and age are two frequently used variables in mathematics research, they are used in this study as control variables. Sex and age differences in mathematics are

consistently reported by early adolescence, and those differences favor the boys (Maccoby and Jacklin, 1974). This pattern may change in early adulthood where Archer (1978), in an ex-post facto study, reported that males failed developmental mathematics at a higher rate than females (p. 84). This might indicate that there are other characteristics which interact with sex and achievement. It may be that the relationship is not a linear one when age is also investigated.

Not only does achievement appear to curve downwards for females from adolescence onwards but also the decline in attitude towards mathematics parallels achievement (Crosswhite, 1971; Maccoby and Jacklin, 1974). Sarason suggests that the more depreciated attitude scores for girls may be a willingness to admit feelings. Maccoby and Jacklin (1974) counter such an argument with "... the scores might be just as much a function of the scales as of the girls' greater readiness to disclose [their feelings]" (p. 186). Perhaps both are true.

Sex and anxiety have been the subject of not only professional journal articles but newspaper (Chicago Sun Times, November 21, 1979) and magazine features (Ms., September, 1976). Tobias, (1946) referred to math anxiety as "a condition that disproportionately affects females" (p. 56) and, further, "... there is no question that math anx-

iety is a significant handicap for most women ... If we could develop a cure for math anxiety and 'bottle' it up for women [they] would show increased self-realiance and with it increased self-esteem" (p. 92).

Edith Luchins, in an invited address before the Mathematics Association of America meeting in 1978, told the association:

> ... differences in attitudes toward mathematics ... may be more influential than sex differences ... [There is a need to] consider concrete changes that can be made in methods of teaching ... to take into account sex differences in mathematical achievement, attitudes and interests (p. 167).

The other demographic variable in this study, age, is in itself, only a time marker. With the passage from adolescent to adult thought, it is not possible to generalize intellectual development from one subject or one environment to another (Piaget, 1972, p. 7). Except for the Phase I and Phase II studies mathematics studies have generally used students of similar ages. In an analysis of the earlier research, no significant differences were reported between sexes and anxiety and sexes and self-concept. The same was true with the six age categories (18-19; 20-24; 25-34; 35-44; 45-54; 55-64). Regardless of the discrepancy between the community college findings (Phase I, Phase II) and the reports of sex differences in mathematics (e.g., Maccoby and Jacklin, 1976), it may be that further replication with more

control will clarify the differences.

Student Participation

Ever since the days of Plato, educators have searched for the "best" method of instructing students. Today, it is accepted that there is no one best method for all students. Researchers today are asking the question: For which student characteristics is a method best?

Although a considerable list can be made of treatments used in past studies, Dowaliby and Schumer (1975) found that all approaches could be reduced to two by considering the amount of structure offered in the classroom, i.e., whether or not the class was teacher-centered or student-centered. The former followed a lecture, teacher-dominated plan; whereas, the latter had a discussion, student-dominated plan. The Dowaliby and Schumer study used 69 junior college students in an introductory psychology course. Anxiety was measured with the MAS and intelligence was controlled. They hypothesized that anxiety might be differentially related to course structure. The results supported the hypothesis: the teacher-centered mode of instruction optimized learning for high anxious students; the student-centered approach optimized learning for the low-anxious students.

In addition to the above structure, Peterson (1977) found that the amount of student participation interacted

with the level of student anxiety and ability to optimize learning differentially. The study was made with four sixth grade social science classes taught by the same teacher. Peterson found that when ability was held constant the effects for structure were mixed: subjects with high anxiety and low ability did their best in low structure; whereas, high anxiety with high ability showed a decrement with low structure. When structure was combined with level of participation (high vs. low), the high anxious/high ability subjects did less well with low structure/low participation. This is the mode which optimized learning for the low anxious/high ability and high anxious/low ability. Peterson suggested that "... perhaps high anxious/low ability students are paralyzed and frustrated by situations like the high structure/low participation classes because the teacher tells them what they should be learning and doing ... and the low ability students think they cannot do it" (p. 88).

Although the literature did not appear to contain references to this approach to instruction with remedial students, the strong interactions in both the Dowaliby and Schumer (1975) and Peterson (1977) studies indicate that instruction differentiated by level of anxiety may be effective. It must be remarked that the general method descriptors used in Pahses I and II did not reveal any significant differences. This might be attributed to what Charters and

Jones (1973) refer to as a nonevent which occurs when "... differences between what researchers regard as 'experimental' and 'control' programs are more fictional than factual ..." (p. 5). The researcher found that this was true of the traditional vs. non-traditional in Phase I as well as the traditional vs. self-paced in Phase II. Nevertheless, conclusions in the Dowaliby and Schumer (1975) and Peterson (1977) studies indicated that student participation has potential for maximizing treatment in a remedial algebra class. Further, Aiken (1976) included the following conclusion in his update on research in mathematics attitudes:

> most important from the standpoint of potential influence on students' attitudes toward mathematics are investigations of the classroom behaviors and techniques employed by teachers. (Aiken, 1976, pp. 302-3).

The instructional treatment in this study includes two levels of student participation with the same instructor in both experimental groups. The use of one instructor removed the teacher effect prevalent in other studies. To control for foreseeable limitations of using one teacher for both groups, low inference measures of the treatment from the perspectives of students, instructor and researcher. Further description of these controls will be presented in the next chapter.

Summary

In the first section of this chapter, a theoretical overview of anxiety was briefly presented through several

disciplines: philosophy, biology, psychology and psychoanylytic theory. The anxiety construct was explored in detail because it formed the theoretical foundation for the quasi-experimental treatment used in this study.

The two subsequent sections discussed research which related to the differentiation and measurement of general and specific anxiety and most specifically to mathematics. Although each measure has its uses, the Alpert and Haber argument for measurement of mathematics specific anxiety is strong.

The remaining section reported the relevant research related to anxiety and each of the variables in this study. While many of the previous studies contribute to the understanding of the inter-relationships of the variables, they tend to raise questions which can only be answered through a controlled study in actual mathematics classrooms. As the next chapter indicates, this research answers the need for a controlled study of the effects of anxiety on achievement among higher educations newest students, the remedial adult, in two levels of student participation.

CHAPTER III

PROCEDURES

The present chapter presents the setting, the population, the sample, the instruments, the data collection procedures, the statistical methods, the hypotheses and a summary. Test instruments which have already been discussed will be limited to the advantage/disadvantage and the reported validity/reliability of each. Abbreviations and analyses of Phases I and II data are located in the Appendix.

The Research Setting

This study is set in an urban community college on the north side of Chicago. It is located on a busy thoroughfare near elevated tracks. It is a new structure which shows no signs of abuse. Classrooms are clean, well-lit, and have adequate seating.

The community from which this college draws its students is lower middle to lower in socioeconomic status. It is a racially mixed neighborhood. It is predominantly black and Puerto Rican, with a mixture of Vietnamese, Russian-immigrant Jews, Iranians on student visas, other minorities, and whites.

The Population

Community colleges draw, principally, from the com-

munity they serve. The Phase II study indicated that there were no significant differences among remedial urban, suburban and rural community college students on school characteristics. This conclusion supported the earlier community college study by Martens (1976). Thus, no effort was made to collect background data on this research sample. Nevertheless, since remedial algebra students may differ from any general descriptions of college students and community college students in particular, a brief summary of the student descriptors from Phase II is presented. A random sample of the 1979 subjects was used in the present study as a control group. (Additional 1979 subject data is located in Appendix D).

Phase II descriptive data is summarized briefly: Males and females are about equally represented in some schools, but overall, there appear to be more women. All ages from 18 to 55-and-over are represented, but the greatest numbers are in the 18-19 age group and the 20-34 age group. Most of the students have graduated from high school; some have completed by GED and others have not completed high school. Most of the students plan to take an associative degree, but there are those who plan professional degrees. Most of the students take remedial algebra because they need a credit course in mathematics and need the remedial course to prepare themselves for it. Most students have full-time jobs

of 40 hours and more; those who have a day class tend to have evening jobs and vice versa. Almost all of the students choose the particular class because it is the only section that fits their work schedule. Most students have chosen to take the course on their own, but others have been encouraged to do so by school personnel. In response to the question regarding the students' expectations of the teaching approach being "good" for their way of learning, almost all of the students agree their teacher's method is "best" for them.

In *t*-tests of the means there were no significant background differences among the students. However, since sex is generally of interest in mathematics achievement and age is of current interest in adult education, these two variables are included in the present study.

The Sample

The subjects in this study are the students assigned to each class by computer according to each student's course selection and choice of class time. The students had three choices, two of which were day classes with the same female instructor. The class not used in this study was an evening class with a male instructor and different instructional materials. Since the effects of different instructors, materials and time of day were not of interest in this study, the researcher chose the two back-to-back classes (8:00-9:30 a.m. and 9:30-11:00 a.m.) at Harry Truman Community College.

Table 1

Frequency Statistics for Sex, Age, Groups

		Absolute frequency	Relative frequency	Cumulative frequency
Sex	male	31	44.3	44.3
	female	39	55.7	100.0
Age	18 - 19	23	32.9	33.8
	20 - 24	18	25.7	60.3
	25 - 34	10	14.3	75.0
	35 - 44	14	20.0	95.6
	45 - 54	3	4.3	100.0
	missing	2	missing	(Above adjusted for missing cases.)
Group	Treatment Experimental	26	37.1	37.1
	Treatment Control	16	22.9	60.0
	Random Control	28	40.0	100.0
	Treatment Experimental	26	37.1	37.1
	Controls Combined	44	62.9	100.0

The researcher's observations of the subjects indicated that both classes were mixed racially. There were no physically handicapped or blind students.

Although selection of experimental subjects for this study was non-random, the existing computer-assignment system was not expected to result in classes which differed systematically from one another. A flip of a coin designated the first period class as the experimental high student participation group; the second hour, then, became the low student participation control group. (It is the latter instructional treatment which is the natural mode for the instructor.) The first group is known as T Exp (experimental treatment); the second group as T Cont (control treatment); and the Phase II group as R Cont (random control). The Table below indicates the distribution of subjects.

Table 2

Distribution of Subjects in Groups 1, 2, 3

	Group	Absolute frequency	Relative frequency
T Experimental (1st hour)	1	26	37.1%
T Control (2nd hour)	2	16	22.9%
R Control (Phase II)	3	28	40.0%
	Total	70	100.00%

The Instruments

The aptitudes and achievement measures in this study are all standardized instruments which have been used in previous research. The selection of instruments was based on the particular advantage, reliability and validity of each instrument.

The NLSMA Math Inventory.

This battery has been discussed in the review of literature; therefore, this section is limited to scale definitions, sample items and the reported reliabilities and validities. The main advantage of using these scales is that they have been developed by a team of experts specifically for mathematics. In addition, comparative statistics are available for high school students who have not had geometry as well as a large group of community college students (Phase Two) who were also remedial algebra students. If a disadvantage exists, it may be that math anxiety could be further classified into test anxiety or participation anxiety.

The reliability coefficients reported for the NLSMA scales in this study range from .71 to .87. The lowest was facilitating anxiety (.71) with all of the others in the 80's (debilitating anxiety, .86; ideal mathematics self-concept, .80; actual mathematics self-concept, .81). The Phase Two research reported reliabilities for the same scales between

.59 and .81. Differences in reliability coefficients may be caused by the smaller sample sizes in the community college samples. However, these reliabilities are considered adequate for this study. A table of other statistical properties of the four scales of the NLSMA Math Inventory is found in the Appendix.

The team of experts who analyzed the pilot tests of each scale reported satisfactory construct validity at all age levels for the NLSMA.

Facilitating anxiety is described as the degree to which mathematics performance is facilitated by stressful conditions (e.g., tests, being called on in class). A sample item is given below (NLSMA Reports Number 6, p. 162).

EXAMPLE: I keep my mathematics grades up mainly be doing well on the big tests rather than on homework and quizzes.

(A) always (C) sometimes (E) never
(B) usually (D) hardly ever

Debilitating anxiety is described as the degree to which mathematics achievement performance is harmed by stressful conditions (e.g., examinations, being called on in class). A sample item is given below (NLSMA Reports Number 6, p. 1).

EXAMPLE: When I have been doing poorly in mathematics, my fear of a bad grade keeps me

from doing my best.

(A) never (C) sometimes (E) always
(B) hardly ever (D) usually

Self-concept in mathematics refers to the way the student sees himself in mathematics (actual) and the way he wishes he were in mathematics (ideal). A sample item of Actual Mathematics Self-Concept is given below (NLSMA Reports Number 6, p. 166).

EXAMPLE: I find it hard to talk in front of my mathematics class.

(A) strongly agree (D) mildly disagree
(B) agree (E) disagree
(C) mildly agree (F) strongly disagree

A sample item of Ideal Mathematics Self-Concept is given below (NLSMA Reports Number 6, p. 158).

EXAMPLE: I wish it were easier for me to talk in front of my class.

(A) strongly agree (D) mildly disagree
(B) agree (E) disagree
(C) mildly agree (F) strongly disagree

Quick Word Test

The Quick Word Test (QWT) is an untimed test of 100 vocabulary items, each of which has four possible choices. The subject marks the word which has most nearly the same

meaning as the first word. The test is self-administering and usually takes eight to ten minutes to complete. The QWT correlated .84 with the WAIS on a male adult sample (Borgatta and Corsini, 1960) and .78 with the Kuhlman-Anderson test (Borgatta and Corsini, 1960). In a national survey of university adult education students (N = 4, 563), Groteluseschen and Knox (1967) reported significant Pearson r's between the QWT and college credits completed, age and occupational status (all correlations were significant, $p < .01$). Their extensive report of the results of an analysis of the QWT and data collected from a large sample, led them to conclude that the QWT is "... a very reliable and seemingly valid estimate of adult mental ability" (p. 175). Analyses with sub-sets of as few as 15 QWT items have shown correlations greater than .60 with the WAIS (Borgatta and Corsini, 1960).

An unusual feature of the QWT is the "blocks" of words. The words are assembled in such a way that each block of five words is approximately equal in overall difficulty, i.e., the first block is no more or less difficult than the last block. This helps to keep the interest of the subjects to the end of the test.

The rationale for selecting an untimed verbal rather than a performance test for a measure of intelligence includes the following: (1) timed tests calling for visual acuity or motor performance are susceptible to decline as age increases

(Corsini and Fusseth, 1953); (2) speed-power test scores decline with age (Long, 1980); and (3) verbal aptitude may be age-resistant (Knox, 1977).

Wide Range Achievement Test (WRAT) - Arithmetic, Part II

The WRAT is used in this study as both a pretest and a posttest. It is a computation test ranging from simple addition of two columns of two numbers to square roots. There are no word problems. It is a ten-minute timed test in which all calculations and answers are written on the test itself.

The WRAT was first introduced in 1936, and since then has been used in many and varied fields in which an easily administered and scored test of academic achievement is desired. It has been the test of choice among special education diagnosticians for many years (Bannatyre, 1978).

The authors, Jastak and Jastak, point out that the standardization of the 1978 norms was not based on a representative sample but that they do not consider "... such a sampling essential for proper standardization" (Jastak and Jastak , 1978, p. 43). Thorndike (1972) has questioned the standardization. Grade equivalents, the authors purport, "... are very valid and reliable indicators of achievement" (Jastak and Jastak, 1978, p. 1).

Although the WRAT is widely used here and abroad, by psychologists, reading specialists, neurologists, counselors

and others, the reliability of the WRAT based on split-half coefficients is "inflated" due to the timed aspect of the test (Merwin, 1972). The validity, too, has been questioned. Salvia and Yeseldyke (1978) believe the WRAT has no content validity, i.e., there are too few samples of skills in each of the arithmetic content areas. Silverstein (1978) has recently reported that the WRAT norms under-estimate a subject's achievement level.

Even with the questions raised regarding the standardization procedures and deflated grade equivalents, the WRAT was selected for the criterion test since it appeared to be the best test available which required no reading, was limited to the skill of computation, provided norms to age 65 and has a history of usefulness in measuring arithmetic ability among disabled subjects. The cautions associated with the test will be considered in the results.

Data Collection Procedures

The instruments were collated and number coded by the researcher and also administered by the researcher during the first full week of school. The hesitance of administrators and teachers to give up class time, necessitated using the first part of two separate days. This also allowed a make-up day for those who were absent on the first day. No additional make-ups were allowed. The posttest was given the

day before the final examination along with a three-question evaluation regarding the participation. (This consideration was made at the request of the instructor who wisely felt the students would do better the day before than to have a longer testing period the last day.) Although the numbers in this study are small, the deletion of missing information was not believed to constitute any systematic bias or loss of randomness (to the extent that assigning students to classes by computer from registration sheets is random assignment).

Collection of data on the treatment was done by instructor's daily diary, three classroom visitations by the researcher to tally each of the three criteria for treatment, and a Likert-type questionnaire for the students to complete regarding the three criteria (See Appendix B).

Only that background data which students willingly filled out on the test sheets was used in this study. It consisted of sex and age categories.

The Statistical Method

This section contains the operational definitions, model of the study, statistical analysis, and hypotheses. This section is followed by a chapter summary.

Operational Definitions

For the purpose of this study: (1) The student's facilitating anxiety is defined by the student's score on the NLSMA Math Inventory sub-scale Facilitating Mathematics Anxiety. (2) The student's debilitating anxiety is defined by the student's score on the NLSMA Math Inventory sub-scale Debilitating Mathematics Anxiety. (3) The student's actual mathematics self-concept is defined by the student's score on the NLSMA Math Inventory sub-scale Actual Mathematics Self-Concept. (4) The student's ideal mathematics self-concept is defined by the student's score on the NLSMA Math Inventory sub-scale Ideal Mathematics Self-Concept. (5) The student's verbal intelligence is defined by the student's score on the Quick Word Test. (6) The student's prior achievement is defined by the student's score on the Wide Range Achievement Test -- Arithmetic, Part II. The student's criterion score is defined by the student's score on the posttest of the Wide Range Achievement Test -- Arithmetic, Part II. (7) Participation is defined by the specifications below which are based on the Peterson (1977) study.

Table 3 : Specifications for Two Levels of Student Participation

High	Low
1. Teacher has student give review of previous day's lesson.	1. Teacher gives review of the previous day's work.
2. Teacher uses student responses to signal transitions.	2. Teacher signals for transitions.
3. Teacher asks student to summarize important points.	3. Teacher summarizes during the lesson.

Since the treatment, student participation, is considered an intervening variable between the aptitudes and criterion variable, it must be noted that low inference measures were instituted for its control. These measures, which will be further described in the next chapter, consisted of pre-training of the instructor, a diary kept by the instructor, on-site observations by the researcher and an end-of-the-course short Likert-type instructional evaluation by the students.

Model of the Study

The model used in this study is based on Bloom's Model of Human Learning (1976, p. 18). However, the model has been enlarged to include demographic characteristics and

student participation as the intervening quality of education. The entry characteristics are all considered independent variables.

Student Entry Characteristics	Quality of Instruction	Learning Outcome
	Level of Participation	
Cognitive:	Two levels:	Achievement
intelligence		
prior achievement	High	
Affective:	Low	
Anxiety		
facilitating		
debilitating		
Self-concept		
Actual		
Ideal		
Demographic:		
Sex		
Age		

Figure 3. Model of the study

According to this model, the criterion variable, achievement on a standardized achievement test, is dependent on the extent to which the quality of instruction, (level of participation) is appropriate for the student's learning history in mathematics, his entry characteris-

tics. Using the Cronbach and Snow (1977) interpretation, aptitude is "any characteristic of a person that forecasts his probability of success under a given treatment" (p. 6). This model includes sex and age which have been reported to be characteristics of remedial adults which could affect achievement by amount of student participation (e.g., Archer, 1978).

Statistical Analyses

The questions posed in Chapter I require both bivariate and multivariate analyses. Correlational methods were chosen to relate the aptitude measures to achievement. Pearson-Product Moment correlations were computed for each pair of variables. Partial correlations were used to discern the effects of each variable on the total pattern of aptitude-achievement relations by level of participation. Finally, a step-wise regression analysis was computed for the prediction of achievement. This section briefly discusses the use of bivariate and multivariate analyses in this research.

Bivariate

The first step in the analysis of data was the correlation of each of the pairs of variables: gain scores, posttest scores, pretest scores, IQ, debilitating anxiety, facilitating anxiety, ideal mathematics self-concept, actu-

al mathematics self-concept, sex and age. These correlations were computed by combining the 70 students into one group. The correlations were examined to find which were significant at the .05 level. A significance level of .05 was chosen despite Rosenshine and Furst's recommendation that "it does not seem to be appropriate for investigators to limit themselves to any given level of statistical significance ..." (1971, p. 63). The .05 significance level permitted the researcher to identify the most important relationships among the variables under investigation.

The squared correlation (r^2) was computed. It is interpreted as the proportion of the variance held in common by the two variables, just as $1 - r^2$ is interpreted as the proportion of the variance which the two variables do not share. This interpretation is based on the assumptions that the sample is large and that the relationship between the two variables is linear (Edwards, 1976, p. 45).

The criterion variance was then tested through the regression program. In simple bivariate regression analysis the values of the criterion variable (achievement) are predicted from a linear equation:

$$Y' = A + Bx$$

where Y' is the estimated value of the dependent variable; A is the intercept, the point on the y-axis which locates the predicted value of y when $X = 0$; B is the regression co-

efficient by which each x value is multiplied and represents the change expected in the y variable with a one unit change in X. The predicted values will all fall along a regression line or line of best fit. The difference between the predicted values (Y') and the actual values (Y) is the residuals or errors in prediction (residuals = Y - Y'). The sum of squares (SS) can be partitioned into the part due to regression and that part which is unexplained (residuals).

$$(Y - \overline{Y})^2 = (Y' - \overline{Y})^2 + (Y - Y')^2$$

A measure of prediction accuracy and reliability was computed by taking the square root of the ratio of explained variance in Y to the total variance ($r^2_{xy} = \frac{SS_y - SS_{res}}{SS_y}$). This is known as the Pearson Product-moment correlation.

Multivariate

Since this study was interested in the relationship of mathematics achievement and anxiety with levels of student participation, a multiple regression analysis was chosen to provide control over the inclusion of a number of independent variables, i.e., the selected student entry characteristics. The Statistical Package Program for the Social Sciences (SPSS) multiple regression analysis subprogram (Kim and Kohut, 1975) was used to combine standard multiple regression and stepwise procedures.

The multiple regression technique was used to find the best linear prediction equation and to evaluate the con-

tribution of anxiety and intelligence on achievement by level of student participation. Partial correlations were used to compute the effect of one independent variable on another while holding a third variable constant. The advantage of this statistical procedure is that the partial regression coefficient between the dependent variable and the residuals of an independent variable is not confounded with the effects of other independent variables. This was of interest in this study where the separate and combined effects of aptitudes on achievement is desired. Thus, multiple regression analysis was used in this study to evaluate overall contributions of the aptitudes on achievement and the relationship of a particular aptitude with the influence of other aptitudes controlled.

In the stepwise regression analysis the independent variables were entered one by one. The order was determined by the contribution of each variable to the total achievement variance. The computer was programmed to enter the variable from best to worst, i.e., from the aptitude accounting for the greatest share of the variance to the one accounting for the least amount of variance. The F ratio was also computed in a test of significance of the regression coefficient.

The Hypotheses

The following four hypotheses are all in the null form and are derived from the research questions posed in Chapter I:

(1) There is no significant relationship between specific mathematics anxieties and achievement.

(2) Anxiety has no linear effect on achievement once the effects of the other independent variables are adjusted for.

(3) There is no significant relationship between mathematics self-concepts and mathematics anxieties.

(4) There is no linear relationship between achievement and the set of entry characteristics.

Summary

This chapter has presented the procedures which were used to investigate the research questions. All of the questions were concerned with the effects of certain aptitudes on achievement with different levels of student participation.

The sample of students in the two levels of student participation were summer school remedial algebra students at Harry Truman Community College. The random control group of students was composed of 28 of the 574 students in the Phase II research. The high level of student participation was the experimental group of 26 subjects; the low level of student participation was a group of 16 subjects, another control group.

The instruments used in the research were all standardized tests which although they had their disadvantages

appeared to be the most appropriate for older subjects who may or may not have other learning problems besides arithmetic.

The data collection procedures were kept as simple as possible so as to minimize time away from classwork. It has been this researcher's experience that community college students, unlike some elementary and secondary students, guard their class time.

The statistical methods consisted of both bivariate and multivariate techniques. Pearson-Product Moment Correlations analyses of variances, partial correlations and stepwise regression analyses constituted the major programs used to evaluate the data.

The data was evaluated to answer the research questions asked in the first chapter. All of them were concerned with the effects of aptitudes on achievement under different levels of student participation.

The following chapter presents the results of the analysis and draws some conclusions from it. The last chapter in this dissertation will present some considerations for follow-up studies with the same or similar samples.

CHAPTER IV

RESULTS

Research questions emerging from the literature were developed in Chapter II. The method of study and research questions restated as null hypotheses were presented in Chapter III. This chapter includes the results of the investigation. The final chapter evaluates the study in relation to its purpose and suggests applications of its findings.

The first analysis, the correlational, studies the sample without regard to the group. The second analysis, the analysis of variance, separates the sample into three groups: the Harry Truman Community College students receiving high student participation; the Harry Truman Community College students receiving low student participation, a control group for the high student participation; and a random group from Phase II who had received low student participation. Finally, the regression analyses used the entire group, but where appropriate, contrasts were introduced to separate group effects: Contrast 1 consisted of the high student participation vs. low student participation; and Contrast 2 consisted of the students at Harry Truman Community College vs. the random control group.

The conclusions drawn at the end of the chapter at-

tempt to relate the effect of student participation and specific student anxiety to achievement on a standardized arithmetic achievement test. The analysis of data which follows will include only those statistics which relate to the discussion. Summaries of data are presented in the Appendix.

Analysis of Data

Correlational

Correlational analyses were made to determine the extent to which pairs of variables in this research vary concommitantly. From these analyses the extent of covarying of the variables as well as the direction of the relationships was derived. A value close to 0 has little value, but as the correlation (r) approaches either -1 or +1 there becomes a stronger and stronger linear relationship between the variables. When r is squared, the result is the percentage of variance shared by the two variables. In the following discussion each variable is presented separately. Pearson-product moment correlations were made between variables. A second correlational analysis consisted of partial correlations which controlled for the effects of IQ and age.

Pearson Product Moment Correlations

The two earlier phases of research indicated that more females were enrolled in remedial mathematics than

males but that no difference in posttest results involved sex differences. The literature on mathematics and sex indicated a disadvantage for females (e.g., Luchins, 1979; Maccoby and Jacklin, 1974). In this study, none of the achievement correlations with sex are significant. However, the negative gain score indicates a slight but significant trend ($p < .05$) toward higher gain scores for females.

Other negative trends in the correlations with sex were: age, -.0293, $p = .419$; facilitating anxiety, -.1519, $p = .144$; ideal self-concept, -.1766, $p = .108$; actual self-concept, -.1527, $p = .142$. Approximately 2 percent of variance between each of these variables was accounted for by sex; however, that was not significant at the .05 level or higher. All in all, there are no significant correlations with sex, but the negative direction of the relationship indicates a higher facilitating anxiety and lower debilitating anxiety for female as well as higher mathematics self-concepts for females. This is not the trend in the research literature.

Age was not expected to have an effect on verbal intelligence. The shared variance between age and IQ was less than one percent. Age had its strongest relationship with the self-concepts. Both Ideal and Actual Mathematics Self-concept were significantly related to age ($p < .01$). Age accounts for close to 20 percent of the variance in Actual Mathematics Self-concept. This was a positive correla-

tion indicating that as age increased so did Actual Mathematics Self-concept.

Almost 70 percent of the variance in the posttest is accounted for by the pretest ($r = .8355$, $p = .001$). Over 20 percent of the variance in the pretest is shared with IQ ($r = .4566$, $p = .001$). At a lesser level of significance ($p \leq .05$), both mathematics self-concepts share a negative relationship with the pretest (actual, $r = -.2990$, $p = .017$; ideal, $r = -.2776$, $p = .024$). It appears that the higher the pretest scores the lower the self-concepts whether actual or ideal. They accounted for 9 and 8 percent of the shared variance, respectively, with the pretest.

The posttest correlations are almost the same as the pretest correlations, only they are stronger. IQ accounts for almost 32 percent of the variance in the posttest. The mathematics self-concepts and the posttest continue to maintain a negative direction, but it is stronger (posttest and Actual Mathematics Self-concept, $r = -.3276$, $p = .009$; posttest and Ideal Mathematics Self-concept, $r = -.2824$, $p = .022$).

Again, the gain scores significantly correlate with the posttest and IQ. However, it is the direction of the relationships with the self-concepts and anxieties that is of interest. Both self-concepts continue a negative relationship with gain scores just as debilitating anxiety does.

The facilitating anxiety has a positive relationship with gain whereas it had a negative relationship with both the pretest and the posttest. This suggests a very slight trend ($r = .0660$, $p = .323$) toward higher gains with higher facilitating anxiety even though this correlation is not significant.

In addition to the significant correlations of achievement and IQ, discussed above, facilitating anxiety and the mathematics self-concepts were significantly correlated with IQ (facilitating anxiety and IQ, $r = -.3380$, $p = .008$; ideal self-concept, $r = -.4404$, $p = .001$; actual self-concept, $r = -.4814$, $p = .001$). All of these negative correlations indicate that the higher the verbal intelligence score the lower the facilitating anxiety and self-concepts.

The only significant relationship with this aptitude is facilitating anxiety ($r = -.6235$, $p = .001$). Almost 40 percent of the variance in debilitating anxiety is shared with facilitating anxiety. This negative correlation is to be expected. Although these scales were separate on NLSMA, they do tend to measure test anxiety; facilitating anxiety, positively and debilitating, negatively.

In addition to the relationships discussed above, Ideal and Actual Mathematics Self-concept have a highly significant relationship ($r = .8535$, $p = .001$). Almost 73 percent of the variance in ideal self-concept is accounted

for by actual mathematics self-concept. In other words, as one of the self-concepts rises, so does the other self-concept.

In summary, Pearson Product-Moment correlation coefficients indicate that early achievement has a powerful effect on later achievement. Verbal intelligence has a highly significant relationship with mathematics computation at the pretest and posttest levels.

Partial Correlations

With partial correlations it was possible to analyze the relationship between variables without the effect of the variance each variable shared with IQ or age.

The pretest continued to significantly correlate with the posttest ($r = .7889$, $p = .001$) and gain scores ($-.3187$, $p = .012$) when IQ was controlled. Without the effect of IQ in the posttest the shared variance between pretest and posttest is reduced about 12 percent (from above 70 percent to approximately 62 percent). The difference is seen in pretest and gain score correlations also. Without controlling for IQ, the pretest accounted for little more than 1 percent of the variance in gain scores; with IQ controlled, the variance between accounted for by the pretest in the gain scores is about 10 percent.

When the effects of IQ are removed there is a sig-

nificant and positive relationship between debilitating anxiety and ideal self-concept ($r = .2579$, $p = .035$). Without the variance accounted for by IQ, debilitating anxiety has a significant negative correlation with the posttest ($r = -.3022$, $p = .016$). This relationship did not appear in the significant Pearson correlations. The trend, however, was indicated in the Phase I study where it was suggested that the most non-productively anxious students may wish the hardest to be "good" mathematics students.

Another change that occurs when IQ is controlled is a significant correlation between pretest and gain scores ($r = -.3187$, $p = .012$). The significant correlations indicated in the Pearson correlations for age and self-concepts continued to be significant when IQ effects were removed ($r = .3575$, $p = .005$). Age has no other significant effects with IQ controlled. This relationship may indicate that as age increases the subjects self-concepts in mathematics also increases whether it is the actual or ideal self-concept.

When age is controlled there is negligible change from the Pearson correlations in most of the pairs of variables. However, debilitating anxiety, which was not significantly correlated with IQ in the Pearson correlations, is significantly related to IQ when age is controlled ($r = .2337$, $p = .051$). The change is actually quite small

(Pearson r = .2218, p = .059). It is the established .05 significance level that brings the variables into focus.

In summary, with IQ controlled, some of the correlations are smaller; others are larger. Effects which were significant are: (1) the strong effect of age on actual self-concept with IQ controlled; (2) the significant relationship of debilitating anxiety with ideal self-concept when IQ is controlled; (3) the significant relationship of debilitating anxiety and IQ when a .05 level of significance is established.

To determine treatment effect the experimental and control groups needed to be essentially the same at the beginning of the study with respect to performance on the dependent variable (achievement) and the aptitudes of concern (anxiety and self-concept).

The Bartlett-Box F test for homogeneity of variances was made prior to each *t* test. If a significant value was found, then the *t* value for separate variance estimates was used; if the value was not significant, then the value for the pooled variance estimates was used.

Significant *F* values were found for many of the variables. See Table 4 for a summary of the values.

Table 4 F-Tests for Homogeneity of Variance

	F	p
Age	3.653	.0333 *
Pretest	10.804	.0001 ****
Posttest	11.367	.0001 ****
IQ	5.646	.0063 **
Gain	.376	.6885 n.s.
Debilitating Anxiety	3.003	.0590 n.s.
Facilitating Anxiety	4.728	.0134 *
Ideal Self-Concept	5.228	.0088 **
Actual Self-Concept	6.404	.0034 **

* $p < .05$
** $p < .01$
*** $p < .001$
**** $p < .0001$

The above table indicated that there were highly significant differences between the groups on entry achievement and the posttest criterion variables. The groups were sig-

nificantly different on both self-concepts and IQ. Additionally, there were significant age differences between the groups.

To determine the source of the group differences, comparisons were made between the sample means for three groups. There were three possible pairwise comparisons: $\bar{X}_1 - \bar{X}_2$, $\bar{X}_2 - \bar{X}_3$, $\bar{X}_1 - \bar{X}_3$; where 1 was the high student participation group at Harry Truman Community College, 2 was the low student participation group at Harry Truman Community College, and 3 was the random control group with low student participation from Phase II. Comparisons among means is any linear combination or weighted sums of means in which the coefficients of the comparisons all sum to zero. The contrast coefficient matrix presented in Table 5 presents the coefficients used in the analysis.

Table 5 Contrast Coefficient Matrix

	Group 1	Group 2	Group 3
Contrast 1	1.0	-1.0	0
Contrast 2	.5	.5	-1.0
Contrast 3	1.0	- .5	- .5

Table 6 Contrast Summary

	Experimental vs. H.T. Control	Experimental + H.T. Control vs. Random Control	Experimental vs. H.T. Control + Random Control
Age	n.s.	$p < .05$	n.s.
Pretest	n.s.	$p < .05$	$p < .01$
IQ	n.s.	$p < .01$	n.s.
Gain	n.s.	n.s.	n.s.
Debilitating Anxiety	n.s.	n.s.	n.s.
Facilitating Anxiety	$p < .05$	$p < .01$	n.s.
Ideal Self-Concept	n.s.	$p < .01$	n.s.
Actual Self-Concept	n.s.	$p < .001$	n.s.
Posttest	n.s.	$p < .01$	$p < .01$

The contrast summary indicates that:

(1) Except for facilitating anxiety, the two Harry Truman Community College groups were not significantly different from each other.

(2) The Harry Truman Community College students differed from the other college students (Random Control group).

(3) The experimental group (high student participation) differed from all the controls (Harry Truman control plus Random Control) on pretest and posttest only.

(4) There were no significance differences on gain scores.

Multiple Regression Analysis

The last statistical procedure used to analyze the data was multiple regression analysis. A series of regression analyses were performed to construct a model upon which to account for posttest achievement. In the first regression, the criterion variable, posttest, was regressed with IQ and the pretest, the two most significant correlations in the Pearson-product moment correlations. This F ratio was highly significant. The multiple regression equation was .86786. This meant that over 75 percent of the variance in the post-

test was accounted for by prior achievement and intelligence.

In the second regression the posttest was regressed with Contrast 2 (Harry Truman subjects vs. the random control subjects) and Contrast 1 (the high student participation vs. the low student participation in both controls).

Table 7 summarizes the first two regressions.

Table 7 Multiple Regression Summary Table

Step	Variable entered	Multiple R	p
1	IQ	.59505	.001 ***
	Pretest	.86786	0 ****
2	Contrast 2	.86910	n.s.
	Contrast 1	.87377	n.s.

*** p = .001
**** p < .001

The treatment (student participation) added nothing significant to the total variance in the posttest. Together, the group effect accounted for about one percent of the variance after the effects of IQ and pretest had been accounted for. Using the Beta coefficients of the regression analysis, a significant predictor of the posttest scores (Y') is:

$$Y' = \beta_1 X_1 + \beta_2 X_2 + a$$

where β_1 is the Beta coefficient for IQ (X_1), β_2 is the Beta coefficient for Pretest (X_2) and a is a constant. $\hat{P}$osttest = .0275 (IQ) + .7937 (Pretest) + .5116.

Since this study was concerned with the effect of anxiety on achievement, the last step-wise regression analysis entered the two anxieties on the second step to determine the amount of predictability gained from their addition to the linear model.

Table 8 Multiple Regression
Summary Table with Anxieties Entered on Step 2

Step		Multiple R	p
1	IQ	.59505	.001
	Pretest	.86786	0
2	Debilitating Anxiety	.87566	n.s.
	Facilitating Anxiety	.87791	n.s.

With the addition of anxieties to the prediction equation, there was no significant gain in predictability.

In summary, correlational analyses were conducted to determine the relationship between variables. F and t tests were made to determine differences between groups.

Finally, multiple regression analyses were performed to construct a model for the prediction of posttest scores.

Conclusions

1. The two Harry Truman Community College groups did not appear to differ, but they did differ from the other groups, particularly on pre-measures.

2. When initial standing on the Pretest and IQ was accounted for, group differences vanished.

3. No variables accounted for achievement differences once Pretest and IQ were accounted for.

4. None of the null hypotheses are rejected. The overpowering effects of prior achievement and intelligence all but obliterated the effects of all the other variables, including anxiety and student participation.

5. The level of participation does not appear to change achievement. Students learn as well with high participation as they do with low participation.

6. A prediction equation evolved which includes only the pretest, IQ and a constant to correct for variations that could not be accounted for.

The results indicated the need to control for initial differences in the variables and groups. The results also indicated the need to carry the data analysis beyond simple correlations. The relationship between age and intelligence was not significant, but the mathematics self-concepts were significantly correlated with age. Debilitating anxiety was not significantly related to any variable in the study other than a negative correlation with facilitating anxiety. Facilitating anxiety and each of four other variables (intelligence, posttest, pretest and sex) all shared negative correlations. Although only IQ was a significant relationship, it is the trend reported in previous studies (e.g., NLSMA; Stark, 1979).

Comparisons were used to examine group differences. Treatment effects disappeared indicating that high student participation is no better or worse than low student participation for adults in remedial algebra.

Anxiety and self concept in mathematics did not appear to contribute to achievement on the posttest when the strong effects of the pretest and IQ were considered as presage variables in the regression. Similarly, the effect of intelligence and age, and intelligence and anxiety disappeared leaving only the pretest and intelligence to account for the variability in posttest scores. This means that given this particular sample and these procedures, none of the variables in the model other than prior achievement and intelligence make

a difference on later achievement.

CHAPTER V

EVALUATION AND IMPLICATIONS OF THE STUDY

This study was designed to investigate the relationship of anxiety to achievement with two levels of student participation. Two previous studies in a "flow of research" conducted by this researcher had indicated that certain affective variables and an instructional mode in which students participated might affect achievement in remedial algebra. However, the findings indicate that the effects of prior achievement and intelligence are so strong that none of the other variables (sex, age, Debilitating Math Anxiety, Facilitating Math Anxiety, Ideal Math Self-concept, Actual Math Self-concept, student participation) enter into the prediction of achievement. This finding supports Rappaport's (1977) study of community college psychology students in which he reported that prior achievement and intelligence were the most important variables.

There is no theory of anxiety to adequately account for math anxiety in adults in remedial mathematics. It is of concern on campuses throughout the United States. Math anxiety workshops are in evidence not only at community colleges but universities as well. To investigate this phenomenon in the natural community college classroom requires

a theory that takes into account the drive characteristics of the students and the properties of anxiety which interfere with achievement. To contribute toward such a theory the research design must include some measurement of drive and the interfering effects of debilitating anxiety. To attempt this, some changes in the sample, instruments and treatment are suggested.

The selection of a sample is not a simple task in the community college where revolving and open admissions continually change the number of students in a research sample. When agreements are made with a community college to use a sample of students for an investigation, there is no guarantee that that sample will be in existence. The flexibility of the college hinders research. Nevertheless, a replication of this study should be made during the regular term with larger classes and more classes. A replication should be attempted at Harry Truman Community College to determine if those students are indeed different "from the rest of the world". It is speculated that each community college is unique since it draws students from its own community. Those differences may disappear when the groups are categorized by environment as they were in Phase II.

Changes in the instruments are also suggested. The WRAT was selected because it was economical in terms of student time and involved only computation, thus eliminating

problems with reading and problem-solving. Nevertheless, an instrument should be selected which more reliably estimates the student's achievement. The WRAT is believed to underestimate achievement. It is also suggested that the effects of test anxiety and fear of participation be separated in a study that uses student participation for levels of treatment.

The open door policy of the community college has brought its problems; in particular, how to teach mathematics to students who, for a variety of reasons, have never mastered it well enough to attempt college level mathematics courses with any hope of success. Past research has been concerned with the "best" method of teaching remedial mathematics without concern for the group (remedial students) differences or individual differences. Logically, it seems that no one method will meet the needs of a group when the entry characteristics of the group do not necessarily hold from one sample to the next.

Throughout this "flow of research", this researcher has been made aware of both the students' and instructors' frustrating dilemma: how can sufficient skills be acquired to proceed to higher level mathematics. There are no definitive answers, but it appears to this investigator that a different model is needed to guide further research. Such a model may be Doyle's Ecological Analysis (1979, p. 188). This may be an appropriate direction just as an investiga-

tion of learning as information processing may be fruitful.

The Ecological Analysis breaks from the traditional short-term experiment with previously prescribed and arbitrarily selected student and teacher variables. The newer approach has a three-part framework: (1) the first dimension is a naturalistic perspective; (2) the environment-behavior relationships are focused on directly; and (3) the role of learning as a function of the classroom itself is focused upon. The advantage of this approach appears to be its openness to illucidation of seemingly hidden relationships.

Variables which might emerge are time on-task or attention and concentration. These are variables of interest at the pre-college level among learning disabilities specialists (Clarizio and Bernard, 1981, p. 7). The current literature supports an attention-concentration factor for discriminating learning disabilities from the educable mentally handicapped. Although none of the students in any of the three phases of this research had been diagnosed as learning disabled, there is no reason to believe that there were none with specific learning disabilities.

A second approach to further research would consider learning as information processing: a series of events beginning with the reception of information; then the processing itself of that information; and, finally, the encoding of

the information for evaluation. Students could have problems at any of these stages, but thus far, conclusions have been drawn from only the last step. As researchers, it is important to focus on the entire learning process, being cognizant that there are students who know more than they are able to write on a piece of paper. A cursory scan of some of the mathematics answers indicated that there could very well be some learning problems. For instance, there were numbers which had been reversed, there were sheets where the first and simplest problems were wrong but an algebraic problem near the bottom of the page was correct. This is not unusual with individuals with learning disabilities where certain aspects of learning are difficult or even impossible, but more difficult operations are handled with seeming ease and accuracy.

There will be difficulties with a new model. The researcher will need to know much more about the subjects and need much more of their time. Both of these concerns resulted in the impersonal and economical (time-wise) research in the past three studies. Cooperation from administration should be forthcoming, however, in order to be in compliance with federal legislation and entitlement to federal monies. There are community colleges in Illinois that are adding special education services to their programs.

Each of the 14 colleges in the second phase and the

college in this study have requested feedback to the mathematics instructors and the president of the college. This offers a responsibility to promote an interest in productive research on a most perplexing phenomenon, i.e., remedial students choose to learn mathematics, an area in which they fail repeatedly.

Without basic skills, however, the open door of the community college leads to frustration and failure instead of the bright new future the entering adult envisioned (Cross, 1980).

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APPENDIX

APPENDIX A

ABBREVIATIONS

ABBREVIATIONS

ANOVA.....Analysis of variance

Anx.....Anxiety

ASC.....Actual Mathematics Self-Concept

Debanx.....Debilitating Mathematics Anxiety

F.....F ratio

Facanx.....Facilitating Mathematics Anxiety

GED.....General Educational Development

HT.....Harry Truman Community College

ISC.....Ideal Mathematics Self-Concept

MAS.....Mathematics Anxiety Scale

n.s. .....not significant

N.....Number

NLSMA.....National Longitudinal Study of Mathematics Achievement

p.....probability

r.....correlation coefficient

r^2.....correlation squared

QWT.....Quick Word Test

SPSS.....Statistical Package Program for the Social Sciences

t.....*t* test

WAIS.....

WRAT.....Wide Range Achievement Test

Y'.....Predicted Achievement

APPENDIX B

INSTRUCTIONAL SURVEY

INSTRUCTIONAL SURVEY

DO NOT WRITE YOUR NAME ON THIS PAPER. Please circle the letter that you feel best completes each sentence below.

1. In my math class the teacher gave the review of the previous day's lesson (a) never (b) sometimes (c) most of the time (d) always.

In my math class the students gave the review of the previous day's lesson (a) never (b) sometimes (c) most of the time (d) always.

2. In my math class the teacher went from one part of the day's lesson to the next part when (a) all the students seemed to understand the material (b) all of the students' questions were answered (c) when she had finished what she wanted to say (d) when she had to go to the next part of the lesson in order to get all the lesson covered before the period ended.

3. In my math class the teacher asked students to summarize or repeat the teacher's explanations (a) never (b) sometimes (c) almost always (d) always.

In my class the teacher herself summarized the explanations she had given before going on to the next part of the lesson (a) never (b) sometimes (c) almost always (d) always.

APPENDIX C

STATISTICAL SUMMARY

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
18.	1	1.4	1.5	1.5
21.	1	1.4	1.5	2.9
24.	4	5.7	5.9	8.8
26.	1	1.4	1.5	10.3
28.	3	4.3	4.4	14.7
30.	2	2.9	2.9	17.6
32.	1	1.4	1.5	19.1
34.	3	4.3	4.4	23.5
38.	4	5.7	5.9	29.4
40.	2	2.9	2.9	32.4
42.	3	4.3	4.4	36.8
44.	1	1.4	1.5	38.2
46.	1	1.4	1.5	39.7
47.	2	2.9	2.9	42.6
50.	3	4.3	4.4	47.1
52.	4	5.7	5.9	52.9
55.	1	1.4	1.5	54.4
56.	2	2.9	2.9	57.4
58.	2	2.9	2.9	60.3
59.	1	1.4	1.5	61.8
60.	2	2.9	2.9	64.7
61.	1	1.4	1.5	66.2
62.	1	1.4	1.5	67.6
64.	1	1.4	1.5	69.1
66.	3	4.3	4.4	73.5
67.	1	1.4	1.5	75.0
69.	1	1.4	1.5	76.5
71.	2	2.9	2.9	79.4
72.	2	2.9	2.9	82.4
74.	2	2.9	2.9	85.3
75.	2	2.9	2.9	88.2
76.	1	1.4	1.5	89.7
77.	1	1.4	1.5	91.2
83.	1	1.4	1.5	92.6
85.	1	1.4	1.5	94.1
86.	1	1.4	1.5	95.6
90.	1	1.4	1.5	97.1
92.	1	1.4	1.5	98.5
94.	1	1.4	1.5	100.0
-99.	2	2.9	MISSING	
TOTAL	70	100.0	100.0	

MEAN	52.779	STD ERR	2.387	MEDIAN	52.000
MODE	24.000	STD DEV	19.688	VARIANCE	387.607
KURTOSIS	-.876	SKEWNESS	.167	RANGE	76.000
MINIMUM	18.000	MAXIMUM	94.000	SUM	3589.000
C.V. PCT	37.302	.95 C.I.	48.014	TO	57.545

VALID CASES 68 MISSING CASES 2

PRETEST

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
3.9	4	5.7	5.8	5.8
4.3	3	4.3	4.3	10.1
4.6	1	1.4	1.4	11.6
5.0	4	5.7	5.8	17.4
5.3	7	10.0	10.1	27.5
5.6	7	10.0	10.1	37.7
5.9	5	7.1	7.2	44.9
6.2	4	5.7	5.8	50.7
6.6	7	10.0	10.1	60.9
6.9	5	7.1	7.2	68.1
7.2	2	2.9	2.9	71.0
7.6	3	4.3	4.3	75.4
7.8	3	4.3	4.3	79.7
8.1	1	1.4	1.4	81.2
8.4	4	5.7	5.8	87.0
8.8	3	4.3	4.3	91.3
9.2	2	2.9	2.9	94.2
9.4	1	1.4	1.4	95.7
10.4	1	1.4	1.4	97.1
11.6	2	2.9	2.9	100.0
-99.0	1	1.4	MISSING	
TOTAL	70	100.0	100.0	

STD ERR	.209	MEDIAN	6.275
STD DEV	1.737	VARIANCE	3.018
SKEWNESS	.790	RANGE	7.700
MAXIMUM	11.600	SUM	454.500
.95 C.I.	6.170 TO		7.004

MEAN	6.587
MODE	5.300
KURTOSIS	.601
MINIMUM	3.900
C.V. PCT	26.372

POSTTEST

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
4.3	2	2.9	3.5	3.5
4.6	1	1.4	1.8	5.3
5.0	1	1.4	1.8	7.0
5.3	7	10.0	12.3	19.3
5.6	2	2.9	3.5	22.8
5.9	5	7.1	8.8	31.6
6.2	4	5.7	7.0	38.6
6.6	6	8.6	10.5	49.1
6.9	2	2.9	3.5	52.6
7.2	2	2.9	3.5	56.1
7.6	4	5.7	7.0	63.2
7.8	1	1.4	1.8	64.9
8.1	2	2.9	3.5	68.4
8.4	2	2.9	3.5	71.9
8.8	3	4.3	5.3	77.2
9.4	1	1.4	1.8	78.9
9.7	3	4.3	5.3	84.2
10.0	3	4.3	5.3	89.5
10.4	1	1.4	1.8	91.2
11.3	2	2.9	3.5	94.7
11.6	2	2.9	3.5	98.2
12.0	1	1.4	1.8	100.0
-99.0	13	18.6	MISSING	
TOTAL	70	100.0	100.0	

MEAN	7.419	STD ERR	.272	MEDIAN	6.850
MODE	5.300	STD DEV	2.056	VARIANCE	4.228
KURTOSIS	-.594	SKEWNESS	.610	RANGE	7.700
MINIMUM	4.300	MAXIMUM	12.000	SUM	422.900
C.V. PCT	27.714	.95 C.I.	6.874	TO	7.965

VALID CASES 57 MISSING CASES 13

GAIN

CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
-1.6	1	1.4	1.8	1.8
-1.2	1	1.4	1.8	3.6
-.9	4	5.7	7.1	10.7
-.8	2	2.9	3.6	14.3
-.7	1	1.4	1.8	16.1
-.4	2	2.9	3.6	19.6
-.3	1	1.4	1.8	21.4
0	7	10.0	12.5	33.9
.3	8	11.4	14.3	48.2
.4	1	1.4	1.8	50.0
.6	4	5.7	7.1	57.1
.7	1	1.4	1.8	58.9
.8	1	1.4	1.8	60.7
.9	2	2.9	3.6	64.3
1.0	2	2.9	3.6	67.9
1.1	1	1.4	1.8	69.6
1.2	2	2.9	3.6	73.2
1.4	1	1.4	1.8	75.0
1.5	1	1.4	1.8	76.8
1.6	4	5.7	7.1	83.9
1.7	1	1.4	1.8	85.7
1.8	1	1.4	1.8	87.5
2.0	2	2.9	3.6	91.1
2.1	1	1.4	1.8	92.9
2.8	1	1.4	1.8	94.6
2.9	1	1.4	1.8	96.4
3.1	1	1.4	1.8	98.2
3.7	1	1.4	1.8	100.0
-99.0	14	20.0	MISSING	
TOTAL	70	100.0	100.0	

MEAN	.636	STD ERR	.151	MEDIAN	.450
MODE	.300	STD DEV	1.132	VARIANCE	1.282

- - - - - - - - - - - P E A R S O N C O R R E L A T I O N C O E F F I C I E N T S - - - - - - - - - - -

	GAIN	POSTTEST	PRETEST	IQ	DEBANX	FACANX	IDEAL	ACTUAL	SEX	AGE
GAIN	1.0000	.4548	-.1093	.3438	-.0494	.0660	-.0609	-.1079	-.0307	.1526
	(0)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)
	P=******	P= .001	P= .223	P= .007	P= .365	P= .323	P= .335	P= .225	P= .415	P= .143
POSTTEST	.4548	1.0000	.8355	.5992	-.1030	-.0738	-.2824	-.3276	.0742	-.0499
	(51)	(0)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)
	P= .001	P=******	P= .001	P= .001	P= .236	P= .303	P= .022	P= .009	P= .302	P= .364
PRETEST	-.1093	.8355	1.0000	.4566	-.0845	-.1231	-.2776	-.2990	.1018	-.1499
	(51)	(51)	(0)	(51)	(51)	(51)	(51)	(51)	(51)	(51)
	P= .223	P= .001	P=******	P= .001	P= .278	P= .195	P= .024	P= .017	P= .239	P= .147
IQ	.3438	.5992	.4566	1.0000	.2218	-.3380	-.4404	-.4814	.1737	-.0586
	(51)	(51)	(51)	(0)	(51)	(51)	(51)	(51)	(51)	(51)
	P= .007	P= .001	P= .001	P=******	P= .059	P= .008	P= .001	P= .001	P= .111	P= .341
DEBANX	-.0494	-.1030	-.0845	.2218	1.0000	-.6235	.1281	.0472	.0062	.1498
	(51)	(51)	(51)	(51)	(0)	(51)	(51)	(51)	(51)	(51)
	P= .365	P= .236	P= .278	P= .059	P=******	P= .001	P= .185	P= .371	P= .483	P= .147
FACANX	.0660	-.0738	-.1231	-.3380	-.6235	1.0000	.3056	.2778	-.1519	.0762
	(51)	(51)	(51)	(51)	(51)	(0)	(51)	(51)	(51)	(51)
	P= .323	P= .303	P= .195	P= .008	P= .001	P=******	P= .015	P= .024	P= .144	P= .298
IDEAL	-.0609	-.2824	-.2776	-.4404	.1281	.3056	1.0000	.8535	-.1766	.3462
	(51)	(51)	(51)	(51)	(51)	(51)	(0)	(51)	(51)	(51)
	P= .335	P= .022	P= .024	P= .001	P= .185	P= .015	P=******	P= .001	P= .108	P= .006
ACTUAL	-.1079	-.3276	-.2990	-.4814	.0472	.2778	.8535	1.0000	-.1527	.4303
	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(0)	(51)	(51)
	P= .225	P= .009	P= .017	P= .001	P= .371	P= .024	P= .001	P=******	P= .142	P= .001
* SEX	-.0307	.0742	.1018	.1737	.0062	-.1519	-.1766	-.1527	1.0000	-.0293
	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(0)	(51)
	P= .415	P= .302	P= .239	P= .111	P= .483	P= .144	P= .108	P= .142	P=******	P= .419
AGE	.1526	-.0499	-.1499	-.0586	.1498	.0762	.3462	.4303	-.0293	1.0000
	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(51)	(0)
	P= .143	P= .364	P= .147	P= .341	P= .147	P= .298	P= .006	P= .001	P= .419	P=******

* Sex was coded 0 = male, 1 = female. Regression of variables with the coded sex variable was used to test significance of relationships. For purposes of comparison with other potential predictors of outcomes, the Pearson product-moment correlation of sex with the variables under study is reported here.

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
T EXP	1.	26	37.1	37.1	37.1
T CONTROL	2.	16	22.9	22.9	60.0
R CONTROL	3.	28	40.0	40.0	100.0
	TOTAL	70	100.0	100.0	

MEAN	2.029	STD ERR	.106	MEDIAN	2.063
MODE	3.000	STD DEV	.884	VARIANCE	.782
KURTOSIS	-1.737	SKEWNESS	-.057	RANGE	2.000
MINIMUM	1.000	MAXIMUM	3.000	SUM	142.000
C.V. PCT	43.587	.95 C.I.	1.818	TO	2.239

CONTRA1 EXPERIMENTAL VS. TWO CONTROLS

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
CONTROLS	0	44	62.9	62.9	62.9
T EXP	1.	26	37.1	37.1	100.0
	TOTAL	70	100.0	100.0	

MEAN	.371	STD ERR	.058	MEDIAN	.295
MODE	0	STD DEV	.487	VARIANCE	.237
KURTOSIS	-1.755	SKEWNESS	.544	RANGE	1.000
MINIMUM	0	MAXIMUM	1.000	SUM	26.000
C.V. PCT	131.028	.95 C.I.	.255	TO	.487

VALID CASES 70 MISSING CASES 0

CONTRA2 TEACHER VS. RANDOM CONTRL

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
R CONTROL	0	28	40.0	40.0	40.0
T E+C	1.	42	60.0	60.0	100.0
	TOTAL	70	100.0	100.0	

MEAN	.600	STD ERR	.059	MEDIAN	.667
MODE	1.000	STD DEV	.493	VARIANCE	.243
KURTOSIS	-1.880	SKEWNESS	-.417	RANGE	1.000
MINIMUM	0	MAXIMUM	1.000	SUM	42.000
C.V. PCT	82.239	.95 C.I.	.482	TO	.718

VALID CASES 70 MISSING CASES 0

SEX

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
MALE	0	31	44.3	44.3	44.3
FEMALE	1.	39	55.7	55.7	100.0
	TOTAL	70	100.0	100.0	

MEAN	.557	STD ERR	.060	MEDIAN	.603
MODE	1.000	STD DEV	.500	VARIANCE	.250
KURTOSIS	-2.003	SKEWNESS	-.235	RANGE	1.000
MINIMUM	0	MAXIMUM	1.000	SUM	39.000
C.V. PCT	89.799	.95 C.I.	.438	TO	.676

VALID CASES 70 MISSING CASES 0

AGE

CATEGORY LABEL	CODE	ABSOLUTE FREQ	RELATIVE FREQ (PCT)	ADJUSTED FREQ (PCT)	CUM FREQ (PCT)
18-19	0	23	32.9	33.8	33.8
20-24	1.	18	25.7	26.5	60.3
25-34	2.	10	14.3	14.7	75.0
35-44	3.	14	20.0	20.6	95.6
45-54	4.	3	4.3	4.4	100.0
	-99.	2	2.9	MISSING	
	TOTAL	70	100.0	100.0	

MEAN	1.353	STD ERR	.154	MEDIAN	1.111
MODE	0	STD DEV	1.267	VARIANCE	1.605
KURTOSIS	-1.051	SKEWNESS	.478	RANGE	4.000
MINIMUM	0	MAXIMUM	4.000	SUM	92.000
C.V. PCT	93.637	.95 C.I.	1.046	TO	1.660

Means, Standard Deviations, T Values for Groups and Contrasts

	T Exp	T Con	R Con	Control 1	Control 2	Control 3
Age						
Mean	1.75	1.43	.79			
St. Dev.	1.16	1.51	1.10			
T-Value				.62	2.24	1.74
Pretest						
Mean	5.51	6.94	7.68			
St. Dev.	1.07	2.54	1.54			
T-Value				-1.44	-2.48	-3.21
Posttest						
Mean	5.92	7.61	8.38			
St. Dev.	1.07	2.31	1.95			
T-Value				-1.87	-2.68	-3.88
IQ						
Mean	45.2	46.8	63.0			
St. Dev.	19.19	19.96	17.41			
T-Value				-0.20	-3.07	-1.70
Gain						
Mean	.41	.67	.70			
St. Dev.	.85	1.14	1.34			
T-Value				- .56	- .44	- .86
Debilitating Anxiety						
Mean	3.16	2.61	3.15			
St. Dev.	.68	.47	.43			
T-Value				2.35	-1.81	1.55
Facilitating Anxiety						
Mean	2.76	3.24	2.56			
St. Dev.	.64	.30	.44			
T-Value				-2.13	2.83	- .90
Ideal Self-Concept						
Mean	4.17	4.66	3.50			
St. Dev.	1.15	.82	.77			
T-Value				-1.19	3.23	.30
Actual Self-Concept						
Mean	3.57	3.79	2.97			
St. Dev.	.70	.62	.64			
T-Value				- .75	3.53	.92

- - - - - - - - - - - - - - - P A R T I A L C O R R E L A T I O N C O E F F I C I E N T S - - - - - - - - - - -

CONTROLLING FOR.. IQ

	SEX	AGE	PRETEST	POSTTEST	GAIN	CONTRA1	CONTRA2	DEBANX	FACANX	IDEAL	ACTUAL
SEX	1.0000	-.0195	.0256	-.0378	-.0977	-.1268	-.3151	-.0337	-.1006	-.1133	-.0800
	(0)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)
	P=*****	P= .447	P= .430	P= .397	P= .250	P= .190	P= .013	P= .408	P= .244	P= .217	P= .290
AGE	-.0195	1.0000	-.1386	-.0185	.1843	.3224	.3654	.1673	.0600	.3575	.4595
	(48)	(0)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)
	P= .447	P=*****	P= .168	P= .449	P= .100	P= .011	P= .005	P= .123	P= .340	P= .005	P= .001
PRETEST	.0256	-.1386	1.0000	.7889	-.3187	-.4584	-.3719	-.2142	.0373	-.0957	-.1016
	(48)	(48)	(0)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)
	P= .430	P= .168	P=*****	P= .001	P= .012	P= .001	P= .004	P= .068	P= .398	P= .254	P= .241
POSTTEST	-.0378	-.0185	.7889	1.0000	.3310	-.4597	-.3316	-.3022	.1708	-.0258	-.0558
	(48)	(48)	(48)	(0)	(48)	(48)	(48)	(48)	(48)	(48)	(48)
	P= .397	P= .449	P= .001	P=*****	P= .009	P= .001	P= .009	P= .016	P= .118	P= .430	P= .350
GAIN	-.0977	.1843	-.3187	.3310	1.0000	-.0052	.0597	-.1373	.2061	.1073	.0700
	(48)	(48)	(48)	(48)	(0)	(48)	(48)	(48)	(48)	(48)	(48)
	P= .250	P= .100	P= .012	P= .009	P=*****	P= .486	P= .340	P= .171	P= .075	P= .229	P= .315
CONTRA1	-.1268	.3224	-.4584	-.4597	-.0052	1.0000	.7179	.2103	-.0902	.0518	.1343
	(48)	(48)	(48)	(48)	(48)	(0)	(48)	(48)	(48)	(48)	(48)
	P= .190	P= .011	P= .001	P= .001	P= .486	P=*****	P= .001	P= .071	P= .267	P= .360	P= .176
CONTRA2	-.3151	.3654	-.3719	-.3316	.0597	.7179	1.0000	-.0233	.1713	.2494	.3031
	(48)	(48)	(48)	(48)	(48)	(48)	(0)	(48)	(48)	(48)	(48)
	P= .013	P= .005	P= .004	P= .009	P= .340	P= .001	P=*****	P= .436	P= .117	P= .040	P= .016
DEBANX	-.0337	.1673	-.2142	-.3022	-.1373	.2103	-.0233	1.0000	-.5977	.2579	.1802
	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(0)	(48)	(48)	(48)
	P= .408	P= .123	P= .068	P= .016	P= .171	P= .071	P= .436	P=*****	P= .001	P= .035	P= .105
FACANX	-.1006	.0600	.0373	.1708	.2061	-.0902	.1713	-.5977	1.0000	.1855	.1396
	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(0)	(48)	(48)
	P= .244	P= .340	P= .398	P= .118	P= .075	P= .267	P= .117	P= .001	P=*****	P= .099	P= .167
IDEAL	-.1133	.3575	-.0957	-.0258	.1073	.0518	.2494	.2579	.1855	1.0000	.8152
	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(0)	(48)
	P= .217	P= .005	P= .254	P= .430	P= .229	P= .360	P= .040	P= .035	P= .099	P=*****	P= .001
ACTUAL	-.0800	.4595	-.1016	-.0558	.0700	.1343	.3031	.1802	.1396	.8152	.0000

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CONTROLLING FOR.. AGE

	SEX	IQ	PRETEST	POSTTEST	GAIN	CONTRA1	CONTRA2	DEBANX	FACANX	IDEAL	ACTUAL
SEX	1.0000	.1723	.0985	.0729	-.0265	-.1775	-.3686	.0107	-.1502	-.1775	-.1552
	(0)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)
	P=*****	P= .116	P= .248	P= .307	P= .428	P= .109	P= .004	P= .471	P= .149	P= .109	P= .141
IQ	.1723	1.0000	.4538	.5980	.3575	-.3474	-.4443	.2337	-.3350	-.4485	-.5063
	(48)	(0)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)
	P= .116	P=*****	P= .001	P= .001	P= .005	P= .007	P= .001	P= .051	P= .009	P= .001	P= .001
PRETEST	.0985	.4538	1.0000	.8386	-.0884	-.5264	-.4798	-.0634	-.1132	-.2433	-.2628
	(48)	(48)	(0)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)
	P= .248	P= .001	P=*****	P= .001	P= .271	P= .001	P= .001	P= .331	P= .217	P= .044	P= .033
POSTTEST	.0729	.5980	.8386	1.0000	.4685	-.5681	-.5163	-.0967	-.0703	-.2829	-.3395
	(48)	(48)	(48)	(0)	(48)	(48)	(48)	(48)	(48)	(48)	(48)
	P= .307	P= .001	P= .001	P=*****	P= .001	P= .001	P= .001	P= .252	P= .314	P= .023	P= .008
GAIN	-.0265	.3575	-.0884	.4685	1.0000	-.1850	-.1658	-.0740	.0552	-.1227	-.1946
	(48)	(48)	(48)	(48)	(0)	(48)	(48)	(48)	(48)	(48)	(48)
	P= .428	P= .005	P= .271	P= .001	P=*****	P= .099	P= .125	P= .305	P= .352	P= .198	P= .088
CONTRA1	-.1775	-.3474	-.5264	-.5681	-.1850	1.0000	.7265	.0715	.0140	.0956	.1625
	(48)	(48)	(48)	(48)	(48)	(0)	(48)	(48)	(48)	(48)	(48)
	P= .109	P= .007	P= .001	P= .001	P= .099	P=*****	P= .001	P= .311	P= .462	P= .254	P= .130
CONTRA2	-.3686	-.4443	-.4798	-.5163	-.1658	.7265	1.0000	-.1840	.2846	.3087	.3513
	(48)	(48)	(48)	(48)	(48)	(48)	(0)	(48)	(48)	(48)	(48)
	P= .004	P= .001	P= .001	P= .001	P= .125	P= .001	P=*****	P= .100	P= .023	P= .015	P= .006
DEBANX	.0107	.2337	-.0634	-.0967	-.0740	.0715	-.1840	1.0000	-.6440	.0822	-.0194
	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(0)	(48)	(48)	(48)
	P= .471	P= .051	P= .331	P= .252	P= .305	P= .311	P= .100	P=*****	P= .001	P= .285	P= .447
FACANX	-.1502	-.3350	-.1132	-.0703	.0552	.0140	.2846	-.6440	1.0000	.2985	.2723
	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(0)	(48)	(48)
	P= .149	P= .009	P= .217	P= .314	P= .352	P= .462	P= .023	P= .001	P=*****	P= .018	P= .028
IDEAL	-.1775	-.4485	-.2433	-.2829	-.1227	.0956	.3087	.0822	.2985	1.0000	.8319
	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(0)	(48)
	P= .109	P= .001	P= .044	P= .023	P= .198	P= .254	P= .015	P= .285	P= .018	P=*****	P= .001
ACTUAL	-.1552	-.5063	-.2628	-.3395	-.1946	.1625	.3513	-.0194	.2723	.8319	1.0000
	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(48)	(0)

MULTIPLE REGRESSION

ODEPENDENT VARIABLE.. POSTTEST

SUMMARY TABLE

STEP	VARIABLE ENTERED	VARIABLE REMOVED	F TO ENTER OR REMOVE	SIGNIFICANCE	MULTIPLE R	R SQUARE	R SQUARE CHANGE	SIMPLE R	OVERALL F	SIGNIFICANCE
1	IQ		11.52757	.001	.59505	.35408	.35408	.59505	74.76448	.000
	PRETEST		79.23336	0	.86786	.75318	.39910	.83374		
2	CONTRA2		.13723	.713	.86910	.75534	.00216	-.50175	37.92914	.000
	CONTRA1		1.61797	.210	.87377	.76348	.00814	-.55496		

1PARTIALS AND REGRESSION

MULTIPLE REGRESSION

ODEPENDENT VARIABLE.. POSTTEST

SUMMARY TABLE

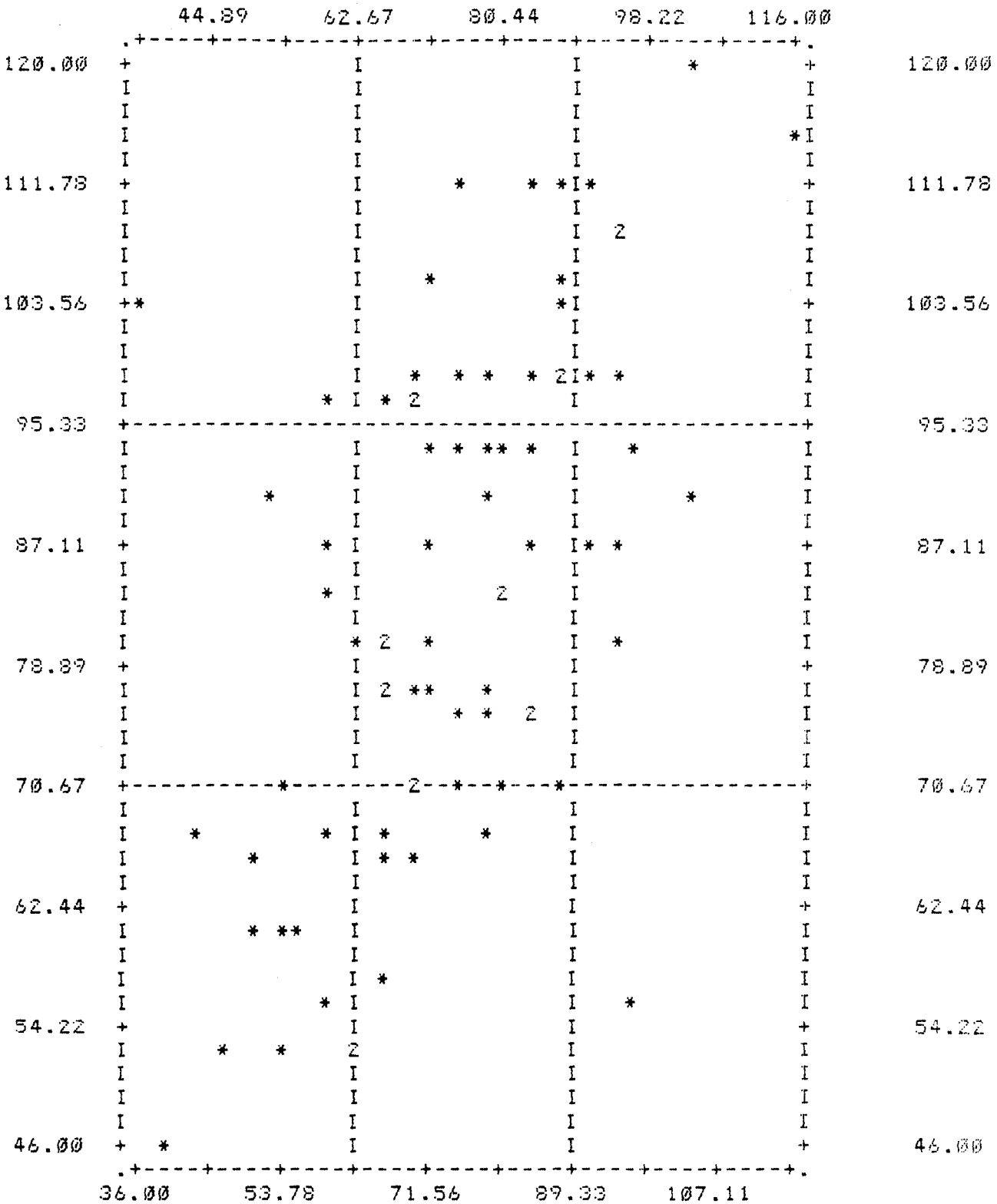
STEP	VARIABLE ENTERED	VARIABLE REMOVED	F TO ENTER OR REMOVE	SIGNIFICANCE	MULTIPLE R	R SQUARE	R SQUARE CHANGE	SIMPLE R	OVERALL F	SIGNIFICANCE
1	IQ		11.52757	.001	.59505	.35408	.35408	.59505	74.76448	.000
	PRETEST		79.23336	0	.86786	.75318	.39910	.83374		
2	DEBANX		.60275	.441	.87566	.76678	.01359	-.10855	39.49680	.000
	FACANX		.80772	.373	.87791	.77072	.00394	-.06642		

1PARTIALS AND REGRESSION

APPENDIX D

PHASE II

SCATTERGRAM OF (DOWN) POST
(ACROSS) PRE



STATISTICS..

CORRELATION (R)-	.56427	R SQUARED -	.31*
SIGNIFICANCE R -	.00001	STD ERR OF EST -	14.73*
INTERCEPT (A) -	37.69586	STD ERROR OF A -	7.96*
SIGNIFICANCE A -	.00001	SLOPE (B) -	.63*
STD ERROR OF B -	.10515	SIGNIFICANCE B -	.00*

PLOTTED VALUES - 79 EXCLUDED VALUES - 0 MISSING VALUES - 209

IQ

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
5.	1	0	0	46.	5	2	20	71.	6	2	75
15.	1	0	1	47.	5	2	22	72.	5	2	77
18.	1	0	1	48.	5	2	24	73.	3	1	78
20.	1	0	2	49.	5	2	26	74.	2	1	78
21.	1	0	2	50.	6	2	28	75.	5	2	80
22.	1	0	2	51.	6	2	30	76.	2	1	81
23.	1	0	3	52.	7	3	33	77.	5	2	83
24.	1	0	3	53.	7	3	36	78.	4	2	85
27.	1	0	3	54.	4	2	37	79.	7	3	87
28.	2	1	4	55.	10	4	41	80.	5	2	89
30.	4	2	6	56.	3	1	42	82.	1	0	90
31.	3	1	7	57.	6	2	45	83.	2	1	90
32.	2	1	8	58.	2	1	45	84.	4	2	92
33.	2	1	8	59.	4	2	47	85.	4	2	93
34.	3	1	10	60.	13	5	52	86.	1	0	94
35.	1	0	10	61.	11	4	56	87.	1	0	94
36.	2	1	11	62.	11	4	60	88.	1	0	95
37.	1	0	11	63.	2	1	61	89.	5	2	97
38.	3	1	12	64.	5	2	63	90.	1	0	97
39.	1	0	13	65.	5	2	65	91.	2	1	98
40.	3	1	14	66.	5	2	67	92.	2	1	98
41.	4	2	15	67.	4	2	68	93.	2	1	99
42.	3	1	17	68.	3	1	70	94.	2	1	100
44.	3	1	18	69.	2	1	70				
45.	1	0	18	70.	5	2	72				

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
-0	28				

MEAN	59.473	STD ERR	1.073	MEDIAN	60.115
MODE	60.000	STD DEV	17.297	VARIANCE	299.177
KURTOSIS	-.171	SKEWNESS	-.230	RANGE	89.000
MINIMUM	5.000	MAXIMUM	94.000	SUM	15463.000
C.V. PCT	29.083	.95 C.I.	57.361	TO	61.585
VALID CASES	260	MISSING CASES	28		

PRE

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
36.	2	1	1	62.	11	5	33	92.	6	3	89
39.	1	0	1	66.	20	9	42	94.	7	3	92
43.	3	1	3	69.	15	7	48	97.	6	3	95
46.	6	3	5	70.	1	0	49	100.	1	0	95
50.	7	3	9	72.	16	7	56	104.	6	3	98
52.	1	0	9	76.	16	7	63	106.	1	0	99
53.	8	4	13	78.	14	6	70	110.	1	0	99
56.	12	5	18	81.	14	6	76	113.	1	0	100
59.	20	9	27	84.	10	5	81	116.	1	0	100
60.	1	0	28	88.	13	6	86				

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
-0	67				

MEAN	71.946	STD ERR	1.062	MEDIAN	71.656
MODE	59.000	STD DEV	15.788	VARIANCE	249.252
KURTOSIS	-.272	SKEWNESS	.258	RANGE	80.000
MINIMUM	36.000	MAXIMUM	116.000	SUM	15900.000
C.V. PCT	21.944	.95 C.I.	69.853	TO	74.039
VALID CASES	221	MISSING CASES	67		

POST

CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT	CODE	FREQ	ADJ PCT	CUM PCT
46.	1	1	1	76.	4	4	30	100.	10	10	83
53.	4	4	5	78.	5	5	35	104.	4	4	87
56.	2	2	7	81.	7	7	42	106.	2	2	89
59.	1	1	8	84.	4	4	46	110.	3	3	92
62.	3	3	11	88.	6	6	52	113.	5	5	97
66.	3	3	14	92.	5	5	57	116.	2	2	99
69.	5	5	19	94.	8	8	65	120.	1	1	100
72.	6	6	26	97.	7	7	72				

M I S S I N G D A T A

CODE	FREQ	CODE	FREQ	CODE	FREQ
-0	190				

MEAN	86.541	STD ERR	1.743	MEDIAN	88.333
MODE	100.000	STD DEV	17.250	VARIANCE	297.570
KURTOSIS	-.650	SKEWNESS	-.262	RANGE	74.000
MINIMUM	46.000	MAXIMUM	120.000	SUM	8481.000
C.V. PCT	19.933	.95 C.I.	83.082	TO	89.999
VALID CASES	98	MISSING CASES	190		

APPENDIX E

PHASE I

Summary of Data

χ^2 Values for Math Attitude Scales by NLSMA Group Comparisons with Levels of Significance

	NLSMA Group	Math vs. non math	Math Fun vs. dull	Promath	Debilitating Anxiety	Facilitating Anxiety	Ideal Self-Concept (95% Confidence)	Actual Math Self-Concept (95% Confidence)	Math Easy vs. Hard
Only Dec.	GroupI	17.653 n.s.	32.23 *	20.31 n.s.	21.09	22.35	30.08 * (28.25-65.70)	11.88 (9.72-22.34)	21.54
	Group II	18.22 n.s.	30.37 *	27.44	19.22 n.s.	21.18	33.58 **	10.96 n.s.	21.61
Only Sept.	Group I	22.157	22.45	21.59	22.427	20.06 n.s.	32.32 * (30.40-73.84)	11.55 (9.46-22.69)	18.1396 n.s.
	Group II	22.87	21.156	18.66 n.s.	20.43 n.s.	19.01 n.s.	36.09 **	10.65 n.s.	18.20 n.s.
Only AM-Sept.	Group I	4.49	10.286 **	13.256 **	13.767 ***	8.87 *	16.146 *** (34.49-160.02)	3.38 (6.42-29.80)	6.32
	Group II	4.64	9.69 *	4.45	12.54 **	8.40 *	18.03 (***)	3.12 n.s.	6.34
Only Am-Dec.	Group I	5.00 *	6.13 *	3.167	3.289	5.143 *	5.57 * (15.18-95.75)	3.81 (9.214-58.128)	3.79
	Group II	5.166 *	5.95 *	4.15	2.997	4.875 *	6.22 *	3.51	5.35
Only MM-Sept.	Group I		3.77 n.s.	4.70	4.88	6.28	5.49 (13.44-62.34)	5.52 (10.48-49.62)	6.04
	Group II	12.15 **	3.55 n.s.	7.412	4.44	6.34	7.02	5.09	6.06
Only MM-Dec.	Group I	5.69	7.45 **	7.54 **	7.83 **	9.289 ***	8.81 *** (23.84-182.84)	2.308 (6.01-42.37)	7.58 **
	Group II	5.857	7.02 **	9.32 ***	7.137 **	8.80 ***	9.84 ***	2.129	7.61 **
Only SS-Sept.	Group I	4.52	6.81 *	2.529 n.s.	2.63	3.48	8.73 ** (22.21-127.60)	1.67 (3.79-21.75)	4.105
	Group II	4.67	6.42 *	3.14	2.39 n.s.	3.36	9.742 **	1.54 n.s.	4.11
Only SS-Dec.	Group I	3.38	5.02 *	4.16 *	4.32 *	1.67	4.91 * (5.64-125.85)	1.659 (4.69-37.73)	3.936
	Group II	3.93	4.998 *	3.92 *	3.94 *	1.59	5.49 **	1.53 n.s.	3.95 *
Only SS/MM Sept.	Group I	6.78 n.s.	28.40 ***	8.337 n.s.	8.658 n.s.	11.1435 n.s.	16.10 (27.44-64.92)	7.34 (8.679-26.29)	10.55 n.s.
	Group II	17.85 *	10.49 n.s.	11.53	7.89 n.s.	10.56 n.s.	17.97 *	6.77 n.s.	10.58 n.s.
Only PM-Dec.	Group I	3.188	11.00 ***	5.046 **	5.24			2.359 (5.33-30.64)	5.33
	Group II	3.29	10.37 ***	9.183 **	4.775	data not printed	data not printed	2.176 n.s.	

Levels of Significance:

n.s = no significance at any level

sig, at .90 = *

sigg. at .75 = **

sig. at .50 = ***

sig. at .25 = (****)

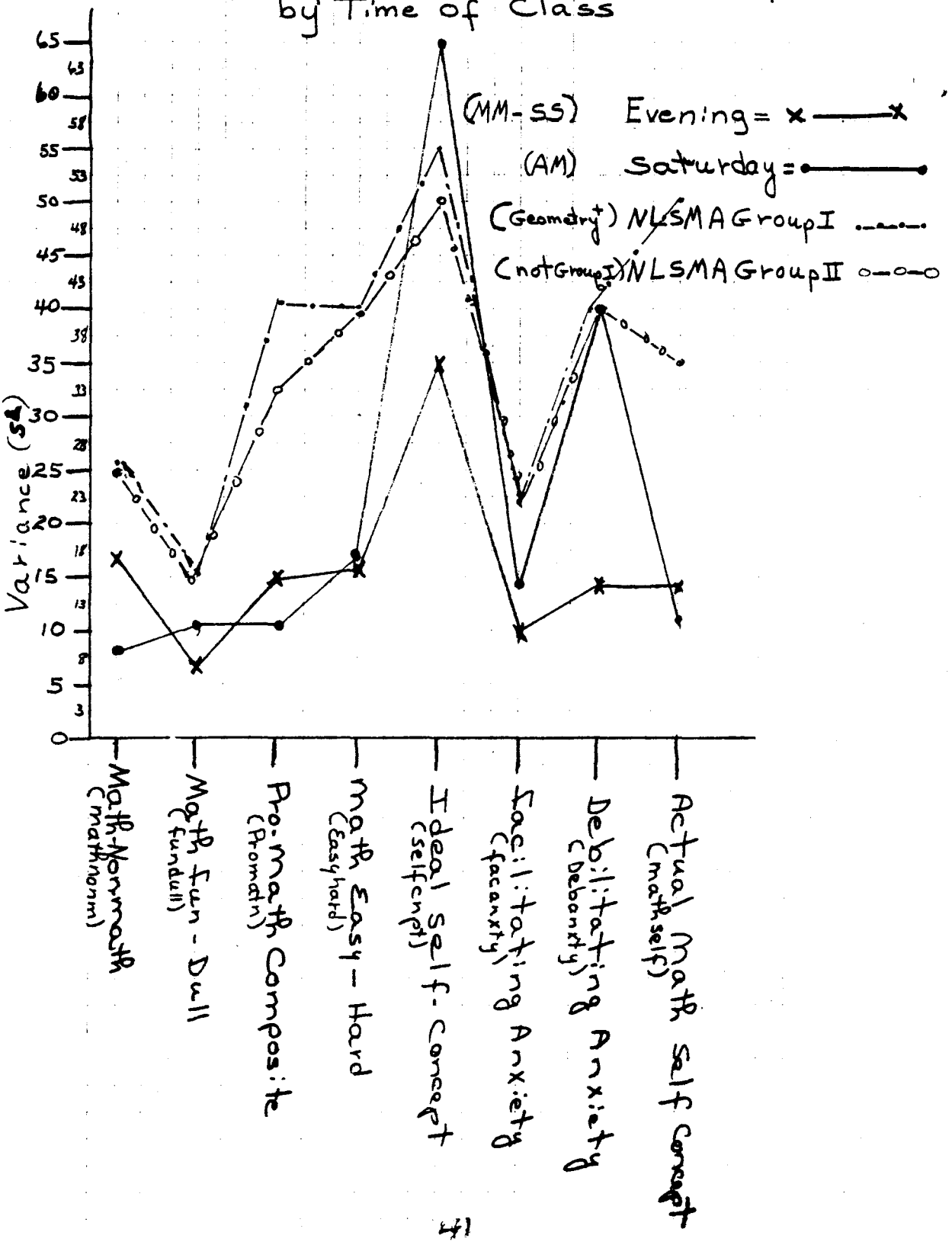
Group sizes

Only Dec. = 42
Only Sept. =42
Only AM Sept=15
Only AM Dec.=11
Only MM Sept.==15
Only MM Dec. =10
Only SS Sept. =12
Only SS Dec. = 10
Only SS/MM Sept. =27
Only PM Dec. = 12

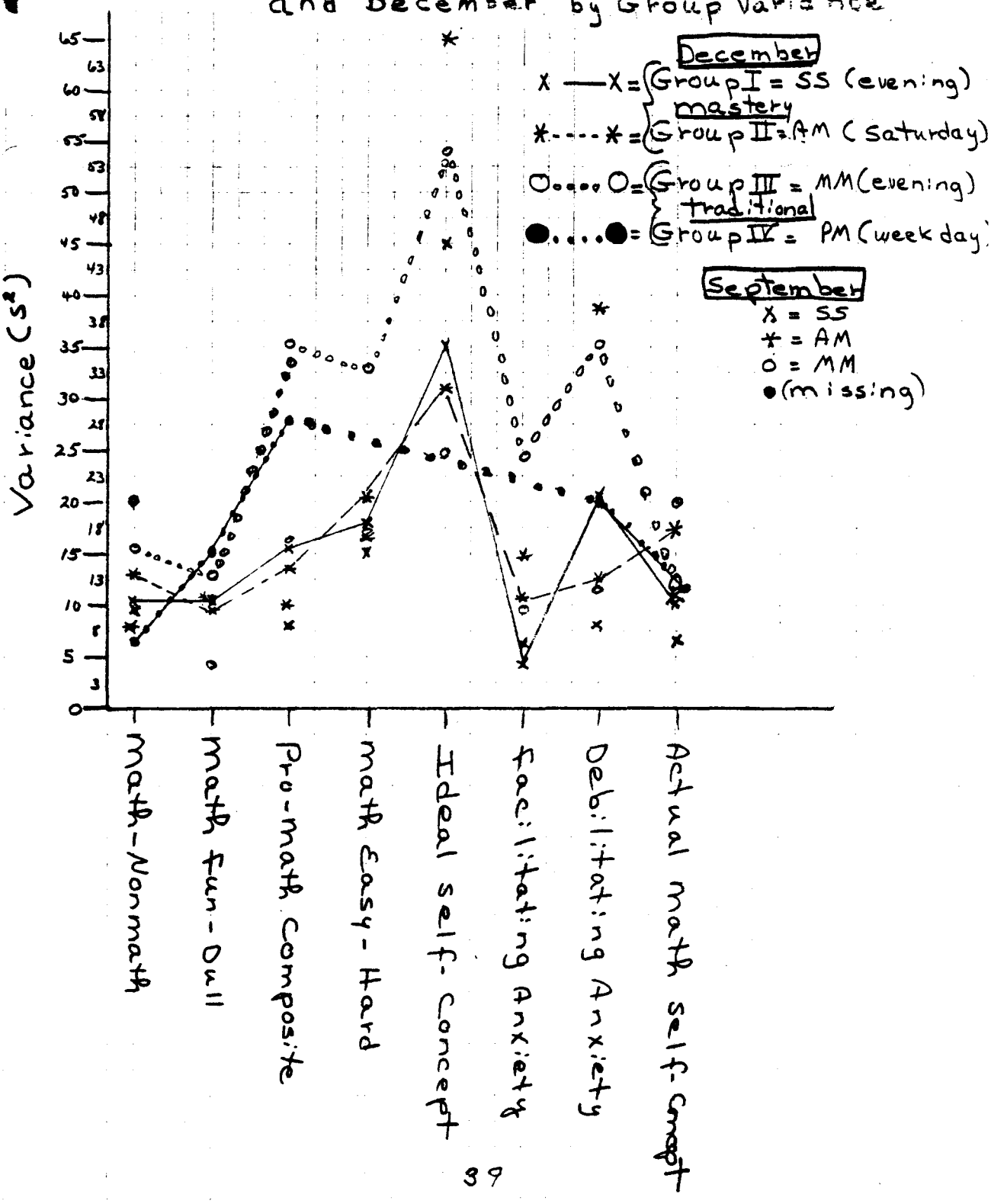
(Above statistics arrived at by hand calculation using the following formula: $\chi^2 = \frac{(n-1)s^2}{\sigma^2}$)

95% Confidence Interval:

$\frac{(n-1)s^2}{\chi^2(df\ \alpha/2)}$ to $\frac{(n-1)s^2}{\chi^2(df\ 1-\alpha/2)}$


A Profile of Math Attitudes in September by Time of Class
(MM-SS) Evening = x——x
(AM) Saturday = •——•
(Geomdry+) NLSMA GroupI .-.-.
(notGroupI) NLSMA GroupII o-o-o
Variance (SA)
65 63 60 58 55 53 50 48 45 43 40 38 35 33 30 28 25 23 20 18 15 13 10 8 5 3 0
Math Nonmath (mathnonm)
Math fun - Dull (fundull)
Pro-math Composite (Promatn)
math Easy - Hard (Easyhard)
Ideal self-Concept (selfcnpt)
Facilitating Anxiety (facanxty)
Debilitating Anxiety (debanxty)
Actual math self Concept (mathself)

41


A Profile of math Attitudes in September and December by Group Variance
December
X——X = Group I = SS (evening)
mastery
---- = Group II = AM (Saturday)
O....O = Group III = MM (evening)
traditional
●....● = Group IV = PM (week day)
September
X = SS
* = AM
O = MM
● (missing)
Variance (s²)
65
63
60
58
55
53
50
48
45
43
40
38
35
33
30
28
25
23
20
18
15
13
10
8
5
3
0
math-Nonmath
math fun-Dull
Pro-math composite
math Easy-Hard
Ideal self-Concept
facilitating Anxiety
Debilitating Anxiety
Actual math self-Concept
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APPROVAL SHEET

The dissertation submitted by Jean P. Stark has been read and approved by the following committee:

Dr. Robert Cienkus

Dr. Martha Wynne

Dr. Jack Kavenaugh .

The final copies have been examined by the director of the dissertation and the signature which appears below verifies the fact that any necessary changes have been incorporated and that the dissertation is now given final approval by the committee with reference to content and form.

The dissertation is therefore accepted in partial fulfillment of the requirements for the degree of Doctor of Education.

5/25/81
Date

Dr. Robert C. Cienkus
Director's signature