UNIVERSITY OF ALBERTA

THE SELF-REGULATION OF TEST ANXIETY USING METACOGNITIVE STRATEGY INSTRUCTION

BY

WENDY D. CREIGHTON-LACROIX ©

A Dissertation submitted to the Faculty of Graduate Studies and Research in partial fulfilment of the requirement for the degree of Doctor of Philosophy in Special Education.

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State-Trait Anxiety Inventory for Adults

Self-Evaluation Questionnaire
STAI Form Y-1 and Form Y-2

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ABSTRACT

Due to the importance placed on achievement and testing in our competitive society, test anxiety is a concern for an increasing number of students. A number of different interventions have addressed the anxiety and its debilitating effects on performance. However, metacognitive strategy instruction, the focus of this study, has not been adequately investigated as an effective way of dealing with test anxiety.

This study, comprised of two substudies, involved teaching the general strategies Road Signs and SCORER, using Strategies Program for Effective Learning and Thinking (SPELT), a metacognitive instructional program. The first part of the study examined the effects of strategy instruction on levels of test anxiety and math test performance in 43 grade eight high test-anxious junior high math students. The second part involved developing a math self-efficacy scale (<u>Me and Math</u>) to investigate differences between high and low test-anxious students in math self-efficacy. The norming group in this study consisted of 317 grade eight and nine junior high students. The scale was used to investigate the effects of strategy instruction on math self-efficacy in students in Study 1. Test anxiety was measured using the state form of the State-Trait Anxiety Inventory. Math unit tests constructed by the classroom teachers were used as the measures of math test performance.

Findings of Study 1 indicated that strategy instruction did not make a significant impact on test anxiety levels and math test performance. Findings of Study 2 indicated that math self-efficacy was significantly higher for low test-anxious students. Low test-anxious students' perceptions of their ability and resiliency in math were more positive than

high test-anxious students' ability and resiliency perceptions. High and low test-anxious students' perceptions of their effort in math, however, were similar. Gender differences for the effects of metacognitive instruction on test anxiety levels, math test performance and math self-efficacy were analyzed, but were not significant. An incidental finding, however, was that females were found to have higher levels of test anxiety than their male counterparts. This finding was consistent with previous research.

Dedicated to those who are test anxious: you are not alone and you must persevere.

I wrote my name at the top of the page....But thereafter I could not think of anything connected with it that was either relevant or true. Incidentally there arrived from nowhere in particular a blot and several smudges. I gazed for two whole hours at this sad spectacle; and then merciful ushers collected up my piece of foolscap and carried it up to the Headmaster's table.

Winston Churchill
(1874-1965)
(cited by Covington, 1992, p. 105)

strong in will
To strive, to seek, to find, and not to yield.

Alfred Tennyson
(1809-1892)
(*Ulysses*)

"The Sky is the Limit!"

Skylar, Ty Inc., 1993

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TABLE OF CONTENTS

APPENDIX B

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Imagine the scene of a student about to take a test. These are the thoughts going through his/her mind as the test commences.

> I don't think I can do this. I studied all night and think I know the stuff...no I don't. I forget it. I'm not very smart... This stuff was way too hard to learn... I think I'm going to be sick... I'm getting dizzy and hot.... I can't remember anything...I want to get out of here...What will my parents think? They expect me to get good marks... What will everyone think if I leave?...What's this question mean? I can't answer it! I'm doomed. I might as well give up now. Look at all those questions! I'm no good at multiple choice. I don't have enough time to do all that.... What's the point of trying?

Test anxiety is a pervasive issue whose negative consequences need to be addressed in schools in an effective and practical way so that true potentials do not go unrecognized, underestimated, or unrealized (Hembree, 1988; Hill & Wigfield, 1984; Sarason, Davidson, Lighthall, Waite, & Ruebush, 1960). Test anxiety is a special need necessitating greater awareness and understanding by teachers, parents and students, as well as intervention, and ultimately prevention, than it has received in our Canadian school system to date.

The student described above is likely to be experiencing test anxiety. Society has been described as test oriented, test consuming, and test conscious, and the results of these tests are used to make major decisions about people's lives (Sarason, 1959; Zeidner & Most, 1992). Test anxiety is not adequately recognized or addressed in North American culture (Tobias, 1992). As a result, Hill (1984) estimates that approximately 25 percent of elementary and secondary students in the United States struggle with test anxiety and its resulting debilitating effects on performance, while McGuire, Mitic, and Neumann (1987) indicate that such is the case for 22% of Canadian school children. If not addressed, debilitating effects increase with time (Hill & Wigfield, 1984), affecting career choice and course selection (Stipek & Gralinski, 1991), mental and physical health (Depreeuw & De Neve, 1992; Gerzon, 1997), performance (Hembree, 1988; Zeidner, 1998), grade retention (Hill & Wigfield, 1984), learning difficulties (Zeidner, 1998), self-efficacy (Schwarzer & Jerusalem, 1992), and student drop out rates (Tobias, 1979). Test anxiety affects the validity of virtually all types of test results, including both individual and group tests, as well as criterion and norm referenced tests (Hill, 1984; Paris, Lawton & Turner, 1991; Zeidner & Most, 1992). It disproportionately affects students with learning disabilities and behavior disorders who "exhibit higher levels of test anxiety than do their peers without disabilities" (Swanson & Howell, 1996).

The present study investigated metacognitive strategy instruction as a method of alleviating test anxiety and addressing the problems of low performance and low self-efficacy associated with test anxiety. Metacognitive instruction is a method of instruction which explicity teaches, monitors and evaluates learning strategies. This instructional method has been shown to be effective in improving students' learning and performance (Butler, 1995; Marfo, Mulcahy, Peat, Andrews & Cho, 1991; Pressley & Wharton-MacDonald, 1997; Tobias, 1992).

Gender differences were also included in the investigation. The literature indicates that female students are higher in test anxiety (Hembree, 1988) and lower in self-efficacy (Arch, 1987) and math self-efficacy (Pintrich & De Groot, 1990; Skaalvik & Rankin, 1994) than male students. Differences in math performance are significantly in favor of males, but do not manifest themselves until high school (Hyde, 1993; Skaalvik & Rankin, 1994). Gender differences in metacognitive strategy use have not been a major focus of metacognitive and self-regulation research, but Zimmerman and Martinez-Pons (1990) found females more likely to use cognitive strategies than males.

At this point it may be useful to define and discuss test anxiety, math anxiety and math test anxiety and explain why math was chosen as the school subject such that the main focus of the study -- test anxiety -- may be clearly understood. At the same time the discussion will clarify why math test performance and math self-efficacy rather than "test performance" and "self-efficacy" are variables of interest.

Test anxiety is a dynamically interactive, multidimensional construct (Wigfield & Eccles, 1990) consisting of cognitive, affective, behavioral, and physiological components. It is an apprehension, fear, or dread of tests which results in interference in cognitive processing (Tobias, 1992). It is characterized by "feelings of inadequacy, helplessness, heightened somatic reactions, anticipations of punishment or loss of status and esteem, and implicit attempts at leaving the test situations" (Mandler & Sarason, 1952 as cited by Spielberger, Anton, & Bedell, 1976, p. 319). It can have a negative impact on learning and performance in evaluative situations in a variety of academic subjects.

Math anxiety is "the panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve a mathematical problem" (Tobias & Weissbrod, 1980, p. 65). Math anxiety consists of anxiety as it relates to math content, classes, homework, and tests (Hembree, 1990; Richardson & Woolfolk, 1980). In the literature math test anxiety is not a separate construct from math anxiety, although it is accepted as a form of test anxiety (Richardson & Woolfolk, 1980; Sapp, 1993).

This study investigated test anxiety rather than math (test) anxiety. The sample of students used in this study were all anxious in the testing situation. Whatever their reasons for being test-anxious, be it the math content, lack of study skills, or past experiences of failure (see the following chapter), they all experienced test anxiety. Math was chosen as the subject for several reasons (hence math test peformance and math self-efficacy). Math anxiety parallels test anxiety in a number of properties, including how the anxieties affect and are affected by performance and gender differences. Both types of anxiety respond to the same forms of treatment (Hembree, 1990). Math is also a required course, along with English and the Sciences, which tends to elicit anxiety because it is a mandatory subject (Hembree, 1988) and is generally perceived as being difficult. More difficult subjects tend to elicit anxiety (Everson, Tobias, Hartman, & Gourgey, 1993). Further, math requires frequent problem solving and testing, important to this study because strategy use and self-monitoring can be practised on a regular basis, a main tenet of metacognitive instruction.

The focus of this study then, is test anxiety rather than math anxiety or math test anxiety. This study investigated the effect of metacognitive instruction on test anxiety levels, math test performance and math self-efficacy in two substudies. As mentioned, low performance is associated with test anxiety and can be improved through strategy instruction. Performance, in this study, is math test performance which is defined as students' achievement on classroom math tests. Low self-efficacy is associated with test anxiety as well and can be improved though strategy instruction (Zimmerman, Bonner, & Kovach, 1996). In this study self-efficacy is math self-efficacy which is defined as students' confidence in their math abilities. The first study, Test Anxiety and Math Test Performance, examined the effect of metacognitive instruction on test anxiety levels and math test performance. The second study, Math Self-Efficacy and Test Anxiety, focused on the development of a math self-efficacy scale, Me and Math, which was then used to examine the differences between high and low test-anxious students and the effect of metacognitive instruction on math self-efficacy in high test-anxious students. Me and Math was developed for two principal purposes. One, it was developed to provide a math self-efficacy scale that would be practical for research purposes. Second, development was based on the characteristics of a self-efficacious individual, and as such it was expected that the scale would generate individual math self-efficacy profiles in addition to an overall math self-efficacy score which would be helpful in identifying and addressing students' need.

In summary, test anxiety and its associated problems of low test performance and low self-efficacy must be addressed if high test-anxious students are to be successful in their learning and performance, and believe they are capable and have the ability to be successful. Metacognitive strategy instruction is an intervention that has not been investigated adequately in the area of test anxiety. Research indicates that metacognitive strategy instruction is beneficial, and therefore it may be a viable intervention in assisting students to self-regulate their test anxiety, math test performance and math self-efficacy.

Definitions

For the purposes of this research the following definitions have been utilized:

1. Test Anxiety is a dynamically interactive, multidimensional construct (Wigfield & Eccles, 1990) consisting of cognitive, affective, behavioral, and

physiological components. It is an apprehension, fear, or dread of tests which results in interference in cognitive processing (Tobias, 1992). It is characterized by "feelings of inadequacy, helplessness, heightened somatic reactions, anticipations of punishment or loss of status and esteem, and implicit attempts at leaving the test situations" (Mandler & Sarason, 1952 as cited by Spielberger, Anton, & Bedell, 1976, p. 319). It was assessed using the A-State component of the State-Trait Anxiety Inventory (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983).

Test anxiety is also defined as consisting of two basic components: Emotionality and Worry (Liebert & Morris, 1967). Emotionality refers to the physiological reactions of anxiety while Worry refers to the concern about one's performance.

2. Math Anxiety is "the panic, helplessness, paralysis, and mental disorganization that arises among some people when they are required to solve a mathematical problem" (Tobias & Weissbrod, 1980, p. 65). Math anxiety consists of anxiety as it relates to the content, classes, homework, and tests in math (Hembree, 1990; Richardson & Woolfolk, 1980).

3. Metacognitive Strategy Instruction involves the teaching and learning of cognitive strategies and the monitoring and evaluation of these strategies. The terms "metacognitive strategy instruction" and "strategy instruction" are used interchangeably. The Strategies Program for Effective Learning and Thinking (SPELT) was the metacognitive instructional approach used to teach the cognitive strategies Road Signs and SCORER.

4. Cognitive Strategies are specific plans and mental activities that enable students to facilitate their learning and performance (Cole & Chan, 1990). Support cognitive strategies help students to "maintain a suitable state of

mind for learning" (Dansereau, 1985, p. 209). For test anxious students there are relaxation and systematic desensitization support strategies that address the Emotionality component of test anxiety. There are also self-talk support strategies that address the Worry component of test anxiety. Primary cognitive strategies help students to learn subject content by operating "directly on the material to be learned" (Mulcahy, Marfo, Peat, & Andrews, 1987, p. 22). Road Signs and SCORER are the primary cognitive strategies used in this study.

5. Metacognitive Strategies monitor and evaluate the use of cognitive strategies. Students monitored their use of cognitive strategies with a student log (see Appendix A) and evaluated the same strategies with the PNI form (P = Positive, N = Negative, I = Interesting points about the strategies; see Appendix A).

6. Self-Efficacy refers to the belief or confidence in one's ability to perform a task.

7. Math Self-Efficacy is the belief or confidence in one's math abilities. It was assessed using Me and Math, a scale developed for this research (see Appendix B).

8. Math Test Performance refers to students' academic achievement on classroom math tests. The tests were constructed by the classroom math teachers and achievement was presented in percentages. Tests 1 and 2 for the experimental group were tests on the math units fractions and equations, respectively. Tests 1 and 2 for the control group were on ratio and geometry, respectively. Equations and geometry, the content for tests 2, were considered more difficult than fractions and ratio in tests 1.

9. Task Difficulty is the difficulty of the content of the math tests as determined by teachers' experiences and perceptions as to what content students have difficulty with in both learning and testing situations. Task difficulty is also determined by students' reports that content is difficult because more effort and problem solving skills are necessary when working on easier content.

CHAPTER II

REVIEW OF THE LITERATURE

This chapter presents a review of the literature related to test anxiety and metacognitive instruction. The chapter is divided into five sections. Section one provides an overview of some of the sources of test anxiety and then describes the characteristics of typical test-anxious students. From this description a number of specific characteristics, such as self-efficacy, performance and task difficulty, and problem solving, that are relevant within the study, are discussed. Section two outlines the history of the treatment of test anxiety based on three major approaches. Section three reviews the self-regulation and metacognitive instruction literature, with a detailed description of the metacognitive instructional approach used in the study. Section four discusses gender differences in test anxiety, math test performance, math self-efficacy, and metacognitive strategy instruction. The fifth section provides the rationale for the study. Section six delineates the hypotheses for Studies 1 and 2.

Test-Anxious Students

Ahlawat (1989) pointed out that in attempting to assist test-anxious students it is important to know who they are. This knowledge necessitates understanding some of the many interrelated sources of test anxiety as well as how test anxiety is manifested cognitively, affectively, behaviorally, and physiologically. Some of these characteristics can be used as the basis for categorizing types of test-anxious students while other characteristics are common to all test-anxious students in varying degrees of severity.

Sources of Test Anxiety

Spielberger's (1966) theory of anxiety conceptualizes anxiety as being a state and a trait:

> State anxiety (A-State) may be conceptualized as a transitory emotional state or condition of the human organism that varies in intensity and fluctuates over time.... characterized by subjective, consciously perceived feelings of tension and apprehension.... Trait anxiety (A-Trait) refers to relatively stable individual differences in anxiety proneness, that is, to differences in the disposition to perceive a wide range of stimulus situations as dangerous or threatening, and in the tendency to respond to such threats with A-State reactions. (p. 321-322)

A-State factors are "immediately and directly responsible for anxiety reactions" (Zeidner, 1998, p. 145) in the testing situation while A-Trait factors are indirectly responsible. This distinction provides a conceptual framework by which to identify the factors affecting the sources of test anxiety. This framework can be divided into three interrelated components: biological constitution (A-Trait), socialization (A-Trait), and educational environment (A-State) (Zeidner, 1998).

Biologically, anxiety is a basic personality trait, in part genetically determined, which dictates how individuals detect and react to threatening events and situations. It is relatively constant, but can be influenced by learning, sociocultural determinants, personal choice, and cognitive processes (Hergenhahn, 1994). Test anxiety is construed as a form of trait anxiety (Zeidner, 1998), therefore some individuals are more prone than others to react to test situations with increased anxiety.

Socialization refers to the importance of family and interpersonal influences. Although this area of research is still in its infancy (Zeidner, 1998), a number of models attempt to explain these influences and examine how parental child-rearing practices, standards and expectations, and feedback and support impact test-anxious students in evaluative situations. Consistency of parental practices is extremely important as it removes ambiguity and provides structure. Without consistency test-anxious students may develop feelings of helplessness and an external locus of control. In response to unrealistically high parental and teacher standards and expectations test-anxious students develop derogatory self-talk, overdependence on significant others for approval, and fear of failure. Negative feedback and support leads to negative competency expectancies and deters students from developing general problem-solving strategies. Parental control, rather than flexibility, limits the development of independence, autonomy and creativity.

The educational environment can be divided into five components: subjective variables (Zeidner, 1998), school environment, failure experiences, test related variables, and situational variables. The first component, subjective variables, includes students' perceptions of themselves in relation to learning and testing situations. A number of these variables are discussed later in the context of self-efficacy.

School environment, the second component, which emphasizes competition and evaluative practices, tends to heighten anxiety in the those students who are anxious at the outset. Evaluation which emphasizes quantitative rather than qualitative grades and comparison of self to others (Wigfield & Eccles, 1990) negatively affects students, especially students in the higher grades where these practices are more common. The third component, accumulated failure experiences, is an important determinant of test anxiety and negatively affects self-perceptions. Evaluation becomes associated with repeated failure resulting in negative self-talk, the development of maladaptive coping strategies, the lowering of ability perceptions, a de-emphasis on effort, and attempts to avoid failure rather than attempts to be successful, success being perceived as unlikely.

Test related variables, the fourth component, include task difficulty, item arrangement, test format and choice among test items. When tasks are perceived as difficult anxiety increases. When items are arranged from easy to difficult anxiety is reduced, although Zeidner (1998) states that there are few studies which support this relationship. Test format is another variable requiring more research. Zeidner (1987) reported that elementary school students found essay type exams more anxiety-inducing than multiple choice exams, while Shaha (1984) found that high school students preferred matching exams over multiple choice. Zoller and Ben-Chaim's (1990) sample of future science teachers indicated that take home exams were the preferred exam type with oral exams the least preferred. Test format preference appears to be dependent on subject and education level. Providing students with choice of test items to respond to on a test appears to result in lower test anxiety scores with concomitant improved test scores (Keinan & Zeidner, 1987) because the students feel they are in control. Perceived control decreases anxiety (Seligman, 1975).

Situational variables represent the the final component of educational determinants of test anxiety. The testing environment, including an evaluative versus a nonevaluative atmosphere and achievement versus neutral test instructions, affects test-anxious students (Hill & Wigfield, 1984), with the latter conditions (nonevaluative atmosphere and neutral instructions) being beneficial. The presence of external observers has been reported to negatively impact students' test anxiety (Geen, 1977; Hill & Wigfield, 1984), as do timed test conditions (Wigfield & Eccles, 1989).

Types and Characteristics of Test-Anxious Students

Test-anxious students are a heterogenous group of individuals. There are different types or categories of test-anxious students with both distinctive and overlapping characteristics. This section describes the types of students with the main charactertic(s) exemplifying each type. Following these descriptions is an inventory of characteristics as compiled from a review of the literature. These characteristics can be exhibited by all types of test-anxious students in varying degrees of intensity. The types and characteritics are integrated in Figure 1 then explained in detail to further identify and understand test-anxious students.

Mealey and Host (1992) identified three main categories of test-anxious students: those who are strategy deficient, those who are distracted during the testing time, and those who falsely believe they have the appropriate strategies. Zeidner (1998) also categorized test-anxious students. Derived from a review of the literature Zeidner (1998) delineated six types of test-anxious students: those who are deficient in study and test-taking skills, those who experience information blockage and retrieval problems, failure-accepters, failure-avoiders, self-handicappers, and perfectionistic overstrivers. Zeidner's (1998) categorizations are thought to provide greater insight and understanding as to the needs and motives of test-anxious students, and therefore deserve further explanation.

The first type, students who are deficient in study and test-taking skills, experience difficulties in encoding, storing and retrieving information. They are unprepared both in learning and testing situations.

The second type experience information blockage and retrieval problems during the testing situation even though efficient study skills are in place. The stress of the testing situation is too much and they engage in task-irrelevant thoughts which block and interfere with the retrieval of information.

The third type are the "failure accepters" (Covington, 1992). They are the students who have poor study skills and low academic ability. With repeated failure they exhibit apathy, resignation, and defeat, and self-derogation with regard to their ability. They are not unlike students who experience learned helplessness.

Failure-avoiding students, the fourth type, perceive success as being a result of one's ability, not effort. They want to be successful and avoid failure so their ability will not be in question. Their goal in the testing situation is not mastery and competence of the material, but rather doing better than others. These students exhibit an external locus of control, exert minimal effort, and employ superficial learning strategies (Ames, 1992).

For self-handicappers (Harris, Snyder, Higgens & Schrag, 1986), the fifth type of test-anxious students, test anxiety serves as a "defensive rationalizing function" (Zeidner, 1998). Test anxiety is used as a reason for anticipated failure, and to avoid failure students may lower expended effort or avoid the testing situation.

The last type, perfectionistic overstrivers (Covington, 1992), are students who expect high personal standards of success, imposed by themselves or others (parents, teachers, peers). They are meticulous, organized and study excessively, but their anxiety interferes with deep level processing and retrieval of information. Those who feel they must meet the expectations of others often feel they do not have control and tend to experience helplessness.

Typically, in learning and testing situations, test-anxious students experience difficulties with selective and sustained attention (Hill & Wigfield, 1984), problems in encoding and retrieving information, comprehending sentences (King, Ollendick, & Gullone, 1991; Tobias, 1992; Zeidner, 1998), and attending to relevant information (Hill & Wigfield, 1984). They experience cognitive interference (Sarason, 1980a; Tobias, 1992) and often utilize task irrelevant and self-derogatory inner speech (Mandler & Sarason, 1952 as cited by Spielberger, Anton, & Bedell, 1976; Wine, 1971) and ineffective test-taking skills during the testing situation (Bruch, 1981; Kirkland & Hollandsworth, 1980), resulting in lower expectations of success. They show inefficient or deficient organizational, study, cognitive, metacognitive, problem solving and memory skills (Cole & Chan, 1990; Culler & Holahan, 1980; King, Ollendick, & Gullone, 1991; Tobias, 1992), and are less likely to benefit from incidental learning (Phillips, Martin & Meyers, 1972), often spending an excessive and unnecessary amount of time studying (Culler & Holahan, 1980; Hembree, 1988). High distractibility is evident with difficulties in the deep processing, elaboration, and rehearsal of information (Zeidner, 1998). They are more comfortable when study and testing environments are congruent (Mueller & Jacabsen, 1996; Mueller, Lenhart, & Gustavson, 1989). They are negatively affected by time limits or pressures as well as material perceived to be difficult and complex, opting to choose less challenging tasks where their persistence is not taxed (Hill, 1984; Hill & Wigfield, 1984; Sarason, 1980) and where success is more likely.

Test-anxious students fear and try to avoid evaluative situations to avoid criticism and failure (Covington, 1985; Hill & Wigfield, 1984; Phillips, Pitcher, Worsham, & Miller, 1980). Physiologically, these students experience increases in heart and respiration rates, feelings of nausea, sweating and trembling

(Fossum, 1990; Zeidner, 1998) in testing or evaluative situations. They can be inclined towards an external locus of control, dependency and conformity, susceptibility to persuasion, defensiveness, social isolation, cautious rigid thinking, a proneness to feeling unprotected, and low self-efficacy, self-acceptance, self-control, and tolerance (Hembree, 1988; Phillips, Martin, & Meyer, 1972). Quite often they perceive themselves as "having something wrong" (Student, personal communication, Spring, 1997) that will never change.

Figure 1, Test-Anxious Students and Achievement Goals and Behaviors Model, integrates the types of test-anxious students with Dweck's (1986) Achievement Goals and Achievement Behavior model. The integration provides further understanding of the test-anxious student in terms of cognitive set (beliefs and attitudes), learning, performance, strategy use, self-efficacy, motivation, and behavior. It is important to understand these attributions to understand the effects of anxiety on performance (Dweck, 1986). It also provides information as to what cognitive sets and behaviors, for example, should be the focus in intervention in conjunction with strategy instruction. The model is in early stages of development.

Individuals can hold either an entity theory of intelligence or an incremental theory, although given the nature of typical test-anxious students the former is more likely to be prevalent (Pintrich & Garcia, 1991.) Entity theory students perceive little or no control in their learning and performance. They view intelligence as fixed or stable, while incremental theory students, who believe they control their learning and performance, view intelligence as malleable (Dweck, 1986). Entity students strive for performance goals which are to avoid failure and negative judgements

Theory of Intelligence	Goal Orientation	Self-Efficacy	Task Choice	Test Anxiety Type/Behavior
Entity (Intelligence is fixed) (Little or no perceived controllability)	**Performance**	**High** Efficient and Effective Strategy Use	**Challenging**	**Active Avoidance of Failure** Failure Avoider Perfectionistic Overstriver (non-adaptive) * high persistence * high effort * positive affect
		Low Less Efficient and Effective Strategy Use	Easy	**Passive Avoidance of Failure** Failure Accepter Self -Handicapper * low persistence * low effort * negative affect * helplessness * low resiliency Skills Deficiencies Retrieval Difficulties
Incremental (Intelligence is malleable) (Perceived controllability)	**Learning**	**High** or **Low** Most Efficient and Effective Strategy Use	**Challenging**	**Active Avoidance of Failure** Perfectionistic Overstriver (adaptive) * high persistence * high effort * positive affect

Figure 1. Test Anxious Students and Achievement Goals and Behaviors
Source: Adapted from Dweck's (1986) Achievement Goals and Achievement Behavior Model

because failure and judgements question ability. Covington (1985) states that students "may reason, unwittingly and without recognition of the consequences, that if [they] cannot be sure of succeeding, then [they] can try to protect a sense of dignity by avoiding failure" (p. 391). They will do so in one of two ways, depending on their self-efficacy or confidence in their ability (Dweck, 1986). If students' self-efficacy is high they are likely to choose challenging tasks because they are confident in their ability to succeed. They can be described as "active avoidant" test-anxious students (Depreeuw & De Neve, 1992), meaning they actively avoid failure by exerting effort and persistence while maintaining positive affect. They engage in the task and its preparation by using efficient and effective strategies. These students are called "active failure avoiders" (Ames, 1992) and "non-adaptive perfectionistic overstrivers". If self-efficacy is low test-anxious students are described as "passive avoidant" (Depreeuw & De Neve, 1992), meaning they avoid taking the responsibility of failure by selecting easy tasks and exerting little effort and persistence (Geen, 1980). If they fail it is because they did not try, not because they lack the ability. These student do not engage in the task or its preparation (inefficient and ineffective strategy use), maintain negative affect or self-talk, and experience difficulty recovering from obstacles and setbacks. These students are called "failure accepters" (Covington, 1992), and "self-handicappers" (Harris, Snyder, Higgins, & Schrag, 1986). Students with skill deficiencies and retrieval difficulties, based on their inefficient and ineffective use of strategies, likely fall in the passive avoidance of failure group.

Incremental theory students believe they control their learning and performance, and strive for learning goals to increase their academic competency. Regardless of their level of self-efficacy they seek challenges, are persistent in their learning, exert effort, maintain a positive affect, and utilize strategies efficiently and effectively. This is the "adaptive perfectionistic overstriver" test-anxious student.

The degree of controllability as perceived by students, which is either little or non-existent for typical test-anxious students, is a key factor in success (Seligman, 1975). Perceived controllability not only dictates motivational and cognitive consequences, but emotional consequences (Seligman, 1975), hence test anxiety levels. If students perceive uncontrollability, motivation decreases, cognitions distort perceptions of success and failure, and test anxiety increases (Leppin, Schwarzer, Belz, Jerusalem & Quast, 1987; Seligman, 1975). Phillips et al. (1980), however, also point out that test-anxious individuals with negative attributions may "subsequently give up and disengage from the task" (p. 327), suggesting a decrease in anxiety rather than an increase. Sieber (1980) also holds that students may avoid the task and become defensive, denying the anxiety or their lack of skill. These apparently contradictory relationships suggest a developmental pattern for controllability. When there is at least some perceived control, anxiety increases, but when there is no perceived control anxiety decreases. If there is no sense of control and no assistance, helplessness and defeat pervade and students give up. They may have started out as the failure avoiders, for example, but circumstances lead them to become failure accepters. Failure avoidance tactics such as cheating, setting easily attainable goals or goals set so high that achievement is impossible so they "fail with honour" (Covington, 1985), procrastination (Woolfolk, 1987), and reducing the value of the task (Wigfield & Eccles, 1990) are maladaptive behaviors which are attributable to test anxiety. These behaviors may or may not be characteristic of failure accepters and failure avoiders.

Covington (1985) states that perceptions and feelings of failure are a result of inappropriate learning conditions and lack of self-regulation skills. Hence, this study proposes metacognitive strategy instruction, of which self-regulation is central, which in turn increases controllability, is a viable approach in addressing the special needs of test-anxious students.

Self-Efficacy

In the previous description of test-anxious students it was noted that high test-anxious students are typically low in self-efficacy. Self-efficacy is a core concept in Bandura's social-cognitive theory. Bandura (1997, p. 3) describes self-efficacy as a "major basis of action" and regulation; as

> beliefs in one's capabilities to organize and execute the course of action required to produce given attainments.... [which] may entail regulating one's own motivation, thought processes, affective states, and actions, or it may involve changing environmental conditions, depending on what one seeks to manage.

It is, as Schwarzer (1997) calls it, a "can-do" – or "I can-do" – cognition. It is a confidence or belief in one's ability, distinct from one's actual abilities. Math self-efficacy is specific to abilities in the mathematical domain.

Self-efficacious students exhibit optimistic thought patterns, focusing on self-aiding (i.e., task relevant, strategic thinking) rather than self-hindering (i.e., personal deficiencies, the impossibilities of the task, adverse consequences) self-talk (Bandura, 1989, 1997). In academic situations they select challenging tasks, set high goals and maintain a commitment to those goals, invest effort in their tasks, persist in the face of difficulty, and recover quickly from setbacks, frustrations, failures, and self-doubt (Bandura, 1989, 1997 ; Schwarzer, 1997). Hackett and Betz (1989) found the value or usefulness of a task to the individual to be positively related to self-efficacy. Self-efficacy is also positively related to cognitive and self-regulatory strategy use (Bouffard-Bouchard, Parent, & Larivee, 1991; Pintrich & Garcia, 1991; Pintrich & De Groot, 1990), and therefore an internal locus of control because individuals see themselves as having control over the situation and act accordingly. It is negatively associated with depression, helplessness, and anxiety (Bandura, 1997). Zimmerman (1989) summarizes the research indicating that high self-efficacy is related to quality learning strategies, the self-monitoring of learning outcomes, effective study skills, and skill acquisition. Research findings have indicated that self-efficacy has a direct positive effect on anxiety (Pajares & Kranzler, 1995; Schwarzer & Jerusalem, 1992) and performance (Jinks & Morgan, 1999; Pajares & Miller, 1994), since students with higher levels of self-efficacy have been found to exhibit lower levels of test anxiety and higher levels of performance than students with lower levels of self-efficacy.

There is a relationship between self-efficacy and strategy instruction and strategy use that is cyclical in nature. Positive self-efficacy (Bouffard-Bouchard, Parent, & Larivee, 1991; Pintrich & Garcia, 1991; Pintrich & De Groot, 1990) and mathematical self-efficacy (Zimmerman & Martinez-Pons, 1990) are associated with more effective and efficient strategy use, and strategy instruction and effective and efficient strategy use can positively influence and promote self-efficacy (Jinks & Morgan, 1999; Laube, 1998; Schunk, 1993).

Test Anxiety, Performance and Task Difficulty

Anxiety can be both "facilitating" and "debilitating" (Alpert & Haber, 1960). Facilitating anxiety stimulates and enhances motivation and performance, while debilitating anxiety has the opposite effect. The differential effects of these two types of anxiety on performance are accounted for by students' perceptions of the testing situation. If the test is perceived as threatening, anxiety is debilitating; if perceived as challenging, anxiety is facilitating. The debilitating relationship increases throughout schooling and appears to level off in high school (Gaudry & Spielberger, 1971; Hill, 1984; Wigfield & Eccles, 1989).

The debilitating anxiety, or toxic anxiety (Gerzon, 1997), also accounts for the negative relationship between test anxiety and various measures of performance (i.e., classroom and standardized tests, grade point averages) and learning (Gaudry & Spielberger, 1971; Tobias, 1992). Figure 2, Test Anxiety, Performance and Task Difficulty, depicts the inverted-U relationship between test anxiety, performance, and task difficulty, referred to as the Yerkes-Dodson law. Simply stated, anxiety which is too low or too high is detrimental, resulting in ineffective performance, while optimal anxiety results in optimal or effective performance. Further, many variables moderate this relationship. A number of these, such as reference group, item arrangement, test format, type of instructions, test atmosphere, and so forth, were discussed in the previous section on sources of test anxiety. Task difficulty is an additional variable which affects the relationship.

Hembree (1988) reported that task difficulty and students' perceptions of task difficulty affect the magnitude of the test anxiety-performance relationship, with a substantial negative correlation for difficult or complex tasks as opposed to a trivial correlation with easy tasks. Complex tasks require higher levels of anxiety for success (Kirby & Williams, 1991) and more cognitive resources and capacity to hold and process the information. Test-anxious students are at a disadvantage because their anxiety limits the amount of cognitive resources and capacity of working memory they have available to apply to the task at hand (Mueller, 1992). They also experience attentional

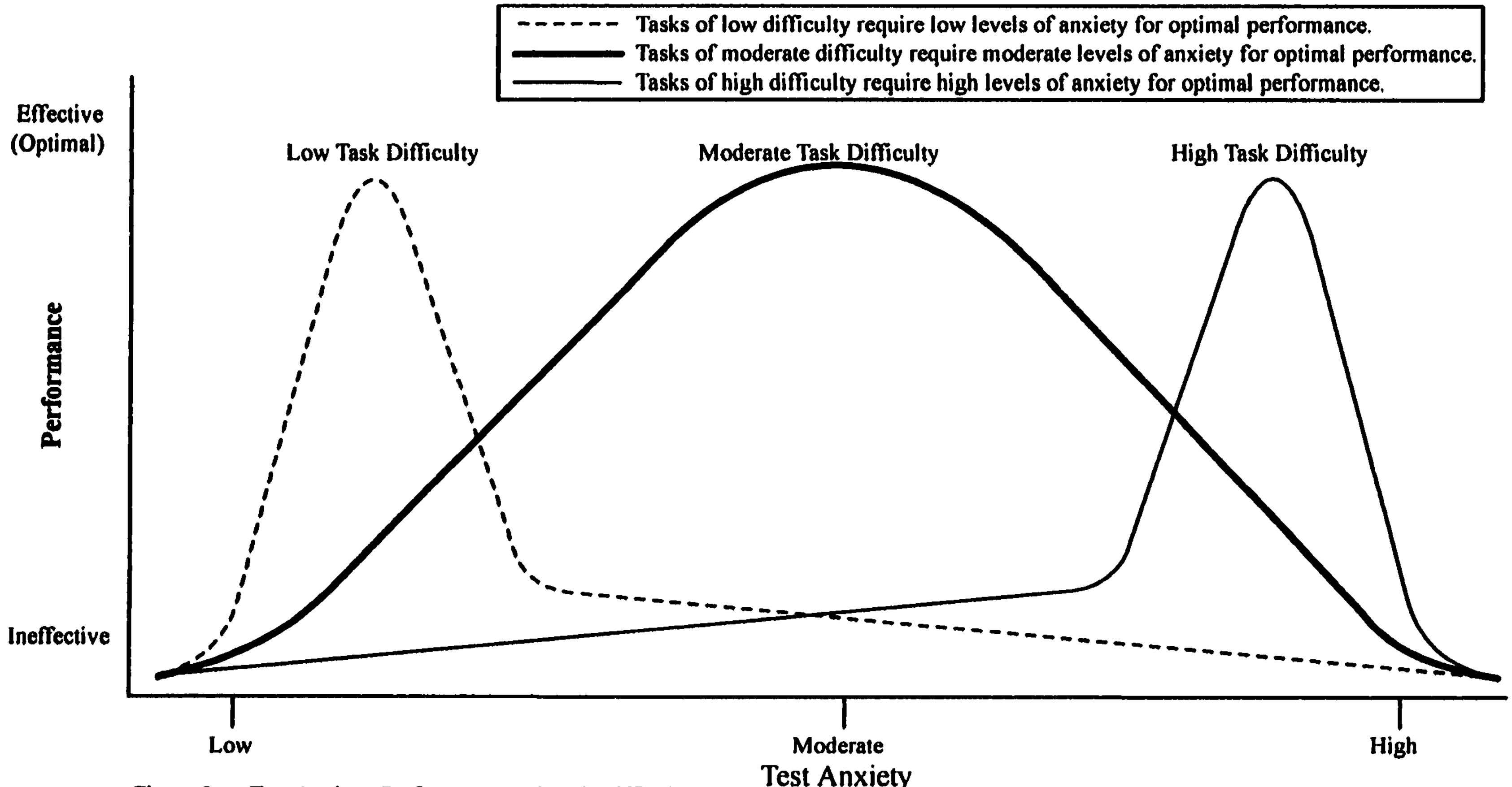

Figure 2. Test Anxiety, Performance and Task Difficulty
Adapted from Lefrançois (1997)

difficulties (Wine, 1971) and cognitive interference by indulging in task irrelevant cognitions which consist of "how poorly they are doing, how other people are faring, ... what the examiner will think about them" (Sarason, 1980a, p. 135), and how they are feeling physically. These self-preoccupations deter students from focusing and approaching the task in an orderly, systematic manner for task completion. With increased task difficulty these problems become more pronounced.

While it is agreed that task difficulty or complexity does affect performance, at the present time there is no consensus as to how to assess task difficulty or at what level task difficulty evokes its debilitating effects. Task difficulty can be related to the "actual complexity of the material itself or ... to other factors such as the ability of the examinee, amount of preparation, and prior experience with the material" (Zeidner, 1998, p. 172). Mueller (1992) points out it can be measured using Sternberg's (1984) componential analysis or Gagne's (1985) hierarchy of learning, or by information processing demands (encoding, storing, retrieving). It can also be assessed by students' perceptions, since perceptions of subject matter difficulty relate to test anxiety (Hembree, 1998; Everson et al., 1993; Zeidner, 1998). Math test content is considered easy or difficult as perceived by students in two ways, both of which take the difficulty of the material into consideration. First, students' perceptions are indirectly implied by teachers' understanding of what content students experience difficulty with in learning and testing situations. Second, the content is also considered difficult by students' reports (their perceptions) of the cognitive requirements for processing: more effort and more problem solving skills are necessary (Mueller, 1992; Student communication, March, 2000).

Problem Solving

Problem solving is the primary component of math and it is an area, in general, in which test-anxious students are weak (Salame, 1984; Zoller & Ben-Chaim, 1990). Test anxiety inhibits the use of higher cognitive process, such as problem solving, because it triggers the use of "well learned and firmly established responses" (Herrmann, Liepmann, & Otto, 1987, p. 95). Furthermore, test-anxious students tend to be pessimistic and hesitant during the problem solving process, conservative rather than flexible in their approach, and do not attempt to get an overview of the context of the problem (Herrmann, Liepmann, & Otto 1987).

Matlin (1994) delineates a number of interrelated factors which influence problem solving, three of which are problematic for test-anxious students. The first is the mental set, which tends to be a "mindless rigidity that blocks effective problem solving" (p. 358). Closely related to this factor is functional fixedness which prevents flexiblity in problem solving. Functional fixedness results in objects being used in one way and one way only. The third factor is lack of metacognitive skills. That is, the problem solving process is not self-regulated and hence, appropriate changes are not made when necessary. Making changes is difficult if the individual's thinking is not flexible. These three factors are addressed by teaching students problem solving strategies explicitly, using a metacognitive instructional approach, so that the strategies become firmly established yet require flexibility in utilization. The instruction not only enhances performance, but indirectly alleviates feelings of anxiety.

Test Anxiety "Treatment"

The nature of test anxiety has been of interest for over fifty years (Spielberger, Gonzalez, & Fletcher, 1979), but research addressing treatment for the symptoms and consequences, with the primary goal of improving performance, did not begin until the 1960s (Hembree, 1988). There are three major approaches used for treatment: cognitive-attentional interference, skills-deficits, and school programs.

Test anxiety treatment began by adhering to a Cognitive-Attentional (Interference) Model (Culler & Holahan, 1980; Sarason, 1980a; Wine, 1971) which was based on the physiological (behavioral) and cognitive components of test anxiety identified by Liebert and Morris (1967). These components were labelled Emotionality and Worry. Treatment implementation approaches were described as behavioral, cognitive, and cognitive-behavioral. Interference refers to the physiological and cognitive effects interfering with performance, attention and cognitions (i.e., divided attention between the task and personal concerns, negative self-talk). From an information processing perspective test-anxious students, due to anxiety, experience cognitive interference at the pre-processing (i.e., comprehending and encoding information), processing (i.e., reduced cognitive capacity and hence less working memory available for learning and performance), and post-processing (i.e., difficulty in retrieving prior learning from long term memory) stages of the information processing model, all of which negatively impact performance (Tobias, 1992). These early methods were followed in the 1980s and 1990s by study skills and test-taking skills training approaches. These approaches are explained by the Skills-Deficit Model (Culler & Holahan, 1980; Kirkland & Hollandsworth, 1980). The Skills-Deficit Model focuses on deficient or inefficient study and test-taking skills as the cause of anxiety and reduced performance. A third major approach has focused on"school-based programs" which change the school environment to accommodate students.

Cognitive-Attentional (Interference) Model

Test anxiety was first treated by addressing the first component of Liebert and Morris's (1967) conception of test anxiety, Emotionality, through the implementation of behavioral techniques. Emotionality refers to the "emotional nature" (Liebert & Morris, 1967) or the automatic "physiological and affective reactions to stress of the test situation" (Morris & Liebert, 1970, p. 332), the autonomic reactions (Anton & Klisch, 1995). Physiological reactions include feelings of fear, dread, nervousness, and bodily changes such as sweaty palms, generalized sweating, abdominal discomfort or pain, nausea, heartburn, rapid or shallow breathing, racing heart, and feelings of dizziness (Fossum, 1990; King, Ollendick & Gullone, 1991; Nicaise, 1995; Salame, 1984). These reactions are seen as constituting test anxiety; therefore, it is believed that if these symptoms are dealt with, then test anxiety will be alleviated and performance will improve. Various treatments and programs (i.e., implosion, modelling, observational learning, hypnosis) (Tryon, 1980) have been developed and tested, the most popular and successful being systematic desensitization and relaxation. After much research it is generally agreed that behavioral treatments result in reduced test anxiety. However, the approach has little impact on performance (Finger & Galassi, 1977) which is consistent with several studies that indicate there is "little or no relation between emotionality and performance" (Sarason, 1980; Spielberger & Vagg, 1995) and that emotionality "bears an inconsistent relationship to test performance" (Nicaise, 1995).

Treatment then focused on cognitive approaches, addressing the second component, Worry. Worry is defined as "any cognitive expression of concern about one's own performance" (i.e., concern about the consequences of failure, doubt about ability) (Morris & Liebert, 1970, p. 332). Worry "consistently correlates negatively with test performance" (Sarason, 1980, p. 118) and for this reason is perceived as more damaging to performance than physiological changes (Morris & Liebert, 1970; Wine, 1971; Zeidner, 1998). Cognitive treatments attempt to modify "behavior and emotion by influencing the client's pattern of thought" (Ledwidge, 1978 as cited by King, Ollendick & Gullone, 1991, p. 30), by concentrating on off-task attention, negative self-talk, and self-evaluation. Past research with a purely cognitive approach has focused on counselling students and has not resulted in reduced test anxiety or improved performance (Hembree, 1988; Nicaise, 1992).

It became apparent that treatment addressing both the behavioral and cognitive (Emotionality and Worry) components would be more effective in reducing the anxiety and improving performance because a cognitive-behavioral approach would teach the individual how to interpret and alleviate physiological reactions, reevaluate the threatening nature of tests, and rephrase negative self-talk (Nicaise, 1992). Hembree's (1988) meta-analysis indicates cognitive-behavioral approaches can reduce anxiety and improve performance on intelligence, aptitude and achievement tests and in grade point averages.

Skills-Deficit Model

The Skills-Deficit Model views lack of preparation in terms of poor study or test-taking skills as the cause of test anxiety and reduced performance, and addresses those cases where cognitive-behavioral approaches are not successful. Study skills consist of those behaviors which will improve encoding, acquiring, storing and retrieving learned knowledge (Tobias, 1985). Test-taking skills are "methods that increase the probability of (a) accurate interpretation of test questions, (b) recall of appropriate information, and (c) proper application of one's knowledge in solving a question" (Bruch, Juster, &

Kaflowitz, 1983, p. 529). This model is based on the findings that test-anxious students have poor study habits and fewer test-taking strategies than non-anxious students. Lack of preparation and poor performance causes anxiety.

Tryon's (1980) and Nicaise's (1995) overview and critique of study skills intervention indicates that addressing study skills alone is not effective in alleviating test anxiety or improving performance. When combined with desensitization, relaxation or anxiety management (behavioral or cognitive approaches), however, test anxiety is reduced and performance improves. Hembree (1988) reported similar results in his meta-analysis. Test-taking skills intervention alone produces no significant effects on performance, although test anxiety is moderately affected (Hembree, 1988). When study skills and test-taking skills are combined there are no significant test anxiety or performance effects (Hembree, 1988).

School-Based Programs

A third approach which began in the 1980s, but which has not received as much attention, can be labelled "school-based programs" (Wigfield & Eccles, 1989). These programs change traditional school practices and focus on, and attempt to alter, specific factors which cause difficulties for test-anxious students. Working in collaboration with parents, teachers, principals, district administrators, and educational agencies, researchers (Hill & Wigfield, 1984) have concentrated on time pressures/limits, test item arrangements, report cards, and familiarizing students with test mechanics. Others (i.e., Sarason, 1972) have concentrated on changing testing examination instructions which, if presented as ego-threatening or ability-threatening, heighten test anxiety. Another component of this approach is cognitive strategy training whereby students are taught imagery, sentence elaboration (Cubberly, Weinstein & Cubberly, 1986), text processing, and concentration strategies (Dansereau, Brooks, Holley & Collins, 1983), with reported improvement in both learning and test anxiety. Encoding (Dusek, Kermis, & Mergler, 1975; Dusek, Mergler & Kermis, 1976 as cited by Walter and Tobias, 1985) and word clustering strategies (Walters & Tobias, 1985) also report learning improvements.

It should be noted that there is great variability in the results of research on test anxiety treatment programs and what is beneficial for test-anxious students. This variability is a result of practices and procedures which make comparisons and generalizations difficult. For example, a common problem is the small sample size in many studies, which affects the power to detect statistical significance (Hembree, 1988; Wigfield & Eccles, 1989). Sample sizes of 30 (each, for control and experimental groups) are necessary to observe significance, but the majority of studies have sample sizes under 20 with one third using 8, 9, and 10 (Hembree, 1998). A second problem is the methods used to identify test-anxious students, which range from recommendations from counsellors to the use of the top 25th percentile to the top 33rd percentile as determined by a number of different anxiety scales. A third problem is that treatments vary in length of time (from one session to 6 weeks) and usually there is no follow-up to determine whether treatment effects were long lasting. A fourth major problem is that the intervention programs are not integrated into the classroom and quite frequently the tests are not classroom tests, but a variety of standardized tests in a variety of skills and subjects. These problems and others (see Sapp, 1993) need to be addressed in future test anxiety research.

All the approaches just discussed are described, in the literature, as "treatments" which are prescribed by, implemented and regulated by others. "Treatment" implies a cure with the individual being passive in the process. In actuality, test anxiety cannot be cured, but it can be and must be self-regulated, rather than "other-regulated", by the individual experiencing the symptoms and consequences. A new and little studied approach (Tobias, 1992) incorporates self-regulation as manifested in explicit and direct metacognitive strategy instruction.

Self-Regulation and Metacognitive Instruction

This section describes self-regulation and metacognitive instruction in terms of what they are and the relationship between the two. Reasons why metacognitive instruction is used in this study to address test anxiety are then delineated.

"Academic self-regulation refers to self-generated thoughts, feelings, and actions intended to attain specific educational goals, such as analyzing a reading assignment, preparing to take a test, or writing a paper" (Zimmerman, Bonner, Kovach, 1996, p. 2). It is the degree to which "individuals are metacognitively, motivationally, and behaviorally active participants in their own learning process" (Zimmerman, 1994, p. 3) and is dependent on three major components: metacognitive strategies, cognitive strategies, and effort management and control (Pintrich & De Groot, 1990). The student is relatively independent, relying on self to acquire knowledge and skills (Zimmerman & Schunk, 1989), but is not hesitant to ask for help when necessary. Self-regulation is a skill that can be taught (Whitman, 1990; Zimmerman & Schunk, 1989). It is the goal of education, which is to provide the opportunities "to gain the necessary skills, knowledge and attitudes to become life long learners and responsible citizens in a changing society" (Mission Statement, Pembina Hills Regional School Division No. 7, 1997). Self-regulated students rely on "a planned or an automatized method of learning" (Zimmerman, 1994, p. 11) which metacognitive instruction provides, and which would benefit test-anxious students because they are typically deficient or inefficient in this area. Ultimately, the goal of test anxiety interventions is to "help students understand their problem and cope effectively" (Spielberger, 1976, p. 317). Since the best agent to change oneself is oneself (Thoresen & Mahoney, 1974) self-regulation, rather than "other-regulation", is the preferred method of change.

Self-regulation, as mentioned, is manifested in metacognitive instruction. There are two parts to metacognitive instruction, namely the learning and implementation of cognitive strategies, and the monitoring and evaluation of the implementation of these cognitive strategies. "Cognitive strategies are invoked to *make* cognitive [and academic] progress, metacognitive strategies to *monitor* it." (Flavell, 1979. p. 909). Cognitive strategies are specific plans or mental activities students use in learning, and which facilitate learning and performance (Cole & Chan, 1990). Metacognitive strategies monitor the use of cognitive strategies to determine if the strategies are helpful and if they need to be modified to suit individual needs and enhance success. The use of both cognitive and metacognitive strategies is important because it is the cognitive strategies used metacognitively, not simply the use of cognitive strategies, which predict academic performance (Borkowski & Kurtz, 1984; McCombs, 1989; Zimmerman, 1994). Previous strategy research, as manifested in study and test-taking skills in the test anxiety field, appears not to have addressed the metacognitive component. The effectiveness of teaching strategies by way of a metacognitive approach in improving students' learning and performance (Harris & Pressley, 1991; Marfo, Mulcahy, Peat, Andrews & Cho, 1991; Tobias, 1992) and self-efficacy (Butler, 1995), without attention to test anxiety, is well established. As such, there are a number of reasons why metacognitive instruction would also be a sound and viable approach to alleviate test anxiety, and enhance math test performance and math self-efficacy.

The first reason is that test anxiety intervention strives "to help students understand their problem and cope effectively" (Spielberger, 1976, p. 317) so that anxiety is alleviated and performance improved. Similarly, metacognition is "conscious awareness of and control of cognitive processes" (Chipman, Segal, & Glaser, 1985, p. 13) that affect learning and performance. Both fields advocate awareness, understanding, and self-regulation in addition to the prevention of difficulties (Hembree, 1988; Phillips, Martin, & Meyer, 1972; Tobias, 1992). Students can use the knowledge actively, efficiently and independently in learning to cope with or regulate their anxiety and performance, thus maximizing their power to succeed (Ariel, 1992). Test anxiety intervention and metacognitive instruction, then, strive for common goals.

The concepts of control and perceived control are important in self-regulation and metacognitive instruction. Perceived control can improve performance (Dweck & Wortman, 1982; McCombs, 1988), motivation and self-efficacy (McCombs & Whisler, 1989) because it results in the use of efficient and appropriate learning strategies (i.e., deep and elaborative processing), confidence in learning potential (McCombs, 1988), and leads the individual to recognize the role and importance of effort in learning. Perceived lack of control, on the other hand, discounts effort. Students perceive ability as the only prerequisite for success, especially in math (Pressley & McCormick, 1995), resulting in increased anxiety, decreased motivation and distorted academic perceptions. Students engage in irrelevant strategies rather than positive coping strategies and disengage from learning and performance situations. To assist these students a focus on effort is necessary in intervention and the intervention must include a metacognitive component (McCombs, 1988; Pintrich, 1995; Schraw & Brooks, 1999). This can be accomplished by way of learning strategies, cognitive and metacognitive, which bridge the gap between effort and ability. Strategic learning emphasizes the tenet that ability increases through appropriate effort. It holds that "failure is produced by inappropriate learning strategies and that ability to generate appropriate strategies can be acquired and improved" (Derry, 1990, p. 27) with effort and practice. Students with high metacognitive knowledge perform better than those with low metacognitive knowledge regardless of ability levels (Swanson, 1990). Metacognitive knowledge increases personal control and competence (Mulcahy, 1991). Covington (1992) stated, "When students are taught how to think, effort and ability become mutually reinforcing dimensions" (p. 68).

The second reason to look to a metacognitive approach is that "highly test-anxious students can be expected to have less adequate metacognitive abilities than those with lower anxiety" (Tobias, 1992, p. 28). Pintrich and Roeser (1994) concur, having found that test-anxious students were less likely to use cognitive and self-regulatory strategies. Therefore, providing these students with metacognitive instruction addresses their deficits as postulated by the Skills-Deficit Model of test anxiety (i.e., lacks strategies) by providing them with strategies and ensuring strategy use through self-monitoring. The Cognitive-Attentional (Interference) Model, however, is not perceived as incompatible with the Skills-Deficit Model in metacognitive instruction. Inherent in a metacognitive approach strategy use eliminates interference (i.e., by focusing attention on the task at hand rather than on self-preoccupied thoughts) and addresses deficits (i.e., by promoting the acquisition and use of efficient and effective study skills). Thus, a metacognitive approach is beneficial for all types of test-anxious students.

Metacognitive instruction is also beneficial because it enables students to utilize their cognitive resources more effectively, "approach problems more systematically, and increase positive motivational beliefs such as self-efficacy" (Schraw & Brooks, 1999, p. 5). It focuses attention, increases on-task behavior, improves performance, changes causal attributions, develops the ability to cope with failure, and reduces cognitive demands, impulsivity, and self-preoccupied thinking (Cole and Chan, 1990). It also provides structure and organization which enhances learning and recall (Derry, 1990). These are areas in which test-anxious students require assistance.

Third, a metacognitive approach provides a link between affect and cognition (Tobias, 1992). It directly and indirectly addresses affective and cognitive behaviors as a result of using cognitive and metacognitive strategies, knowledge, motives, and affect that influence learning and performance. A metacognitive approach is multimodal. The history of test anxiety "treatment" indicates that a multimodal intervention, which addresses affective and cognitive components, is more successful than a single intervention.

Fourth, a metacognitive approach fulfills the criteria outlined by Schwarzer, van der Ploeg, and Spielberger (1982) as to what issues research on test anxiety must address. Metacognition addresses the role of the self in terms of using "self-enhancement coping strategies" (p. 8); the importance of natural situations, that is, instruction is in the classroom not the laboratory; task oriented cognitions and study skills; and the affective and cognitive components and the link between the two.

Strategies Program for Effective Learning and Thinking (SPELT)

The metacognitive instructional approach of Strategies Program for Effective Learning and Thinking (SPELT) was used in the teaching of two strategies in this study. This program was chosen because it includes the characteristics of a successful strategy program as identified by Hattie, Biggs and Purdie (1996) in their meta-analysis. SPELT promotes active rather than passive learners, embedded rather than detached instruction, the use of multiple rather than single strategies (i.e., combination of strategies rather than one), and addresses the affective and the cognitive domains, all by way of metacognitive awareness and understanding. It also targets elementary and junior high students rather than college students, which is the focus of many programs such as Deshler and Schumaker's (1983) University of Kansas Institute for Research on Learning Disabilities, Dansereau's (1985) Content-Independent Strategy System and Butler's (1995) Strategic Content Learning. In addition, SPELT combines the choice features of several programs (see Strategies Program for Effective Learning and Thinking, 1987).

The metacognitive nature of SPELT is realized in its training techniques. SPELT combines two types of training as identified by Brown and Palincsar (1982, as cited by Cole & Chan, 1990). It is an "Informed Training" (explicit instruction in strategies and their use) and a "Self-Control Training" (explicit instruction in planning, monitoring and evaluating strategy use) program as opposed to "Blind Training" (students are taught strategies with no explanations as to why, where or when). An ideal metacognitive program, according to Cole and Chan (1990), combines informed and self-control training.

The primary goal of SPELT is to train students to become active, independent, planful and strategic learners, thinkers and problem solvers who are aware of and regulate their learning and performance (Peat, Mulcahy & Darko-Yeboah, 1989) so that they can be successful. The program aims to develop autonomous learners who exhibit positive expectations, motivation to learn, and who use a wide range of strategies. This is accomplished by teachers implementing the program in the regular classroom using curriculum content. This form of implementation makes it an embedded approach which is more practical and effective than a detached approach. A detached approach teaches strategies and skills as separate from the subject in which they should be practiced. Students are expected to take the strategies and apply them to their academic subjects. Separate study skills classes are an example of a detached approach. The validity and generalization of what is taught in a detached approach, however, is frequently not recognized or understood by the participating students. Junior high students who have taken a detached study skills course frequently fail to generalize what they had learned in the course to their other courses. Further, many even state that they have not taken a course that helped them to learn and study (Student communications, 1998, 1999).

SPELT provides structure for test-anxious students, making the learning of strategies and content explicit. It emphasizes the importance of the individual student in learning and modifies strategies to suit personal needs. The program is suitable for all test-anxious students regardless of their reasons for, or manifestations of their anxiety.

The program is comprised of three phases (Marfo, Mulcahy, Peat, Andrews, & Cho, 1991). Phase I, Direct Teaching of Strategies, requires the teacher to introduce students to the benefit and use of strategies. Strategies are taught directly to students: students are drilled, and reminded and prompted to use strategies. This is teacher-imposed strategy instruction. In Phase II, Maintenance, Evaluation and Generalization of Strategies, students continue to use the strategies, but also evaluate their strategy use and use the strategies in different subjects or settings. Students begin to take a more active role in their learning during this phase. Phase III, Strategy Generation by Students, necessitates complete student involvement in utilizing, monitoring, evaluating and generating strategies. Students progress from being passive to active learners, self-regulating their learning and performance.

The SPELT program approach has been evaluated in a longitudinal study, the results indicating that it is a viable approach for improved learning and performance (Mulcahy, 1991). Learning disabled and gifted students' reading comprehension, vocabulary, metacognitive reading awareness, and comprehension monitoring improved with instruction. These promising results were not comparable to average students' progress, however, who did not fare as well as the learning disabled and gifted students. Mulcahy (1991) offered as an explanation the fact that learning disabled students initially lack "a systematic approach to task and thus benefit more quickly" (p. 395), gifted students "perceive the usefulness of a more refined approach" (p. 395), while the average student may perceive his approach as effective already, and be less likely to use the strategies and make progress. Average students, then, require more time to both perceive and reap the benefits.

SPELT has been implemented in a number of countries, including Korea, Hong Kong, and Australia. Recent research attests to its benefits with reference to elementary math students using a computerized problem solving version (Ahn, 1998), students with Attention Deficit Hyperactive Disorder (Breton-Haden, 1997), behavior disorders (Moench, 1998), and adult learners (Wiles, 1997). Results indicated improved math problem solving skills via a computer program, increased attention, decreases in inappropriate behavior, and improved attributions, respectively.

Gender

The literature reports gender differences in test anxiety, self-efficacy, math test performance and metcognitive instruction, although gender differences in math self-efficacy and metacognitive instruction have not been extensively researched to date.

Generally, more females are test-anxious than males (Hembree, 1988; Hill & Wigfield, 1984; Phillips et al., 1972; Sarason et al., 1960). Females are also reported to have higher levels of test anxiety (Hembree, 1988; Seipp & Schwarzer, 1996). That is, when compared to high test anxious males high test anxious females' anxiety is greater. Further, research has also indicated that these gender differences are found on the Emotionality and Worry components of test anxiety (Liebert & Morris, 1967), with females scoring higher on the Emotionality component. Some have attributed the differences in anxiety to socialization and child rearing-practices which teach males to deny or repress anxiety and be defensive (Pollack, 1998; Sarason, Davidson, Lighthall, & Ruebush, 1960) and encourage females "to admit to anxiety because it is perceived as a female trait" (Zeidner, 1990, p. 148). Others attribute the difference to differential interpretations of what the test situation means. Females tend to perceive a test situation as a threat (debilitating anxiety) while males tend to perceive it as a challenge (facilitating anxiety) (Arch, 1987).

The anxiety-performance relationship with respect to gender is more complex than the gender-anxiety relationship. Despite the gender differences in test anxiety the general anxiety-performance relationship is similar for males and females (Hembree, 1988; Sowa & LaFleur, 1986) at all educational levels (Zeidner, 1998). That is, even though high test-anxious females are more anxious than their male counterparts their performance is not more negatively affected.

The test anxiety literature, however, does not delimit the anxiety-performance relationship by subject. Performance is usually referred to globally. Gender differences in math test performance is a much researched topic in education and may be applicable to test-anxious students. Generalizations about gender differences in math, however, have been misleading. When discussing math performance, a distinction should be made between classroom math grades and standardized test scores. Kimball (1989) reported gender differences in favor of females for classroom math grades. With respect to standardized tests, the gender difference is in favor of males. Pressley and McCormick (1995) attribute the gender differences in performance to educational practices. For example, males are given more tangible rewards, asked more questions, are given more assistance, dominate discussions, and are provided with "more experience in competitive and publicly interactive activities" (p. 171). Further complicating the picture is the age of the students. There are no gender differences in math performance until junior high (Dweck, 1986; Pajares & Miller, 1994), but by the end of high school males outperform their female counterparts on math achievement tests (Skaalvik & Rankin, 1994).

> ...results indicated a small female advantage in computation in elementary and middle school and no difference in high school, no gender difference in understanding of math concepts at any age, and no gender difference in problem solving in

> elementary or middle school. The only place in which we found small-to-moderate differences favoring men was in problem solving in high school ... and in college-age samples....(Hyde, Fennema, & Lamon, 1993, p. 241)

Meta-analyses (Hyde, Fennema, & Lamon, 1993; Hyde, 1993) report that this difference at the high school level and beyond is attributable to specific math problem solving skills. Hyde, Fennema, and Lamon (1990) conclude it is the responsibility of schools, then, to explicitly teach problem solving at early grades and throughout school so that females have more practice and expertise in this skill.

Although there are gender differences, Hyde, Fennema, and Lamon (1990) suggested that the differences have decreased since 1973 to a level where differences are moderate. They reported their findings were consistent with those of Feingold (1988) who found a decline in gender differences as measured on standardized tests.

With regard to gender and self-efficacy, females tend to be less efficacious than their male counterparts (Arch, 1987; Pintrich & De Groot, 1990). The relationship between gender and math self-efficacy is a relatively new area of research (Pajares & Miller, 1994). Some researchers have found males to be more math-efficacious than females (Hackett & Betz, 1989; Pajares & Miller, 1994), while others have found no gender differences (Pajares & Kranzler, 1995; Zimmerman & Martinez-Pons, 1990).

Gender differences in strategy use, as mentioned, has not been a major focus of self-regulation and metacognitive research. Zimmerman and Martinez-Pons (1990) appear to be the forerunners in this area. In a study of grade five, eight, and eleven students they found female students to show more goal setting, planning, record keeping, and monitoring than male students.

However, there was a decline in goal setting and planning between grades eight and eleven. There were no significant differences by grade in record keeping and self-monitoring. Males tended to show more non-self-related strategies in learning. Knowing that metacognitive strategy use improves learning and performance, these results suggest female students' test anxiety, performance, and self-efficacy are more likely to improve than male students' test anxiety, performance, and self-efficacy.

Rationale

Test Anxiety and Metacognitive Instruction

Figure 3 illustrates the link between test anxiety and metacognition and provides the rationale for this study. The figure outlines the key concepts in each area of study then illustrates through directional arrows how test-anxious students' concerns can be addressed with a metacognitive approach to reduce anxiety, and enhance math test performance and math self-efficacy.

Metacognitive instruction focuses on "the awareness of one's mental processes, the capacity to reflect on how one learns, how to strengthen memory, how to tackle problems systematically - [it is] reflection, understanding, and ... ultimately control" (Nisbet & Shucksmith, 1986, p. 8). The core of metacognitive instruction is metacognitive knowledge which is the interaction of three types of knowledge: knowledge about the person, task, and strategy.

Person knowledge is general knowledge about the universals of cognition and specific knowledge about cognition and cognitive processes as they relate to the self and others, and the interaction of these types of knowledge. Affective variables, such as self-referenced cognitive knowledge

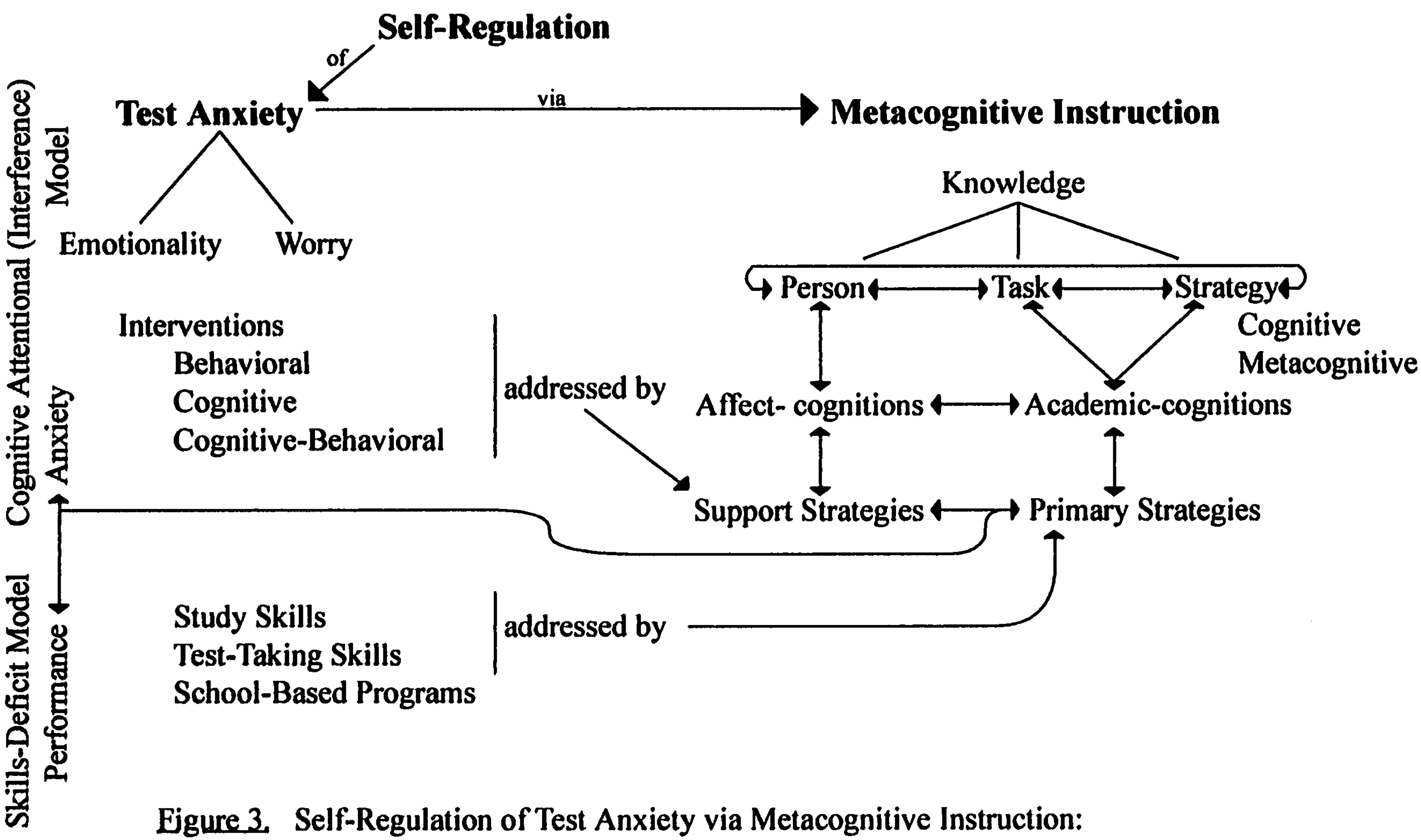

Figure 3. Self-Regulation of Test Anxiety via Metacognitive Instruction: Linking Test Anxiety and Metacognition

(Boekaerts, 1995), self-efficacy, anxiety, mood, and attributions are person knowledge. The importance of this knowledge in learning and performance is receiving more and more recognition among theorists (Boekaerts, 1995; Isen, Kaubman, & Gorgoglione, 1980; McCombs & Marshall, 1995; McCombs & Whisler, 1989).

Task knowledge is information about the task itself. The quantity (i.e., abundance of) and quality (i.e., organization, familiarity, etc.), as well as the demands (i.e., reading a tabloid newspaper versus reading Shakespeare; the number of tasks being performed, etc.) and goals (i.e., answer questions; write an essay; write a test) of the task are taken into consideration in learning and performing the task.

Strategy knowledge consists of three types of information about strategies: declarative, procedural, and conditional. Declarative knowledge asks *what* strategies should be used and *what* is known about the strategies. Procedural knowledge explains *how* to use the strategies. Conditional knowledge specifies *when*, *where* and *why* to use strategies (Palincsar, David, Winn, & Stevens, 1991; Paris & Winograd, 1990). Under strategy knowledge are two forms of strategies, cognitive and metacognitive. Cognitive strategies involve sequenced plans to solve a problem, to "achieve a physical or a mental status" (Amirkhiabani & Hendry, 1994, p. 491), or accomplish a learning or performance goal. Metacognitive strategies are used to plan, monitor and evaluate the use of cognitive strategies. Metacognitive instruction incorporates the teaching of both cognitive and metacognitive strategies.

In the diagram, beneath the types of knowledge, are affect-cognitions and academic-cognitions. This study reconceptualizes strategy and task knowledge as "academic-cognitions" because they focus on academic subject content to attain goals and subgoals; that is, they are task relevant cognitions. These academic-cognitions automatically influence and are influenced by person knowledge, or "affect-cognitions"; that is, task irrelevant cognitions. Affect-cognitions focus on cognitions associated with affect, such as anxiety, positive and negative self-talk, the emotions, and so forth. Recall that test-anxious students experience difficulties with both appropriate strategy use (hence academic-cognitions) and task irrelevant thinking (hence affect-cognitions). In the strategy literature, Dansereau (1985) identifies two types of cognitive strategies: support and primary. Support strategies are those "which are used to maintain a suitable state of mind for learning" (p. 209): these address affect-cognitions. Primary strategies "operate directly on the material to be learned" (Mulcahy, Marfo, Peat, & Andrews, 1987, p. 22): these address academic-cognitions.

Terminology, research, and interventions in test anxiety have focused on Morris and Liebert's (1967) Emotionality and Worry components in alleviating anxiety. These components are equated with affect-cognitions: Emotionality because it is defined as physiological and affective reactions (i.e., anxiety), and Worry because the focus is traditionally on negative self-focused and task-irrelevant cognitions. Support strategies, therefore, would best address Emotionality and Worry problems. Study and test-taking skill interventions, which focus on performance, are equated with academic-cognitions because academic content is addressed directly. Primary strategies are necessary to teach the skills needed to improve performance.

It becomes clear that interventions based on alleviating anxiety should concentrate on teaching support strategies while interventions based on improving performance should concentrate on teaching primary strategies. As such, it becomes apparent why teaching support strategies would not improve performance and why teaching primary strategies would not alleviate anxiety. Dansereau and his colleagues' (Dansereau, Brooks, Holley & Collins, 1983; Dansereau, 1985) research on the sequencing of these primary and support strategies when teaching, however, suggests that primary strategies may serve the purposes of both primary and support strategies. Primary strategies alleviate interference, motivational and concentration difficulties by requiring students to follow a plan. Students are then task-absorbed rather than self-absorbed. The affective and academic components appear to be addressed simultaneously with a primary strategy because students invest their energy in the task rather than in anxiety, and hence the anxiety is alleviated somewhat and performance improves (see Figure 3). In contrast to Dansereau's results, the history of test anxiety "treatment" suggests that study and test-taking skills alone are not affective in reducing anxiety or improving performance (Nicaise, 1995; Tryon, 1980). The lack of significant findings, however, may be a result of comparing unlike programs which are lacking in a metacognitive approach. This study, then, focused on the use of primary cognitive strategies, taught metacognitively, to alleviate test anxiety, improve math test performance, and enhance math self-efficacy.

Primary Cognitive Strategies

Two primary cognitive strategies were taught to students in this study. The first was a general problem-solving strategy called Road Signs. The second was a test-taking strategy called SCORER (Carmen & Adams, 1972) which can also be considered a problem-solving strategy. The general problem-solving strategy was selected because the test anxiety literature indicates there is a negative relationship between problem-solving and test anxiety (Hembree, 1988; Blankstein, Flett, Watson, 1992). Test anxiety is associated with a lower sense of personal control, less confidence in problem-solving ability, and a tendency to avoid solving problems (Blankstein, Flett, & Batten, 1989; Blankstein, Flett, &

Watson, 1992). The test-taking strategy was selected because poor performance and test anxiety can be attributed to weak test-taking skills (Bruch, Juster, & Kaflowitz, 1983; Paris, Lawton, & Turner, 1991).

Problem-solving is a challenging and anxiety producing task for test-anxious students. Problem-solving is defined as "finding a path (solution) that overcomes the obstacles, permitting us to reach the desired goal state" (Glover, Ronning, Bruning, 1990). It is a process involving "visualization, association, abstraction, comprehension, manipulation, reasoning, analysis, synthesis [and] generalization - each needing to be 'managed' and all needing to be 'coordinated'" (Hembree, 1992, p. 242). All can be overwhelming for test-anxious students who experience difficulties with divided attention and concentration at the onset of the process. The process of problem-solving involves four major steps as based on the following adaptation (Pressley & McCormick, 1995) of Polya's work (1957): Understand the Problem; Devise a Plan for Solving the Problem; Carry out the Plan; and Look Back. Test-anxious students experience obstacles at each step.

In step one, Understand the Problem, test-anxious students have trouble due to reading comprehension inefficiency (i.e., need more time to take in the information), word knowledge deficits, and encoding difficulties. They do not get an overview of the problem (Herrmann, Liepman, & Otto, 1987), scan information systematically, or assess all information (Zeidner, 1998), either neglecting or misinterpreting it (Phillips, Pitcher, Worsham, Miller, 1980). They also attend to off-task cues (Herrmann, Liepman, & Otto, 1987; Wigfield & Eccles, 1989).

In step two, Devising a Plan, test-anxious students tend to be conservative rather than flexible in their thinking, thus limiting the generation of ways and alternatives to solve the problem. They are dependent on adults for direction (Dusek, 1980). When alternatives are identified, test-anxious students tend to unsystematically shift back and forth, devote insufficient time to the alternatives, and impulsively select one that promises quick relief (Zeidner, 1998). Test-anxious students Carry out the Plan in step three, but their desire for immediate relief results in the elimination of step four, Look Back. Some test-anxious students, such as the failure accepter test-anxious students, may not carry out the plan and disengage from the process. That is, they give up and no longer exert effort in completing the task.

The teaching of problem-solving strategies to test-anxious students helps to focus attention on task relevant thoughts and provides them with structure and a systematic method for approaching the task (Cubberly, Weinstein, Cubberly, 1986). Within the present study, general (content independent) problem-solving strategies as opposed to domain-specific (content dependent) strategies were selected for a number of reasons. Research indicates that students taught Polya's four steps integrated with math instruction were more successful in problem-solving than those not taught the strategy (Burkell, Schneider, & Pressley, 1990; Charles & Lester 1984; Hembree, 1992), and that mathematical achievement is associated with use of the general strategy (Montague & Bos, 1990). General strategies act as a foundation for specific strategy development and use (Dansereau, 1985). Inherent in specific strategies is the understanding and use of general problem-solving which is illustrated when experts revert to the use of the general strategy when confronted with a difficult problem (Pressley & McCormick, 1995).

The benefit of teaching SCORER as a test-taking strategy, developed by Carmen and Adams (1972), has been investigated in three studies. Results indicated that test performance improved for junior high students with learning disabilities (Lee & Alley, 1981 as cited by Ritter & Idol-Maestas, 1986), senior high students who were mentally challenged (Ritter & Idol-Maestas, 1983 as cited by Ritter & Idol-Maestas, 1986), and poor as well as average and skilled readers in grade six (Ritter & Idol-Maestas, 1986).

Math Test Performance

Math was chosen as the test subject because there is greater test anxiety related to this subject and other mandatory subjects, such as science, English, and social studies (Tobias, 1992), than to elective or optional subjects. Moreover, there are frequent unit tests in math courses allowing for the practice of strategies in testing situations. In addition to daily work, this opportunity is crucial for successful strategy instruction. Fulkerson and Martin (1990) state that frequent tests facilitate short term performance for high test-anxious students, but that this benefit does not necessarily carry over to performance on final exams. The latter was also found in a pilot study performed by the author (Lacroix, 1994). If success using metacognitive instruction is evident on short frequent tests in this study, exam performance should then be the focus of further research.

Hypotheses

Metacognitive instruction has been found to be successful in improving learning and performance (Cole & Chan, 1990) for a variety of students (Mulcahy, 1991). Little research, however, appears to have addressed the effects of metacognitive instruction on test anxiety levels, and the math test performance and math self-efficacy of high test-anxious students. Gender differences in the effects of metacognitive instruction in relation to these variables have also been neglected. The preceding literature review culminated in the investigation of the following hypotheses:

Study 1: Test Anxiety and Math Test Performance

1.1 (a) Primary cognitive strategies taught metacognitively will alleviate levels of test anxiety in high test-anxious students. (b) High test-anxious females will benefit more from primary cognitive strategies taught metacognitively in the alleviation of test anxiety than their male counterparts.

1.2 (a) Primary cognitive strategies taught metacognitively will improve the math test performance of high test-anxious students. (b) High test-anxious females will benefit more from primary cognitive strategies taught metacognitively in the improvement of math test performance than their male counterparts.

Study 2: Math Self-Efficacy and Test Anxiety

2.1 (a) There will be differences in total and subscale math self-efficacy scores between high and low test-anxious students. (b) High and low test-anxious females will have lower total and subscale math self-efficacy scores than high and low test-anxious males.

2.2 (a) Primary cognitive strategies taught metacognitively will enhance total and subscale math self-efficacy scores in high test-anxious students. (b) High test-anxious females will benefit more from primary cognitive strategies taught metacognitively in the enhancement of total and subscale math self-efficacy scores than their male counterparts.

CHAPTER III

METHOD

Design

Study 1, Test Anxiety and Math Test Performance, and Study 2, Math Self-Efficacy and Test Anxiety, were quasi-experimental designs. This design was chosen because the experimental and control groups involved naturally assembled intact classrooms. Random group assignment was not possible due to teachers' schedules and commitments.

In Study 1 the independent variables were strategy instruction (strategy instruction and no strategy instruction), gender, and time (pre- and post- for test anxiety; test 1 and test 2 for math test performance), for high test-anxious students, with test anxiety and math test performance scores as the dependent variables.

In Study 2 the independent variables for hypothesis 2.1 were test anxiety level (high and low) and gender, with the dependent variables being total math self-efficacy and subscale scores (ability, effort, and resiliency). The independent variables for hypothesis 2.2 were the same as those in Study 1: strategy instruction, time (pre- and post- for test anxiety), and gender for high test-anxious students. Total and subscale math self-efficacy scores were the dependent variables.

Participants

Study 1 and Study 2 (Hypothesis 2.2): Test Anxiety and Math Test Performance and Math Self-Efficacy and Test Anxiety

Participants for Study 1 and Study 2 (Hypothesis 2.2) were two volunteer Grade 8 math teachers and their six classes of grade 8 math students. One teacher volunteered to implement the strategy instruction program, and thus became the experimental group, while the second teacher volunteered to take part as the control group. The experimental and control groups were comprised of three classes each: 63 students in the former and 78 students in the latter, a total of 141 students. Due to absences and spoiled questionnaires the final sample consisted of 105 students, with 54 students in the experimental group and 51 students in the control group. Each student was classified as belonging to one of three levels of test anxiety (low, moderate, high) using the A-State scale of the State-Trait Anxiety Inventory (Spielberger et al., 1983). As a result, the final sample size of high test-anxious students for Study 1 was 43 students: 20 (10 females and 10 males) students in the experimental group (strategy instruction), and 23 (15 females and 8 males) students in the control group (no strategy instruction). The final sample size of test anxious students for hypothesis 2.2 in Study 2 was 27 students: 13 (5 females and 8 males) in the strategy instruction group and 14 (12 females and 2 males) in the no strategy instruction group.

The experimental group involved a junior/senior high school located in a small town in rural Alberta, with a student population of 450 students of which 225 were junior high students. This school had posted cognitive strategy posters in a number of classes. Students had been provided with a description of the strategies and informed when to use them. Strategy instruction was not a central issue in any class instruction and did not follow the procedures as outlined by SPELT. The control group involved an elementary/junior high school located in a large major Alberta city, with a student population of 450 of which 330 were junior high students. It was the oldest school in its district with a fair amount of student movement into and out of the school during any given year.

Study 2 (Hypothesis 2.1): Math Self-Efficacy and Test Anxiety

The student sample used to investigate hypothesis 2.1 was the same sample of 141 students described above (see Study 1 and Study 2 [Hypothesis 2.2]). However, both high and low test-anxious student data were analyzed. The final sample size was 75 students: 37 low test-anxious students (21 females and 16 males), and 38 high test-anxious students (21 females and 17 males).

Intervention

Primary Cognitive Strategies

Two primary cognitive strategies were taught by the teacher in the strategy instruction group: a general problem solving strategy called Road Signs and a test-taking strategy called SCORER (Carmen & Adams, 1972). SCORER was also presented as a strategy to apply to daily math assignments. The strategy Road Signs was presented, discussed, and utilized in an everyday activity to make it explicitly relevant for students to understand the problem solving process, and to set the stage for SCORER as a type of problem solving strategy. Road Signs (see Appendix A) presented the basic problem solving steps as: Stop - Stop: What is the problem; Yield - Slow down and devise a plan; Go - Carry out the plan; Exit - Done, but check and reflect. SCORER instruction began immediately after Road Signs instruction. SCORER (see Appendix A) is a mnemonic for the following steps: S - Schedule your time; C - look for Clue words; O - Omit the difficult questions; R - Read carefully; E - Estimate your answers; R - Review you work. It was presented as a plan which was derived from general problem solving ('Yield' in Road Signs) and as applicable when completing daily work, studying, and taking tests.

Metacognitive Components

The metacognitive components were instruction in awareness and understanding test anxiety and its effects, and strategy use and its benefits. This information was imparted by way of direct instruction by the teacher who was provided with step by step lesson plans written by the researcher. This constituted Phase I of SPELT, Direct Teaching of Strategies. Students monitored and evaluated the strategies and their personal use by way of strategy logs (see Appendix A) and a PNI form (Positive, Negative, Interesting points about the strategies) (see Appendix A). The teacher was instructed to verbally prompt and remind students to use the primary cognitive strategies, primarily SCORER, in daily math work as well as in tests. These practices constituted the maintenance and evaluation components of Phase II, Maintainence and Generalization of Strategies. The generalization component of Phase II and student strategy generation of Phase III, Strategy Generation by Students, were not directly addressed in this study.

Instruments

Test Anxiety

The A-State scale of the State-Trait Anxiety Inventory (Form Y, which is "a 'purer' measure of anxiety and is relatively more independent of depression than Form X" [Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983, p. 21]) was utilized to determine test anxiety levels. Form Y was administered for both pre- and post-testing periods. This scale has been used extensively in research as a measure of test anxiety to investigate changes in test anxiety and the effects of anxiety on test performance. It has been translated into at least five languages (Dutch, German, Italian, Portuguese, and Spanish) which illustrates its popularity as a test anxiety measure. The scale is comprised of twenty questions to which students indicate how they feel at a particular moment. In this study the particular moment was immediately prior to writing their math test.

The test-retest reliability for A-State anxiety is low, ranging from .16 to .54 for college and high schools students. This is to be expected, however, given that emotional conditions vary over time and situation, and a valid measure should reflect "the influence of unique situational factors that exist at the time of testing" (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983, p. 13). Internal consistency, a better indicator of reliability of scales of this nature, is high for high school students: .86 for males and .94 for females. Construct validity is evident in studies that indicate that A-State anxiety is higher in exam situations than after relaxation training or during normal conditions. Administration procedures (i.e., informing students of confidentiality, the importance of honesty, emphasizing how they feel "right now...at this moment", brevity in administration time) help to increase the validity and reliability concerns associated with self-reports.

In this study, students indicated how anxious they felt, at the moment immediately prior to writing a math test, on a four point Likert scale ("Not At All" = 1; "Somewhat" = 2; "Moderately So" = 3; and "Very Much So" = 4). There were items which indicated the presence of anxiety as well as the absence of anxiety. Each anxiety-present item was given a score of 1 to 4, while the scores for anxiety-absent items were reversed. Scores of 4 on a anxiety-present items (10 items in all) and anxiety-absent items (10 items in all) indicated high anxiety. Scores were derived by adding the scores of the 20 items and could range from 20 (low anxiety) to 80 (high anxiety). High and low anxious groups were classified using the 40th and 60th percentiles. The raw score equivalent at the 40th percentile was 35 or less, denoting low test anxiety. The raw score equivalent at the 60th percentile was 42 or more, denoting high test anxiety. Using these cutoffs, the experimental group was comprised of 41 students (F = 20; M = 21) with 21 being low (F = 10; M = 11) and 20 being high (F = 10; M = 10) and the control group was comprised of 44 students (F = 26; M = 18), with 21 being low (F = 11; M = 10) in test anxiety and 23 high (F = 15; M = 8). There were 12 students in the experimental group who exhibited moderate test anxiety and 7 in the control group.

Math Performance

Performance was assessed using the test results, in percentages, of the math tests students wrote immediately after they completed the A-State scale. The choice of a routine class math test was based on concerns for face validity (Schwarzer, van der Ploeg, & Spielberger, 1982). Mock tests, standardized measures and grade point averages were not used in order to avoid motivational issues (see Paris, Lawton, & Turner, 1991). Other methods of evaluating performance (i.e., presentations, group collaboration, papers) do not all necessarily increase anxiety as does a testing situation. Since a goal of metacognitive instruction is assisting students in the process of learning and test performance in the classroom with curricular content the use of routine classroom tests was considered congruous. Mulcahy, Marfo, Peat and Andrew (1987) emphasize that "training and test tasks need to be closely related; the further the test task from the training task, the more difficult it becomes to find transfer effects" (p. 100).

The math tests were constructed by the teachers. The two teachers used both similar and different resources and did not teach the same sequence of units as presented in the textbooks, each developing his/her own instructional sequence. The study commenced approximately five months into the school year and therefore did not allow for any major changes in sequencing of instructional material. Consequently, the units tested were not identical for both groups. The experimental group was tested on fractions (test 1) and equations (test 2), while the control group was tested on ratio (test 1) and geometry (test 2).

Four grade 8 math teachers (the two teachers involved in the study, a teacher from the pilot study for Me and Math, and a teacher who attended the training workshop) were asked to rate the level of difficulty (on a scale of 1 to 5) of the content of the tests in the study. Teacher opinion was considered important because of their experience in teaching math and their insights as to what topics cause student difficulties. The consensus was that the content assessed in test 1 in both cases was less difficult than the content in test 2. Student opinion was also considered. A small survey of student opinion indicated that the content for tests 2 required more effort and problem-solving on their part, and therefore these were identified as being more difficult than test 1 in both cases.

Me and Math: Math Self-Efficacy

Me and Math was developed for two purposes: one, to provide an intermediate rather than specific measure of math self-efficacy, and two, to provide a scale which might profile students' strong or weak self-efficacious characteristics. Current math self-efficacy instruments tend to be specific in subject content and questions. A brief discussion about the levels of self-efficacious asssessment further explains why Me and Math, an intermediate measure, was developed for this study. Reasons for focusing on self-efficacious characteristics are also explained in more detail.

To assess self-efficacy Bandura (1997) proposed three levels of assessment: specific, intermediate, and global. A specific level measures self-efficacy in relation to a specific task under specific conditions. In math, for example, students would indicate whether they could successfully answer a specific multiplication question such as 2 X 2. An intermediate level of assessment measures performance within a domain with common properties. For example, items would all be related to math but not to specific math tasks, such as "I worry because I am not good in math." The last level, global, measures self-efficacy without being domain or task specific. It is a "general personality disposition [that] refers to a global confidence in one's coping ability across a wide range of demanding or novel situations" (Schwarzer, 1997, p. 2). For example, an item from Schwarzer and Jerusalem's (1992, as cited in Schwarzer, 1997) General Perceived Self-Efficacy asks respondents to respond to, "I am confident that I could deal efficiently with unexpected events" (Schwarzer, 1997).

The level of assessment used is dependent on the knowledge of situational demands and the purpose, whether that might be predicting achievement or having practical utility. For example, predictability of achievement decreases with each level of assessment, while practicality appears to increase. Specific assessment is necessary if the purpose is to predict or explain achievement. If generic or "prototypic" (Bandura, 1997, p. 49) classes of performance or behavior in certain settings are the focus, intermediate assessment is of more value, although intermediate assessment can predict performance in some situations (Jinks & Morgan, 1999). If the purpose is to look at cultural differences, for example, general levels of assessment are valuable (Schwarzer, 1997). Bandura (1997) points out that choice of level in research is also dependent on people's time and patience and that a drawback of specific assessment may be that self-efficacy is based on the answer to one item, thus questioning reliability. For these reasons, practicality, research participants' time and patience, and reliability, Me and Math was developed as an intermediate level of assessment.

A review of the literature suggested that little research has concentrated on profiling students' self-efficacy using the characteristics and behaviors of a self-efficacious person, with the exception of Jinks and Morgan's (1999) Morgan-Jinks Student Efficacy Scale (MJSES) which examines children's perceived academic self-efficacy using three resultant subscales. The dominant unspoken assumption appears to be that if students' self-efficacy is weak, they are weak in all self-efficacious characteristics. Jinks and Morgan's (1999) results appeared to support this assumption. Intellectual and achievement tests, however, illustrate that this is not a valid assumption. These tests provide full scale scores as well as subtest scores. Two individuals may have the same full scale score, but their profile of strengths and weaknesses will be different based on their subtest scores. What is appropriate for one student may not be appropriate for the other when it comes to content learning or style of learning. With reference to self-efficacy two students may perceive their ability as high but each may differ, for example, in his/her perceptions of effort and its importance, which eventually will affect performance and success. Identification of specific characteristics provides information to assist teachers in motivating students, and modifying instruction, assessment philosophies and practices (Jinks & Morgan, 1999; Pajares, 1996a, 1996b). Further, identification of specific characteristics also helps teachers to realize the importance of paying attention to perceptions of competence as well as important as actual performance (Hackett & Betz, 1989; Pajares, 1996a, 1996b). Finally, the scale was developed with the intent that it may be useful in other academic subjects with little change other than the subject name.

Development of Me and Math. Dominant characteristics of a self-efficacious individual as described in Chapter II were used as the basis for developing this scale. Thirty-seven statements were originally written to constitute the Me and Math scale. These statements were worded both in affirmative and negative format, with four items for each characteristic, with the exception of locus of control which had five items. Three graduate students in the field assessed the face validity of the scale. As a result one item was changed: a "locus of control" item was designated as identifying "ability" which increased the "ability" items to five and decreased the "locus of control" items to four. The following are the characteristics on the original scale and a brief definition of each:

Effort: attributes success/failure to effort, not luck or lack of ability;

Ability: sees oneself as able to perform the tasks; believes ability is malleable due to effort; presents with a learning goal orientation

Persistence: does not give up when experiencing difficulty

Inner Speech: utilizes positive self-talk

Task Choice: selects challenging tasks and does not intentionally avoid them; does not fear failure

Goals: selects challenging goals and performance standards, and strives for them

Resiliency: recovers quickly from setbacks, frustrations, failures, and self-doubt

Value: sees the value and importance of the subject area

Locus of Control: takes responsibility for one's own learning; an internal locus of control

The final scale was administered to grade eight (N = 161: F = 78; M = 83) and nine students (N = 156: F = 75; M = 81) at a local junior high school, a total of 317 students. The researcher administered questionnaires to three classes to screen for potential difficulties and questions. Students appeared to have no difficulty with the instrument and did not require clarification of any kind. The remaining questionnaires were administered by teachers during health classes. One teacher informed the researcher that one item was questioned by students. This item was reworded on the final scale (see Appendix B).

In completing Me and Math students were instructed to respond by thinking how they felt about themselves with reference to math using a five point Likert scale (Strongly disagree" = 1, "Disagree" = 2, "Undecided" = 3, "Agree" = 4, and "Strongly agree" = 5). There were items which reflected both positive and negative math self-efficacy. Each item was given a score of 1 to 5. Reversed scoring was used for the negative items. Scores were derived by adding the scores for each of the 20 items and could range from 37 (low math self-efficacy) to 185 (high math self-efficacy).

Exploratory factor analysis was performed on the Me and Math data with the best solution being offered by the following procedure. An initial extraction using principal component analysis resulted in eight unrotated principal components with eigenvalues greater than one, with the highest loading on the first factor. A scree plot, however, suggested three factors. These three factors accounted for 36.79% of the variance, with factor one accounting for 26.17%, factor two for 7.45%, and factor three for 3.18%. A principal axis factoring, specifying three factors, with quartimax rotation, resulted in 26 items loading on factor 1, 8 items on factor 2, and 2 items on factor three (see Appendix B for original scale, factor loadings and items). Items 1, 15, and 37 did not load on any factors and were eliminated from the final analysis. Items 14 and 20 loaded on both factors 1 and 2 with the higher loadings on factor 1, and were included as factor 1 variables. The three factors continued to account for 36.79% of the variance with slight variations in the variances for each factor: 25.56%, 6.78%, and 4.46%, respectively. The factors were classified according to the dominant self-efficacious characteristic reflected by the items as a group. As a result, the factors were labelled Ability, Effort and Resiliency, respectively, the first two corresponding to what Zimmerman and Martinez-Pons (1990) identify as the "two characteristics closely associated with self-efficacy" (p. 52). The Jinks and Morgan (1999) academics scale also identified these two characteristics. Reliability coefficients were computed for the full scale (math self-efficacy) and subscales (ability, effort, resiliency). These results were .91 for math self-efficacy, .93 for ability, .73 for effort, and .80 for resiliency.

Procedure

Teacher In-service

The strategy instruction teacher attended a one-day workshop presented by the researcher. The teacher was presented with a detailed and comprehensive manual outlining the theoretical background and methodology of SPELT as well as background information about test anxiety (definitions, development, effects on learning and achievement, "treatment"). The manual also included lesson plans and materials for implementation of the strategies. The teacher was advised that the lesson plans could be implemented as written, but modifications of the strategies or the presentation to suit students was encouraged. An underlying assumption of strategy instruction is that the strategies must suit the individual and can be changed to suit the individual's needs. This is the interaction of the person, task, and strategy knowledge of metacognitive knowledge outlined in Chapter II.

Through discussion and observation it was determined that the teachers were not implementing approaches or methods similar to SPELT which would adversely affect this study. Both the experimental and control group teachers utilized traditional instructional formats, as identified by Stodolsky (1985), which consisted of review, instruction, and practice (individual or pairs/small group).

Implementation

Study 1: Test Anxiety and Math Test Performance. The in-service took place in mid-January. The A-State scale of the STAI and math test 1 were administered by the classroom teachers in mid-February for the experimental group and at the end of January for the control group. Post-testing of the A-State anxiety scale and the administration of math test 2 took place in June for both groups. Strategy instruction took place between February and June resulting in approximately four months of instruction.

Weekly telephone contact was maintained between the strategy teacher and the researcher. Discussion centered on the implementation of the strategies, logs, and PNI forms, and whether there were problems, feedback from students, and so forth. The researcher also observed the experimental group math classes on one occasion. The control teacher was contacted by telephone and in person on several occasions with reference to procedure, data distribution, and collection.

Study 2: Math Self-Efficacy and Test Anxiety. The 37 item Me and Math scale was administered to the experimental group prior to math test 1 and after math test 2. The same scale was administered to the control group after math test 1 and after math test 2.

Analysis

Study 1: Test Anxiety and Math Test Performance

Data were analyzed using a three-way (Strategy Instruction X Gender X Time) analysis of variance (ANOVA) with repeated measures on the last factor. The ANOVAs were used to examine between and within-group differences for each of the dependent variables, test anxiety and math test performance. An alpha level of .05 was used for statistical tests, with exact values rounded and reported. There were 43 high test-anxious grade eight math students: 20 (10 females and 10 males) in the strategy instruction (experimental) group and 23 (15 females and 8 males) students in the no strategy instruction (control) group.

Study 2: Math Self-Efficacy and Test Anxiety

A t-test for total math self-efficacy scores and multivariate analysis for subscale math self-efficacy scores were used to answer part (a) of hypothesis 2.1. To investigate gender differences in part (b) of hypothesis 2.1 a two-way (Test Anxiety Level X Gender) analysis of variance (ANOVA) and a two-way multivariate analysis of variance (MANOVA) were computed for math self-efficacy and the math self-efficacy subscales, respectively. The analysis involved 38 high test-anxious students (F = 21; M = 17) and 37 low test-anxious students (F = 21; M = 16). An alpha level of .05 was used for statistical tests, with exact values rounded and reported.

For hypothesis 2.2 data were analyzed using a three-way (Strategy Instruction X Gender X Time) ANOVA and a three-way MANOVA with repeated measures on the last factor, for total math self-efficacy and subscale scores, respectively. The analysis involved 27 high test-anxious students (F = 17; M = 10), 13 in the strategy instruction group (F = 5; M = 8) and 14 in the no strategy instruction group (F = 12; M = 2). Again, an alpha level of .05 was used for statistical tests with exact values rounded and reported.

CHAPTER IV

RESULTS AND DISCUSSIONS

This chapter presents the results and discussion for each of Study 1 and Study 2. For each Study each hypothesis is stated, followed by the results and a discussion of the findings.

Study 1: Test Anxiety and Math Test Performance

Hypothesis 1.1

(a) Primary cognitive strategies taught metacognitively will alleviate levels of test anxiety in high test-anxious students. (b) High test-anxious females will benefit more from primary cognitive strategies taught metacognitively in the alleviation of test anxiety than their male counterparts.

Results

The means and standard deviations for test anxiety levels are shown in Table 1. Results of the three-way ANOVA, presented in Table 2, revealed a significant between group main effect for gender ($F(1,39) = 4.66$, $p < .04$) with females showing higher levels of test anxiety than their male counterparts.

A significant within-group main effect for time was found ($F(1,39) = 5.80$, $p < .02$) (see Figure 4) which indicated that test anxiety decreased significantly over time, but it appeared unaffected by strategy instruction. Although there were no interaction effects, further examination of the data showed that the largest decrease was in the no strategy instruction group with the males showing the largest decrease in this group (see Figure 5). It appeared that the significant decrease in test anxiety scores was attributable primarily to males who did not receive strategy instruction.

Table 1

Means and Standard Deviations of Pre- and Post-Test Anxiety Scores for High Test-Anxious Students by Strategy Instruction and Gender

		Pre-test		Post-test	
	N	M	SD	M	SD
Strategy Instruction					
Total	20	49.60	7.69	47.65	8.63
Female	10	53.20	8.47	50.40	10.76
Male	10	46.00	4.92	44.90	4.98
No Strategy Instruction					
Total	23	52.20	8.36	46.13	13.56
Female	15	51.80	7.20	49.07	11.91
Male	8	53.13	10.71	40.63	15.54

Table 2

Three-Way Analysis of Variance of Test Anxiety Scores for High Test-Anxious Students by Strategy Instruction and Gender

	df	MS	F	Sig.
		Between Subjects		
Strategy Instruction(A)	1	1.74	.00	.99
Gender (B)	1	501.32	4.66	.04*
A x B	1	39.80	.37	.55
Error	39	(107.49)		
		Within Subjects		
Time (C)	1	467.34	5.80	.02*
C x A	1	163.97	2.04	.16
C x B	1	83.07	1.03	.32
C x A x B	1	167.85	2.08	.16
Error	39	(80.53)		

Note. Value enclosed in parentheses represents mean square error.

* $p < .05$

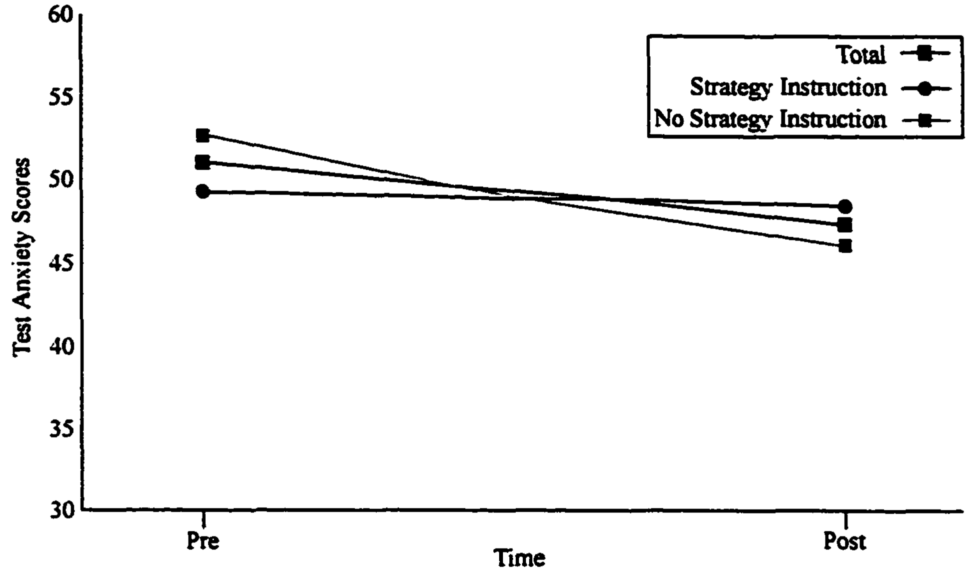

Figure 4. Decreases in Test Anxiety Scores

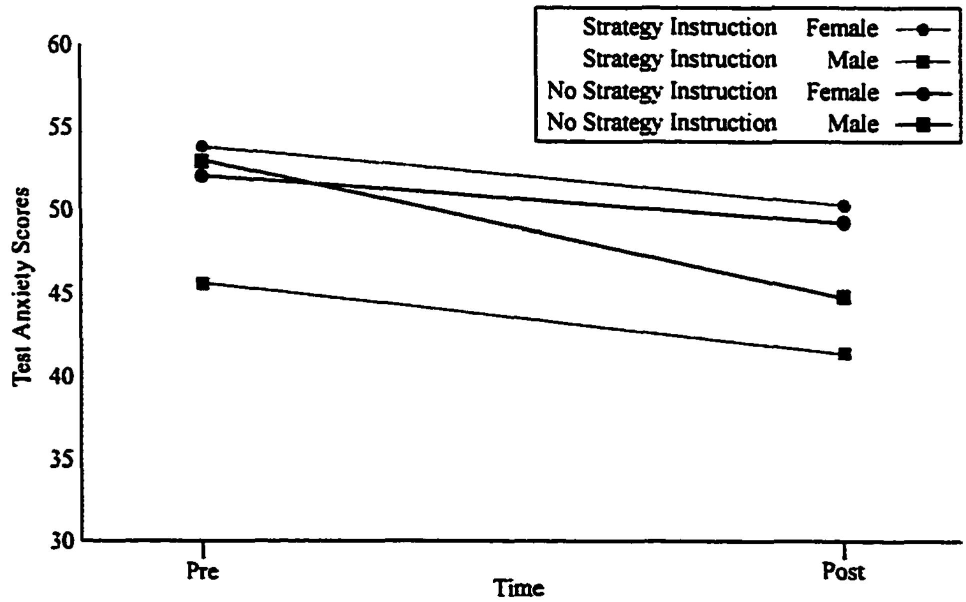

Figure 5. Decreases in Test Anxiety Scores
by Strategy Instruction and Gender

Discussion

Results of the analysis indicated that primary cognitive strategies taught metacognitively did not significantly alleviate test anxiety levels in high test anxious students. Further, there were no gender differences in the benefits of metacognitive instruction in alleviating test anxiety. These results are discussed in terms of why metacognitive strategy instruction may not have been successful, followed by a discussion of statistically significant findings, ending with a look at a non-statistically significant finding which is of interest and value.

Metacognitive Strategy Instruction. There are five possible reasons as to why metacognitive instruction of primary strategies did not make a significant impact in this study: task difficulty, time, ability/achievement, number of strategies taught, and type of strategies taught. These reasons are dynamically interrelated, meaning they influence and are influenced by each other.

The task difficulty of math tests 1 (fractions and ratio) and math tests 2 (equations and geometry) became a confounding variable in this study because math tests 2 were considered more difficult than math tests 1. Difficult, or complex, tasks require higher levels of anxiety for success (Kirby & William, 1991). Thus, while attempting to alleviate test anxiety using strategy instruction, test anxiety was increased by the level of task difficulty of the second set of math tests. Ideally, all tests should have been at the same level of difficulty to determine the true effects of metacognitive instruction.

Time refers to when instruction began and length of the intervention. Teacher feedback suggested that instruction should have begun at the beginning of the school year when routines were first established. They found students to be hesitant and somewhat resistant in accepting new routines five months into the academic year. Nisbet and Shucksmith (1986) maintain that the prime time for "learning to learn" (learning strategies) is between the ages of ten and fourteen years, a span which included the sample of students in this study. So while the age span was conducive to success (Hattie, Biggs, & Purdie, 1996) the time of actual implementation was not. Early implementation would also be more practical for teachers as well, in terms of planning the sequencing of math content so identical math tests, and hence the same level of task difficulty, could be used as the performance measure.

The length of time of the intervention in this study, four months, was likely too short as well. A number of researchers have postulated that problem solving ability (Charles & Lester, 1984) and the long term benefits of strategy instruction do not happen overnight (Butler, 1995; Hattie, Biggs, & Purdie, 1996; Mulcahy, Marfo, Peat, & Andrew, 1987; Pintrich, 1995). Metacognitive strategy instruction is a long process requiring time for practice, automaticity, and success. Further, initial practice can result in performance decrements (Tobias, 1992) because the strategy is not yet automatic. Automaticity, when achieved, does not require the working memory that newly learned strategies require, especially if used with difficult tasks (Zeidner, 1998). Within four months automaticity may not have been achieved. Future metacognitive research should examine the relationship between practice and automaticity and improvements or decrements in performance more closely. Researchers and teachers should also be cognizant that it is unlikely a student who has struggled with test anxiety for several years will quickly learn to cope successfully with problems that are habitual.

The third reason proposed for the lack of improvement in test anxiety levels after metacognitive instruction is the ability/achievement of high test-anxious students. In their meta-analysis of strategy intervention programs

Hattie, Biggs, and Purdie (1996) found underachievers and high ability students to benefit more from metacognitive programs. Schraw and Brooks (1999) and Mulcahy (1991) concur, suggesting that low achieving students have fewer strategies and have far more room for improvement while high ability students "may perceive the usefulness of a more refined approach and thus use and extend the strategies" (p. 395). Further, average students, Mulcahy (1991) suggests, "have a reasonably effective approach to tasks already and thus a greater effort is needed to change or refine their strategic approach" (p. 394). Strategy choice and success, then, is related to ability and achievement levels. Lack of improvement in this study might indicate that the sample was comprised of primarily average students, and therefore, more time and student effort would be needed to see significant benefits.

Success and strategy choice based on ability and achievement is also important in relation to test-anxious students and appropriate interventions. Gaudry and Spielberger (1971) cite a study (Spielberger & Weitz, 1964) in which high anxiety facilitated the performance of high ability students and debilitated the performance of low and average students. With regard to instruction, Birenbaum and Nasser (1994) found high ability test-anxious students to support the Cognitive-Attentional (Interference) Model of test anxiety which meant they would benefit primarily from behavioral training such as relaxation to reduce anxiety. Low ability students, however, supported the Skills-Deficit Model and required a focus on study skills. They further proposed that both types would benefit from cognitive restructuring (positive self-talk). Ability/achievement, then, should be taken into account in future research (Gaudry & Spielberger, 1971) so that strategy choice can be based on appropriate information and individual needs to guide differential and successful strategy intervention for test-anxious students.

The number of strategies students were taught constitute a fourth possibility as to why strategy instruction may not have been successful. This study introduced two cognitive strategies, Road Signs and SCORER, with an emphasis on continued practice in using SCORER, over a four-month period. Schraw and Brooks (1999) stated that "no single strategy is enough to bring about a substantial change in learning " (p. 5) and performance. They recommend a repertoire of four to five interrelated strategies, although the number would be dependent on the students and their needs without overwhelming them while at the same time allowing mastery in skill and the will (i.e., motivation) (Garcia, 1995; Schraw & Brooks, 1999) to use the strategies.

Type of strategies is the fifth factor which requires consideration in strategy instruction success. Hattie, Biggs, and Purdie (1996) indicated that successful strategy programs with multicomponents are more successful than single component programs. For example, addressing study skills (primary strategies) and efficacy expectations (support strategies) components would be more successful than addressing study skill alone. The same conclusion was reached when reviewing test anxiety interventions. That is, that a multimodal approach addressing individual needs has been found to be more successful than concentrating on one component to remediate all difficulties. This study investigated two similar components, study and test-taking skills, which directly addressed performance concerns, and whether it would also indirectly function as a support strategy and address anxiety concerns (see Figure 3). Results indicated anxiety was not alleviated, suggesting the anxiety must be addressed directly and explicitly with a support strategy (i.e., relaxation, positive self-talk) in addition to the primary strategy to address performance.

These results are not consistent with Dansereau's (1985) work where the primary strategy also functioned as a support strategy.

A subsequent concern about what types of strategies to teach leads to a concern regarding order of strategy type instruction. There is the interactive nature of affect and cognition to consider as well as the view that emotion exerts much power on cognition (Borkowski, Carr, Rellinger, & Pressley, 1990; Dansereau, 1985; Ellsworth, 1991; Scruggs & Brigham, 1990). McCombs and Marshall (1995, p. 5) state

> The rich internal world of beliefs, goals, expectations, and feelings can enhance or interfere with learners' quality of thinking and understandings created. The relationship among thoughts, mood, and behavior underlies individuals' psychological health and ability to learn. Learners' interpretations or constructions of reality can facilitate or impede positive motivation, learning, and performance.

Isen, Daubman, and Gorgoglione (1983) also discuss the impact of positive affect on cognition and learning. For example, positive affect influences organization, categorization, and retrieval of material, memory, problem solving, word association and strategy choice. Research is needed, then, to investigate metacognitive instructional effects and the sequencing of strategy types (support-primary; primary-support; simultaneous instruction) as well as the singular effects of support strategies only and primary strategies only on test anxiety.

It is also possible that the cognitive strategies in this study may not have addressed the individual students' reasons for anxiety and their unique needs. Numerous researchers (Birenbaum & Nasser, 1994; Mueller, 1992; Nicaise, 1995; Wigfield & Eccles, 1990; Zeidner, 1998) agree that there are a number of different reasons for test anxiety and that in order to assist test-anxious students these reasons and accompanying symptoms must be identified and understood (Ahlawat, 1989). The information is needed to design individualized intervention plans. A lack of significant improvement in test anxiety may have been due to individual needs not being identified and addressed. For example, rather than a problem solving or test-taking strategy some students may have benefited more from learning about time management for studying or from learning how to read textbooks and take notes effectively and efficiently. The researcher's personal awareness and understanding resulting from this study is that individual test-anxious students' needs necessitate attention.

Strategy type also refers to the specific strategy itself. Road Signs and SCORER were used, but may not have been suitable problem solving and test-taking strategies for some students, although students were encouraged to personalize the strategies to make them more personally effective.

Significant Findings. Strategy instruction did not appear to alleviate test anxiety levels, as proposed, but test anxiety did decrease significantly over time. As mentioned, this decrease appears to be attributable to the male students who did not receive strategy instruction. A qualitative review of these students' marks and discussion with the teacher indicated these students struggled throughout the academic year and seemed to have "given up" on math test 2. They can be described as the passive avoiders of failure (Depreeuw & De Neve, 1992) and the failure accepters identified by Covington (1992) (see Figure 1). Failure accepters are characterized by inefficient and ineffective study habits and low academic ability. Repeated failure has lead to apathy, resignation, learned helplessness, self-degrogation, and a lack of resiliency in recovering from setbacks and obstacles. The testing situation is perceived as a threat rather than a challenge. Phillips, Pitcher, Worsham and Miller (1980) state that students with negative attributions (i.e., self-degrogation, negative self-talk) "give up and disengage from the task" (p. 327), with the result that anxiety decreases rather than increases. They perceive a lack of control in their learning and, therefore, avoid taking responsiblity for their failure by selecting easy tasks and exerting little effort or persistence. Effort is discounted.

This group of males provides convincing evidence as to why test anxiety should be addressed. If not addressed students are at-risk for a range of dynamic problems, as discussed, which will become more debilitating with time (Hill & Wigfield, 1984; Zeidner, 1998), affecting them both in school and life outside of academia. The problem cannot be ignored. Test anxiety should not be considered a topic "like the weather, much discussed but with not much done about it" (Sarason, 1980, p. 5). These males also attest to why we need to not only understand and address test anxiety in general, but also the specific needs of individuals if we are to assist them in dealing and coping with their difficulties so that they may be successful.

Females in this study were statistically more test anxious than their male counterparts, although the difference was modest (52.50 for females versus 49.56 for males, with a difference of 2.94 points). These results are consistent with the literature (Hembree, 1988; Seipp & Schwarzer, 1996). Females, however, did not benefit more from the use of primary cognitive strategies than males in alleviating their test anxiety even though they are reported to be better at using these types of strategies than males (Zimmerman & Pons, 1990). If they are using primary strategies already perhaps the focus for females, then, needs to be more directly on the Emotionality component, which requires the use of support strategies (i.e., relaxation) to alleviate test anxiety.

The literature indicates that females score higher on this component of test anxiety than males (Seipp & Schwarzer, 1996).

Non-Significant Finding. Although strategy instruction did not alleviate test anxiety in the experimental group, it is interesting to note that the level of test anxiety remained relatively constant. Tasks of increased difficulty increase anxiety (Kirby & Williams, 1991). Considering that math test 2 was more difficult, anxiety would have been expected to increase.It can be suggested that the primary strategy may have alleviated test anxiety by maintaining the level of anxiety when the task became more difficult. The primary strategy functioned as a support strategy, as Dansereau (1985) found in his research. However, the teaching of a support strategy may have been more beneficial. Obviously, the need for more research in the types of strategy and the sequencing of these strategy types is necessary.

Hypothesis 1.2

(a) Primary cognitive strategies taught metacognitively will improve the math test performance of high test-anxious students. (b) High test-anxious females will benefit more from primary cognitive strategies taught metacognitively in the improvement of math test performance than their male counterparts.

Results

The means and standard deviations for math test performance expressed as percentages are shown in Table 3. Before the hypotheses were tested, a t-test was performed on math tests 1 to ensure that there was no significant difference between groups. Results indicated there was no significant difference between the strategy instruction and no strategy instruction groups ($t = -.04$, $df = 41$, $p < .97$) in math test scores.

Results of the three-way ANOVA, presented in Table 4, revealed a significant within-group main effect for time and a significant within-group second order interaction. Math test performance decreased significantly over time ($F(1,39) = 12.60$, $p < .01$) (see Figure 6). The three-way interaction ($F(1,39) = 6.94$, $p < .01$) necessitated Post Hoc analyses to determine the nature of the interaction. Significance was not found. However, graphing the results suggested that the greatest decrease was for males who did not receive strategy instruction followed by females who received strategy instruction (see Figure 7).

Discussion

Results indicated that primary cognitive strategies taught metacognitively did not improve math test performance in high test-anxious students. Math test performance, however, decreased significantly. The decrease appeared to be attributable to males who did not receive strategy instruction, followed by females who did receive strategy instruction. Furthermore, there were no gender differences in the effects of strategy instruction on math test performance. Of interest was the lack of gender difference in math test performance. This section discusses these findings.

Lack of improvement in math test performance can be attributed to those same reasons postulated in the discussion of Hypothesis 1.1 as to why metacognitive strategy instruction did not alleviate test anxiety (task difficulty, time, ability/acheivement, number of strategies taught, and type of strategies taught). The overall signficant decrease in math test performance, however, can be explained mainly by the difficulty level of the math tests used to measure performance. Math tests 1 were considered less difficult than math tests 2. Since difficult test items negatively affect performance (Zeidner, 1998), which is more pronounced for test anxious students (Zeidner, 1998), the

Table 3

Means and Standard Deviations for Math Test 1 and Math Test 2 for High Test-Anxious Students by Strategy Instruction and Gender

	Pre-Test Performance			Post-Test Performance	
	N	M	SD	M	SD
Strategy Instruction					
Total	20	69.25	16.92	58.35	20.32
Female	10	71.60	15.25	57.00	21.04
Male	10	66.90	18.95	59.70	20.61
No Strategy Instruction					
Total	23	60.52	20.59	54.70	26.58
Female	15	61.13	19.38	63.13	23.19
Males	8	59.38	24.08	38.89	26.58

Table 4

Three-Way Analysis of Variance of Math Test Scores for High Test-Anxious Students by Strategy Instruction and Gender

	df	MS	F	Sig.
		Between Subjects		
Strategy Instruction (A)	1	1363.66	1.87	.18
Gender (B)	1	1002.04	1.37	.25
A x B	1	736.34	1.01	.32
Error	39	(731.04)		
		Within Subjects		
Time (C)	1	2073.30	12.60	<.01*
C x A	1	13.90	.09	.77
C x B	1	291.08	1.77	.19
C x A x B	1	1141.29	6.94	.01*
Error	39	(164.44)		

Note. Value enclosed in parentheses represents mean square error.

* $p < .05$

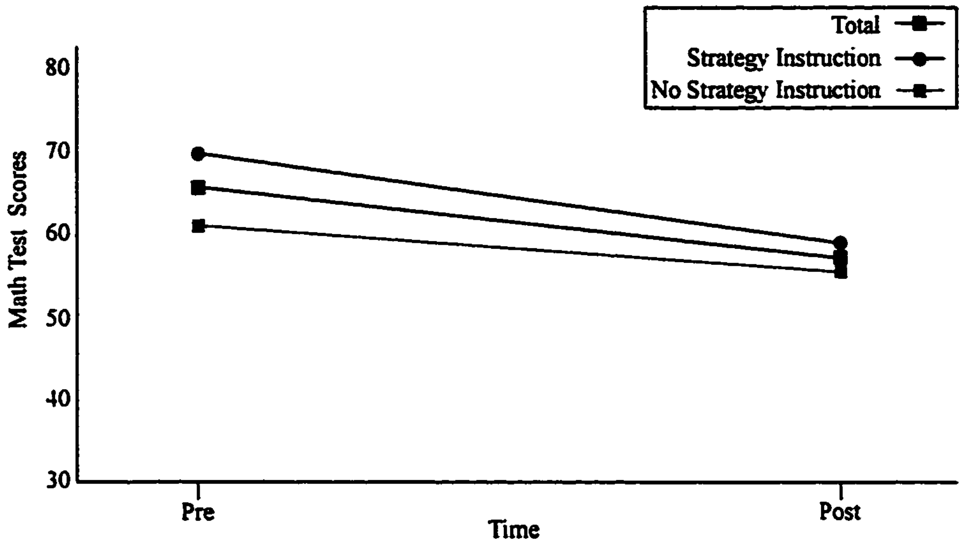

Figure 6. Decreases in Math Test Scores

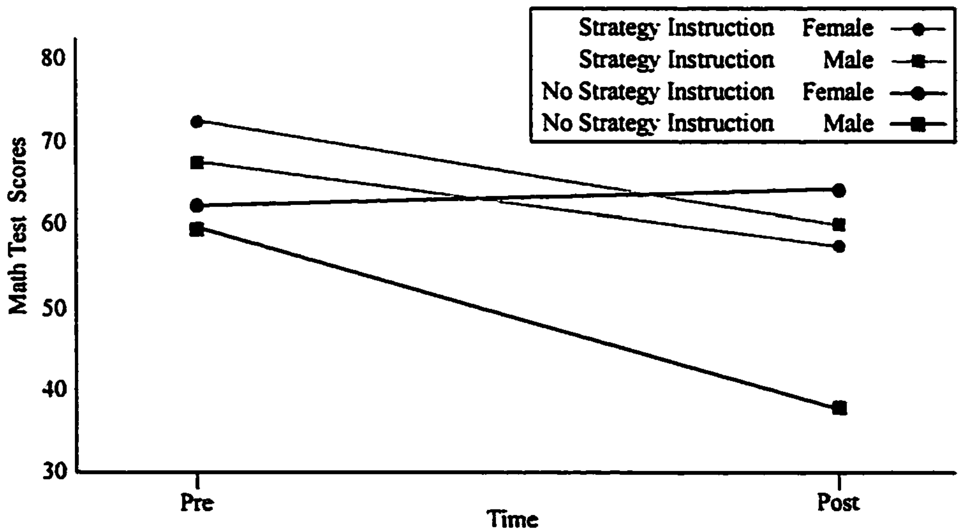

Figure 7. Changes in Math Test Scores
by Strategy Instruction and Gender

decrease then is not surprizing. As mentioned, all math tests should have been at the same level of difficulty not only to measure the effects of strategy instruction on test anxiety, but the effects on math test performance as well.

The lack of improvement in math scores may also have been due to the components of problem solving and how students develop expertise in these areas. Charles and Lester (1984) maintain that problem solving ability takes time. Time for proficiency in each of the three components of problem solving - understanding, planning, results - varies. Over a twenty-three week period (as opposed to approximately sixteen weeks in this study) Charles and Lester (1984) assessed growth in the three components for grades 5 and 7 students. For grade 7 students understanding and planning grew during the first eight weeks and during weeks 17 to 23. Growth in the results component was less than that of understanding and planning. These findings suggest that in the present study an increase or growth in math test performance (results) would be less than in understanding and planning abilities, which were not measured. Further, there may have been additional improvement in understanding and planning after four months of implementation. Future research should consider the three problem solving components in measuring student growth and determine when the growth in understanding and planning makes a significant impact on results.

It was previously mentioned that the decrease in performance appeared to be mainly due to males who did not receive strategy instruction. These same males also appeared to show the greatest (non-significant) decrease in test anxiety (see Hypothesis 1.1). The increased difficulty likely led them to believe they could not be successful so they gave up, resulting in decreased test anxiety and decreased performance. Again, we find the importance of positive affect and its impact on anxiety and performance, suggesting the need for the direct teaching of support strategies (i.e., positive self-talk) in conjunction with primary strategies in a multimodel approach for addressing test-anxious students' needs.

Females who did receive strategy instruction appeared to show the next greatest decrease in scores. This result was surprising, but might find some explanation in the problem solving skills required for math test 2. Hyde, Fennema and Lamon (1990) found females to be more proficient in computation skills in elementary and middle school and less proficient in problem solving skills in high school than males. Math test 1 required more computation skills while math test 2 required more problem solving skills. Another explanation might be that test-taking strategies (SCORER was described as both a problem solving and test-taking primary strategy) improve "multiple-choice and essay test performance but not math test score[s]' (Bruch, Juster, & Kaflowitz, 1983). Therefore, the specific strategy itself may not have been appropriate for the female students in the experimental group.

With regard to gender differences in math performance, this study found no significant difference. The literature that indicates that there are no significant differences in classroom tests scores (Hyde, 1993; Pajares & Miller, 1994; Skaalvik & Rankin, 1994) at the junior high grade level, therefore, can be generalized to high test-anxious students. Although not statistically significant, it is interesting to note that the female students' math test 1 scores in both the strategy and no strategy instruction groups were higher than male students' scores (see Table 3). Again, this is consistent with research which finds females performing better than males on classroom tests (Kimball, 1989).

Study 2: Math Self-Efficacy and Test Anxiety

Hypothesis 2.1

(a) There will be differences in total and subscale math self-efficacy scores between high and low test-anxious students.
(b) High and low test-anxious females will have lower total and subscale math self-efficacy scores than high and low test-anxious males.

Results

A t-test and multivariate analysis were used to answer part (a) of hypothesis 2.1 (see Table 5 for means and standard deviations). The t-test was used for total scores, and multivariate analysis for the subscale scores. The t-test indicated that high test-anxious students' total math self-efficacy scores ($M = 113.52$) were significantly lower than low test-anxious students' scores ($M = 129.16$) ($t = 4.03$, $df = 73$, $p. < .01$).

Multivariate analysis of the subscales, using Hotelling's Trace, indicated significance ($F(1,71) = 7.67$, $p < .01$) confirming that there were differences between high and low test-anxious students in the three characteristics. Univariate analysis of variance indicated that high and low test-anxious students differed significantly on two characteristics, ability and resiliency. High test-anxious students showed lower scores in perceptions of ability ($F(1,74) = 16.21$, $p. < .01$), and resiliency ($F(1,74) = 12.32$, $p. < .01$) (see Table 6). There was no significant difference on the third subscale, effort.

To investigate gender differences, a two-way (Test Anxiety Level X Gender) analysis of variance (ANOVA) and a two-way multivariate analysis of variance (MANOVA) were computed for total math self-efficacy and the subscales, respectively. Results of the ANOVA indicated no significant main gender or interaction effects (see Table 7). Similarly, results of the MANOVA (see Table 8) indicated no main gender or interaction effects.

Table 5

Means and Standard Deviations of Total and Subscale Math Self-Efficacy Scores for High and Low Test-Anxious Students by Gender

	Low Test-Anxious			High Test-Anxious		
	N	M	SD	N	M	SD
Total Math Self-Efficacy						
Total	37	129.16	17.21	38	113.82	15.74
Female	21	132.33	11.18	21	111.29	13.15
Male	16	125.00	22.62	17	116.94	18.38
Ability						
Total	37	99.32	14.58	38	85.92	14.25
Female	21	102.33	10.52	21	83.48	12.18
Male	16	95.38	18.26	17	88.94	16.32
Effort						
Total	37	31.00	5.16	38	30.11	3.80
Female	21	31.67	3.76	21	30.43	3.87
Male	16	30.13	6.61	17	29.71	3.79
Resiliency						
Total	37	7.54	1.48	38	6.10	2.01
Female	21	7.24	1.58	21	5.62	1.77
Male	16	7.94	1.29	17	6.71	2.17

* Scores can range from 37 to 185.

Table 6

Univariate Analysis of Variance of Math Self-Efficacy Subscales for High and Low Test-Anxious Students

	df	MS	F	Sig.
		Between Subjects		
Ability	1	3367.80	16.21	<.01*
Effort	1	15.01	.73	.40
Resiliency	1	38.62	12.32	<.01*

Note. *p <.05

Table 7

Two-Way Analysis of Variance for Total Math Self-Efficacy by Test Anxiety Level and Gender

	df	MS	F	Sig.
Test Anxiety Level (A)	1	3911.98	14.59	<.01*
Gender (B)	1	13.00	.05	.83
A X B	1	779.03	2.91	.09
Error	75	(268.14)		

Note. Value enclosed in parentheses represents mean square error.

*p <.05

Table 8

Two-Way Multivariate Analysis of Variance for Math Self-Efficacy Subscales by Test Anxiety Level and Gender

	df	F	Sig.
Test Anxiety Level (A)	3	7.22	<.01*
Gender (B)	3	1.86	.14
A X B	3	1.22	.31

Note. *$p < .05$

Discussion

Results indicated that there was a significant difference in the total and two subscale math self-efficacy scores between high and low test-anxious students. High test-anxious students scored significantly lower than low test-anxious students in total math self-efficacy and the subscales ability and resiliency, indicating they were not as confident in their ability and take longer to recover from setbacks. There was no difference between high and low test-anxious students and their perceptions of the effort they expend when working on math tasks. There were also no gender differences in the total or subscale math self-efficacy scores. These findings are discussed in relation to each area investigated: total math self-efficacy, math self-efficacy subscales and gender differences.

The literature indicates that there is typically a negative association between test anxiety and self-efficacy (Bandura, 1997; Hembree, 1988; Phillips, Martin, & Meyer, 1972). Results of this study indicate that this negative association also exists between test anxiety and math self-efficacy. That is, high test-anxious students exhibit lower perceptions of their math ability than low test-anxious students.

With respect to the math self-efficacy subscales, the literature also indicates that when a student's self-efficacy is low they are not confident in their ability (ability), experience difficulty in recovering from obstacles and setbacks (resiliency), and tend to exert less effort (effort) on difficult tasks (Bandura, 1982, 1989, 1997; Schunk, 1993; Schwarzer, 1997). Results of this study concur in that high test-anxious students lacked confidence in their math ability and had difficulty recovering from obstacles and setbacks. High test-anxious students' perceptions of their effort, however, are similar to those of low test-anxious students: they do not exert less effort on difficult tasks. This finding does not concur with the literature which states that students with low perceptions of their ability do not exert effort, especially when the task is difficult. However, the literature further indicates that for those students who exert less effort the result is low achievement or performance because expended effort confirms lack of ability (Dweck, 1986; Pintrich & De Groot, 1990). The relationship is validated, though not statistically, by the high test-anxious males who did not receive strategy instruction. Their test anxiety and math performance decreased as they appeared to disengage from the task and not exert effort.

The subscales ability and effort lend themselves to a discussion of the ability-effort relationship because Zimmerman and Martinez-Pons (1995) identify these two characteristics as central to self-efficacy, and Pintrich and De Groot (1990) identify effort as central to self-regulation along with cognitive and metacognitive strategies. This relationship, too, is inherent in understanding students' views of intelligence and how these views affect their learning, self-efficacy, performance, and behavior (see Figure 1).

The relationship between ability and effort is developmental. Covington (1992) identifies four stages. In the preschool years, stage one, the focus is on ability, which is equal to effort. If children are successful they are considered to be smart and to have exerted effort. Covington (1992) states, "'all good things go together' - high ability, effort, and outcome" (p. 82). In early and middle elementary school, stage two, the focus is on effort, but it is still not distinguished from ability. If children are successful it is because they have tried; if unsuccessful, they have not tried. In late elementary, stage three, children make a distinction between ability and effort, with the belief that ability is unstable and, therefore, changeable through effort. The importance of effort is still dominant. These first three stages of the ability-effort relationship correspond to students' view of intelligence as incremental (see Figure 1). That is, intelligence is malleable. In junior high, stage four, the belief changes: ability is perceived as stable and unchangeable, even with effort. In contrast to change through effort, a great deal of effort suggests lack of ability. Effort is not valued. At this stage students hold an entity theory of intelligence. That is, intelligence is fixed.

The complexity of this ability-effort relationship becomes more apparent in light of the results of this study. The assumption in self-efficacy theory is that students with low self-efficacy exert minimal or no effort. According to the stages above, junior high students in this study should be at stage four (ability is important, effort questions ability, therefore effort is not admitted). However, in this study the majority of high test-anxious students with low math self-efficacy perceived themselves as exerting effort (and admitting to exerting effort), similar to students with higher math self-efficacy. This effort, based on the Me and Math questions, is positive and appropriate effort (see Appendix B). Effort, then, still appears to be valued and important. It is possible that junior high students' perceptions that ability is stable and unchangeable even with effort, is more complex than proposed, for all junior high students and students with low math self-efficacy. For example, results of this study suggest a progression based on successes and failures. At first, students exert effort and admit to exerting this effort, especially if successful. The majority of students in this study appear to fall in this category. If there is failure, however, they may exert effort but not admit to putting effort into the task because that would question their ability. With successive failures, however, students exert minimal or no effort. Again, the high test anxious males who did not receive strategy instruction in this study are representative of this third scenario. Further research is necessary in investigating the ability-effort relationship in relation to self-efficacy for junior high students in general as well as in high test-anxious students, and how the relationship is affected by successes and failures in the classroom.

One of the purposes of developing Me and Math was for practicality in terms of providing information to assist teachers in motivating students and determining appropriate self-efficacy interventions. Identifying students' perceptions of ability and effort helps to identify types of test-anxious students and their needs. These needs can then be addressed directly. For example, and again referring to Figure 1, a student with low self-efficacy who exerts little effort may be a failure accepter. Intervention might involve teaching the student positive self-talk, appropriate study skills, and the importance of exerting effort in these areas so that he/she can be successful. In contrast, the failure avoider student might require more assistance with regard to relaxation to address their anxiety and perhaps refinement in strategy use.

No gender differences were found in total math self-efficacy, which concurs with some research (Pajares & Kranzler, 1995: Zimmerman &

Martinez-Pons, 1990), but is not consistent with other research which found males to be more math self-efficacious than females (Hackett & Betz, 1989; Pajares & Miller, 1994). This may be related to the finding that there were also no significant gender differences in math test performance. Skaalvik and Rankin (1994) found gender differences in performance to surface in high school. The same may be true for math self-efficacy. It seems logical that if there are no gender differences in math performance (ability) there might be no gender differences in perceptions of this ability. Further research is needed in these areas.

No gender differences with regard to the subscales ability, effort and resiliency were found, but the research indicates that females are found to have less favourable views of their ability than males (Arch, 1987; Dweck, 1986; Stipek & Gralinski, 1991). Arch (1987) reports females to perceive the test situation as a threat. This perception of threat might be a result of lack of confidence in ability, with students holding a entity theory of intelligence. Dweck (1986) found a greater tendency for bright junior high girls than bright junior high boys to "subscribe to an 'entity' theory of intelligence" (p. 1043). Males, on the other hand, perceive the test situation as a challenge (Arch, 1987), suggesting an increase in effort expended and an incremental theory of intelligence. Research is needed in the area of gender differences in these subscales in general and in relation to test-anxious students and math self-efficacy.

Hypothesis 2.2

(a) Primary cognitive strategies taught metacognitively will enhance total and subscale math self-efficacy scores in high test-anxious students.

(b) High test-anxious females will benefit more from primary cognitive strategies taught metacognitively in the enhancement of total and subscale math self-efficacy scores than their male counterparts.

Results

Data were analyzed using a three-way (Strategy Instruction X Gender X Time) ANOVA and a three way MANOVA with repeated measures on the last factor, for total math self-efficacy and subscales scores, respectively. The means and standard deviations for total math self-efficacy and subscale scores, pre- and post- by strategy instruction and gender, are presented in Table 9.

Results of the three-way ANOVA for total math self-efficacy indicated no main or interaction effects, between or within-groups (see Tables 10). Results of the MANOVA for the math self-efficacy subscales also resulted in no significant main or interaction effects (see Table 11).

Discussion

Data analysis indicated primary cognitive strategies taught metacognitively did not enhance high test-anxious students' total or subscale math self-efficacy scores. Further, there were no gender differences in the affects of primary cognitive strategies taught metacognitively on total and subscale math self-efficacy scores. These results are not consistent with the research which maintains that strategy instruction can influence and promote self-efficacy (Jinks & Morgan, 1999; Laube, 1998; Schunk, 1983). One explanation may be that math self-efficacy is more difficult to enhance than other types of self-efficacy. The lack of change might also be attributable to those reasons discussed under Hypothesis 1.1 with regard to metacognitive strategy instruction: task difficulty, time, ability/achievement, number of strategies taught, and type of strategies taught. The types of strategies taught likely had the greatest impact on the results. Results associated with task

Table 9

Means and Standard Deviations of Total and Subscale Math Self-Efficacy Scores for High Test-Anxious Students by Strategy Instruction and Gender

	Pre - Scores			Post- Scores		
	N	M	SD	N	M	SD
Total Math Self-Efficacy						
Strategy Instruction	13	113.23	14.79	13	111.54	13.79
Female	5	113.20	15.19	5	110.40	15.27
Male	8	113.25	15.59	8	112.25	13.83
No Strategy Instruction	14	112.00	13.27	14	115.00	10.59
Female	12	109.67	12.32	12	113.75	10.37
Male	2	126.00	12.72	2	122.50	12.02
Ability						
Strategy Instruction	13	86.00	14.56	13	84.69	13.17
Female	5	86.00	14.88	5	83.80	14.89
Male	8	86.00	15.38	8	85.25	13.02
No Strategy Instruction	14	83.92	12.12	14	85.79	10.41
Female	12	81.83	11.51	12	84.58	10.51
Male	2	96.50	9.19	2	93.00	8.49
Effort						
Strategy Instruction	13	28.31	3.68	13	28.00	3.32
Female	5	29.00	3.58	9	17.89	3.26
Male	8	27.50	3.74	8	27.38	3.11
No Strategy Instruction	14	30.07	3.93	14	30.07	3.27
Female	12	30.00	4.13	12	29.83	3.49
Male	2	30.50	3.54	2	31.50	.71
Resiliency						
Strategy Instruction	13	7.08	1.98	13	6.23	1.74
Female	5	6.00	1.58	5	5.80	1.92
Male	8	7.75	1.98	8	6.50	1.69
No Strategy Instruction	14	5.86	2.03	14	7.21	1.76
Female	12	5.58	2.07	12	7.42	1.62
Male	2	7.50	.71	2	6.00	2.83

Table 10

Three-Way Analysis of Variance for Total Math Self-Efficacy for High Test-Anxious Students by Strategy Instruction and Gender

	df	MS	F	Sig.
		Between Subjects		
Strategy Instruction(A)	1	286.57	.94	.34
Gender (B)	1	400.79	1.32	.26
A x B	1	295.85	.97	.34
Error	26	(83.29)		
		Within Subjects		
Time (C)	1	5.70	.13	.73
C x A	1	10.58	.23	.63
C x B	1	18.41	.41	.53
C x A x B	1	48.47	1.07	.31
Error	23	(45.48)		

Note. Value enclosed in parentheses represents mean square error.

* $p < .05$

Table 11

Three-Way Multivariate Analysis of Variance of Math Self-Efficacy Subscales for High Test-Anxious Students by Strategy Instruction and Gender

	df	F	Sig.
Time (A)	1	.16	.92
Strategy Instruction (B) X A	1	.56	.65
Gender (C) X A	1	2.72	.07
A X B X C	1	.69	.57

Note. * $p < .05$

difficulty, however, suggest some benefits in primary cognitive strategies taught metacognitively.

Task difficulty increases test anxiety and negatively affects performance (Zeidner, 1998). Therefore, it is logical to assume that if the task increases in difficulty, ability - hence, self-efficacy - would also be questioned and negatively affected. Such did not happen in this study. Task difficulty did increase, math test performance did decrease, but math self-efficacy remained relatively stable, suggesting that the primary cognitive strategy taught metacognitively may have helped to at least maintain math self-efficacy levels. This intrepretation also finds support in research that states that strategy instruction can influence self-efficacy (Jinks & Morgan, 1999; Laube, 1998; Schunk, 1983).

It appears, then, that math self-efficacy might have been positively affected by primary strategies just as test anxiety levels may have been positively affected (see Hypothesis 1.2), although the effect was not statistically significant. It is possible, too, that if students had been taught support strategies, then math self-efficacy may have been enhanced. Support strategies would directly address self-efficacy through positive self-talk (Bandura, 1997), feedback (Schunk, 1993), self-efficacy monitoring (Zimmerman, Bonner, & Kovach, 1996), goal setting (Glover & Bruning, 1987) or some combination of these strategies.

Lack of gender differences in total and subscale math self-efficacy scores as a result of primary cognitive strategies taught metacognitively may be attributable to the type of cognitive strategy as well - primary versus support strategies. Although Zimmerman and Martinez-Pons (1990) found females to use primary type strategies more than males, these primary strategies did not significantly address self-efficacy concerns. The components of test anxiety, Emotionality and Worry (Liebert & Morris, 1967) are addressed with support strategies (see Figure 3). Research indicates females score significantly higher than males on the Emotionality component (Seipp & Schwarzer, 1996; Zeidner & Nevo, 1992). The Emotionality component represents the physiological changes associated with anxiety. A relaxation support strategy would address the anxiety. On the Worry component gender differences are negligible (Zeidner & Nevo, 1992). The Worry Component represents students' concerns about their performance, consequences of failure, and doubt about their ability. In short, self-efficacy issues. Support strategies such as positive self-talk and goal setting would directly address self-efficacy issues. But because gender differences are negligible on this component there should be no gender differences in the benefits of these support strategies taught metacognitively. This is another area necessitating further investigation.

CHAPTER V

CONCLUSION

This study investigated whether the primary cognitive strategies Road Signs and SCORER, taught by way of a metacognitive instructional program, would alleviate test anxiety in high test-anxious grade 8 math students and enhance their math test performance and math self-efficacy. It also examined whether math self-efficacy was lower in high test-anxious students than low test-anxious students. As well, gender differences in math self-efficacy and in the effects of metacognitive instruction on test anxiety, math test performance and math self-efficacy were investigated. This final chapter summarizes the findings of this study, offers recommendation for educational practice and future research, and denotes the delimitations and limitations of the study.

Summary of Findings

The results of Study 1 and Study 2 show that metacognitive strategy instruction did not significantly affect test anxiety levels, math test performance, and total and subscale math self-efficacy scores of high test-anxious grade 8 math students. There were also no gender differences in the effects of strategy instruction on any of the dependent variables. Study 2 found high test-anxious students to be significantly lower in total math self-efficacy, and on the subscales ability and resiliency, than low test-anxious students. High test-anxious students were similar to low test-anxious students in their perceptions of their effort expended on math tasks. Again, there were no apparent gender differences.

As a result of the varied experiences conducting this research study and the significant and non-significant findings a number of educational and research recommendations are offered. Though interrelated, the educational and research recommendations are presented separately.

Educational Recommendations

Educational recommendations fall into three broad categories: identification and intervention for test-anxious students, strategy instruction issues, and student, teacher and parental education.

The identification and appropriate interventions for high test-anxious students is extremely important. This is attested to by the practical and educationally significant finding that males who did not receive strategy instruction appeared to experience the greatest decrease in test anxiety and math test performance suggesting a "type" of test-anxious student (i.e, failure accepter). The identification of test-anxious students refers to knowing and understanding these students in general as well as identifying their individual needs. Identification of the types (see Figure 1) and needs (Figure 3) of test-anxious students is necessary to generate appropriate and beneficial individualized interventions (Zeidner, 1998). Figure 8 takes the information from Figures 1 and 3 and attempts to integrate that information into a model for identification and interventions to address individual needs. The model is an elaboration of Nicaise's (1995) flowchart for organizing test anxiety "treatment" which takes into consideration suggestions as to what the interventions for test anxiety should include in practice and in research. The chart is in the early stages of development.

As the chart is presented, test-anxious students are identified by determining their level of test anxiety through such instruments as the State scale of the STAI (used in this study), and the Test Anxiety Inventory (Spielberger et al., 1980), the latter which identifies both the Emotionality and

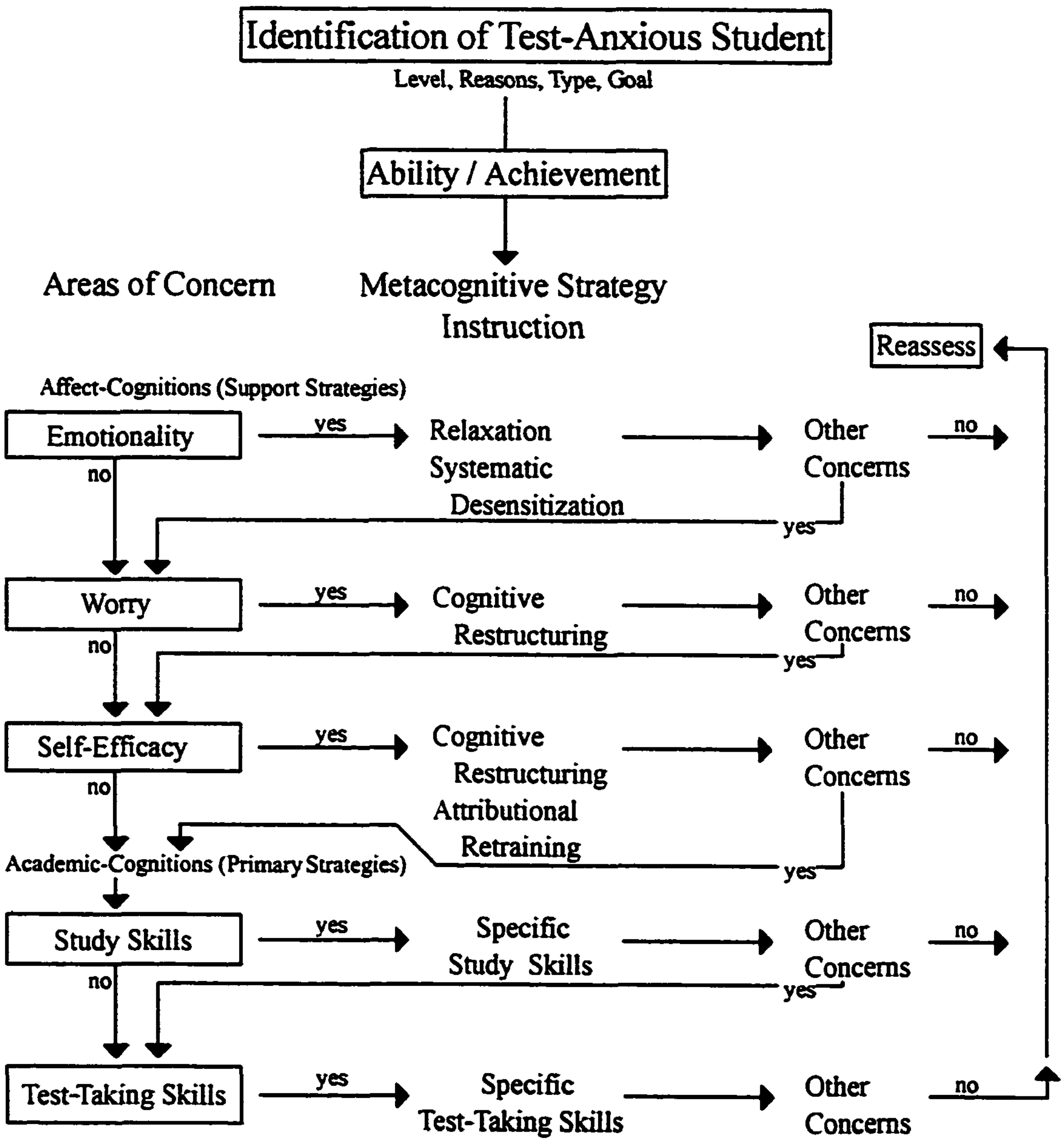

Figure 8. Identification and Intervention Model for Test Anxiety

Source: Modification of Nicaise's (1995) Flowchart for Organizing Treatment of Test Anxiety

Worry components of test anxiety as well as a total score. Inclusion of the Emotionality and Worry scores is necessary in determining the magnitude of these components in the flowchart. The reasons for test anxiety, types of test-anxious students, and goal orientation of test-anxious students can be determined by using Figure 1 and direct questioning, observation and assessment. The ability level of the student should also be known in the planning process since it is known that there are differences in learning needs by ability level (i.e., lower ability students are more likely to be deficient in effective and efficient study skills (Birenbaum & Nasser, 1994) and, therefore, would benefit from strategy instruction). Once information is gathered each component of test anxiety is considered as to whether intervention is necessary at that time. It is held that all test-anxious students have concerns with all components of test anxiety with the severity of the difficulties in the specific components being individually unique, and with their degree of severity determining whether intervention is needed. If intervention is required the needs are addressed through metacognitive strategy instruction. If there are no major concerns in a specific component the next component is examined. When all concerns are addressed reassessment follows to determine improvement and whether further assistance is necessary.

There are five major components, or areas of concern, of test anxiety. The first three components are addressed by affect-cognitions (support strategies; see Figure 3). Emotionality, the first component, refers to the physiological needs of the student and is addressed by relaxation or systematic desensitization techniques. Worry, the second component, refers to the task irrelevant and self-derogatory inner speech characteristic of test-anxious students and is addressed by cognitive restructuring. For example, students would be taught how to rephrase negative self-talk into positive self-talk. Component three, self-efficacy, refers to students' confidence in their ability in specific subjects. Me and Math would be used here to determine math self-efficacy and students' perceptions of ability, effort and resiliency in math. Low self-efficacy would also be addressed by cognitive restructuring (i.e., teaching positive self-talk) in addition to attributional retraining (attributing successes and failures to positive perceptions of ability and effort) goal setting, appropriate use of feedback (i.e., identifying what did or did not lead to success and why), and self-efficacy monitoring. The last method, monitoring self-efficacy, involves the student determining their confidence in succeeding at a task before performing the task and comparing the final achievement to that level of confidence. The comparison determines whether the students are realistically confident of their abilities, or whether they are underconfident or overconfident (see Zimmerman, Bonner, & Kovach, 1996). If underconfident or overconfident, then cognitive restructuring or attributional training to be realistic in their perceptions (Pajares, 1996a) would be necessary while monitoring continues.

The last two components of test anxiety are addressed by academic-cognitions (primary strategies; see Figure 3). Study skills, the first of these two components, refer to such skills as time management, goal setting, note-taking, writing skills, reviewing and so forth. Study skill inventories would be used to assess deficiencies. Finally, test-taking skills refer to skills in writing a variety of test types (i.e., multiple choice, essay, true or false) as well as understanding how to prepare for tests. Observation and questioning would provide information about weaknesses in this area.

Figure 8 provides an identification process and indicates that the intervention for each area of difficulty should be addressed with metacognitive strategy instruction, the second major area of recommendations. Although metacognitive strategy instruction did not have a significant impact on the variables investigated in this study, the non-statistical finding that it appeared to at least maintain test anxiety levels in the face of increased task difficulty suggests that metacognitive instruction may be beneficial, thus, warranting continued research. Further, if the issues related to strategy instruction discussed in Chapter IV (task difficulty, time, ability/achievement, number of strategies taught, type of strategies taught and the sequencing of these types) are addressed, benefits of the approach may be realized. Also identified was the importance of initiating instruction at the beginning of the school year so that students would be more open to accepting the instructional program as part of their daily routine.

Metacognitive strategy instruction, however, should include not only an awareness and understanding of strategies and their uses and benefits, but also student education in their own psychological processes such as information processing, memory, and the structure and functions of the brain. Such instruction would be appropriate in health classes because it addresses the physiology of the brain and its functions, a health topic. Equipped with such information, the use of strategies may be more meaningful to students; thus, increasing not only their skill but their will to use the strategies. We are more likely to be open and willing to try a new approach and make a concentrated effort in using it if we know how and why the approach works and whether it is supported by research. The teaching of this information in health class would not only save teaching time in academic content in regular subject classes, which is a concern for teachers, but also enhance the teaching and learning of academic content. The information, however, must be integrated with the teaching of strategies by all teachers so students are cognizant of the how the information relates to strategies as well as being cognizant of the generalizability of strategies and a strategic approach to learning. This physiological and psychological information should also be included in mandatory junior high study skills courses set in some schools, mentioned earlier, to address student ignorance about the purposes and uses of these courses (see section "Strategies Program for Effective Learning and Thinking (SPELT)").

If identification and interventions for test-anxious students are to be successful teacher education is essential not only in strategy instruction, but in test anxiety as well. Teachers require information in test anxiety, how it develops, how it affects performance, how to identify test-anxious students and their needs and how to address those needs. Many teachers realize that there is a problem, but they do not know what to do, and believe they do not have the time to deal with it. Many teachers contacted to participate in this research study declined to participate giving the time involved as their reason. Still others do not accept it as a legitimate special need. A better understanding of test anxiety would eliminate misconceptions.

In addition to student and teacher education, parental education is equally important because for some students their test anxiety is a result of, though unintentional, high parental expectations and pressure. Ideally, early elementary teacher and parental education would result in a preventive approach to test anxiety. At this level, where the seeds of test anxiety are often unknowingly planted and nurtured, problems could be identified and averted before they become firmly established (Hembree, 1988; Hill & Wigfield, 1984). Further, education and collaboration among teachers, parents and the students themselves would increase the likelihood of the benefits and success of the intervention methods implemented.

Research Recommendations

The main research recommendations resulting from the study focus on the math self-efficacy scale Me and Math, gender differences, classroom tests, and the identification of the types of test anxious students.

Me and Math was devised for this study to assess math self-efficacy. The intent was to provide not only a total math self-efficacy score, but also to look at student profiles by their scores on the subscales identified: ability, effort, and resiliency. With such information appropriate intervention could be planned. Confirmatory factor analysis is necessary to confirm the results found in Study 2: Math Self-Efficacy and Test Anxiety, namely the identification of the three subscales and the reliability of the total and subscale scores.

Assuming confirmatory analysis validates Me and Math and its subscales as reliable, additional applications are proposed. The use of Me and Math, with wording to indicate other academic subjects has been suggested and would be beneficial to understand students' self-efficacy in a variety of subjects, such as Language Arts, Social Studies, French, and so forth. Research should also investigate whether Me and Math can predict performance. Bandura (1997) maintains that only specific measures (i.e., a specific task under specific conditions) of self-efficacy can predict performance. Intermediate (i.e., performance is measured within a domain with common properties) and global measures (measures self-efficacy without being task or domain specific) are less predictive. Jinks and Morgan's (1999) academic self-efficacy scale, an intermediate assessment, however, was able to predict grade four core subject performance. Two of Jinks and Morgan's (1999) four subscales were also ability and effort. Me and Math, then, might predict performance.

The issue of realistic student confidence, underconfidence, and overconfidence should be examined as well. All levels of confidence can negatively or positively affect self-efficacy and performance. Pajares (1996) states that past research indicates that "most students are overconfident about their academic capabilities " (p. 559). Study 2 found high test-anxious students to be significantly lower in total math self-efficacy and the subscales ability and resiliency. These scores, however, were not categorized by high, medium or low confidence. Though high test-anxious students were lower in total math self-efficacy, ability and resiliency, we do not know the actual level of their confidence. They may have been overconfident. This information is important in examining the benefits of strategy instruction on self-efficacy. For example, perhaps there was no change in total math self-efficacy, ability or resiliency because students were confident already. There are advantages (i.e., less anxiety) and disadvantages (i.e., does not study) to overconfidence; therefore, the issue of "how much confidence is too much confidence" (Pajares, 1996, p. 559) must be investigated.

The second research recommendation targets gender differences. Gender issues in strategy instruction and test anxiety intervention deserve more attention than they have had to date. Although females are thought to be more proficient at primary strategies than males (Zimmerman & Martinez-Pons, 1990) their proficiency did not translate into positive measurable benefits (alleviation of test anxiety, improved math test performance, and enhanced math self-efficacy) in this study. It might be because females typically score higher on the Emotionality component of test anxiety than males, and are equal to males on the Worry component (Seipp & Schwarzer, 1996; Zeidner &

Nevo, 1992). Since Emotionality can be addressed by relaxation and systematic desensitization support strategies, perhaps these are the strategies female students should be learning so that they may be more successful. Or perhaps these support strategies in addition to primary strategies and the support strategy of self-talk to address the Worry component may be necessary for success. Further, when support and primary strategies are combined the issue of sequencing of strategy types becomes an additional variable. These issues need to be addressed.

A second major gender issue of interest generated by this study, and which warrants further investigation, is the lack of significant gender differences found in math test performance and math self-efficacy. The literature indicates that gender differences in math test performance become apparent in junior high (Dweck, 1986; Pajares & Miller, 1994), an males outperform females by the end of high school in problem solving (Skaalvik & Rankin, 1994). With little research on gender differences in math self-efficacy the development is unknown at this time, but it can be hypothesized that math self-efficacy follows the same path as math performance. Research tracing math test performance, math self-efficacy and the relationship between the two from grades seven to twelve might shed light on gender differences, changes, and why they occur.

As a third recommendation, research needs to seriously consider the lack of classroom tests used to determine levels of test anxiety and performance. Typically, standardized tests or laboratory tests (i.e., tests made for research purposes only) are utilized, which do not affect students' final marks. As a result students are less likely to take the tests seriously or perform at their best, or the situation does not create the anxiety similar to that of a classroom test (Paris, Lawton, & Turner, 1991). Validity, then, becomes a concern. Since the goal of test anxiety instruction is to help students deal with test situations on a daily basis in the classroom and eventually generalize the benefits to other situations, research should be in the classroom using classroom tests. Consequently, task difficulty, as discussed in Chapter IV, becomes an issue that research procedures must address.

Finally, research needs to concentrate further in identifying the types of test-anxious student (see Figure 1), their characteristics, their needs, and appropriate interventions (see Figures 3 and 8) for each type. We can work with test-anxious students as a homogeneous group. However, if we are to really help them learn to cope with their problem and be successful we must offer interventions which address their specific needs. We need to "examine more fully individual differences in how students experience anxiety, rather than assuming all students experience anxiety in similar ways or for similar reasons" (Wigfield & Eccles, 1989). Thus, both classroom and individual intervention and assistance would benefit test-anxious students.

Delimitations and Limitations

There are four major delimitations and three major limitations which may affect the generalization of the results as well as the validity of comparisons with previous research.

The first delimitation is that the main sample was comprised of grade eight math students (grade nine students were included in the piloting of Me and Math); therefore, results at this point can only be generalized to this grade and subject. Second, teacher selection was based on volunteers. Volunteers may not represent the general population, especially in this research where over twenty schools were contacted for volunteers, but only two teachers agreed to participate. A third delimitation may have been the differences in socioeconomic status (SES) between the two schools, although this variable was not assessed. Hembree (1988) and Lacroix (1994) found a small significant relationship between SES and test anxiety: lower SES students exhibited higher levels of test anxiety. Two circumstances suggested that there may have been SES differences. The experimental school had many educational advantages in terms of technology and a stable student population. In contrast, the control school was situated within a large urban city where resources were more limited and student movement throughout the academic year was frequent. The fourth delimitation which may have affected results was how test-anxious students were identified. High test-anxious students were identified using the top 40th percentile: therefore, scores of 42 or higher on the A-State of the State-Trait Anxiety Inventory were considered to represent high test anxiety. The high test anxiety cut-off point varies from study to study (i.e., some studies use the top 25th percentile, some use the top 33rd percentile). As such, comparing high test-anxious students identified using the top 40th percentile might yield test-anxious students who may not be test-anxious if the top 33rd or 25th percentile were used to identify them. Currently, the top 27th percentile is the standard used when categorizing high groups (Personal Communication, Statistical Consultant, Spring, 2000).

With regard to limitations, the first is related to the last delimitation discussed above. As mentioned, using the top 40th percentile may have identified students as test-anxious who in other studies might not be identified as test-anxious (and hence, another possibility as to why strategy instruction was not significantly beneficial). However, using this cut-off point resulted in a sample of 43 high test-anxious students which is similar to those sample sizes found in the literature. There is a problem, though, when variables such as strategy instruction and gender are included in the analysis, because the groups became smaller, ranging from 8 to 23 students in the first study to as little as two students in the second study. Small group numbers are common in test anxiety research, but Hembree (1988) maintains that groups of 30 are necessary before any significance can be observed. Small groups increase the possibility of a Type II error (maintaining there is no difference when indeed there is). This suggests that some results of this study may have indeed been significant, but due to small numbers in the groups significance was not apparent. For example, the high test-anxious males in the control group showed a decrease in test anxiety and math test performance, but the decreases were not significant. There were, however, only 8 males in the group. A larger sample may have detected statistical significance.

A second limitation was that students in the experimental and control groups did not write the same math tests. The experimental group wrote tests on fractions and equations, while the control group wrote tests on ratio and geometry. These differences in tests resulted in the task difficulty of the tests becoming a confounding variable because tests 2 (equations and geometry) were considered more difficult than tests 1 (fractions and ratio). With an increase in task difficulty, which increases anxiety, the effects of metacognitive instruction to alleviate anxiety, for example, could not be reliably and validly assessed.

A final limitation is that Me and Math is a new instrument requiring further refinement (i.e., confirmatory factor analysis). The number of items comprising the three factors are skewed, with ability having 26 items, effort 8 items and resiliency only 2 items. With regard to the administration of Me and Math, the timing of tests 1 may have confounded results. The experimental group was administered the instrument before math test 1, while the control group was administered the instrument four days after math test 1. For the control group, having written the math test and knowing how they performed may have positively or negatively impacted their math self-efficacy. For example, if they thought or knew they did well, math self-efficacy would be higher than if they thought or knew they might have done poorly.

In conclusion, test anxiety and the effects of test anxiety can be extremely detrimental in a number of debilitating ways. The results of this study suggest metacognitive instruction was not successful in alleviating test anxiety, improving math test performance, and enhancing math self-efficacy. However, it is realistic to suggest that metacognitive instruction remains a viable approach in alleviating the problems of test anxiety when the difficulties identified and suggestions offered in this study are addressed. Teachers, parents and students must be educated about test anxiety so that students can be empowered to help themselves. They must learn to self-regulate their test anxiety by way of their affect-cognitions and academic-cognitions, efficiently and effectively. Test anxiety is a multidimensional construct, and as such intervention must be multidimensional. Metacognitive instruction can address all those dimensions.

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APPENDIX A

Road Signs

SCORER

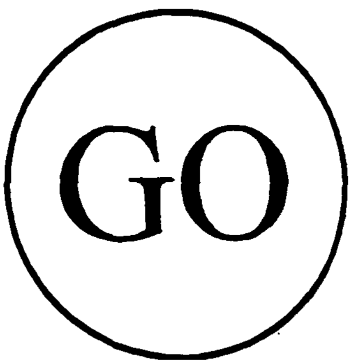
Student Log

PNI

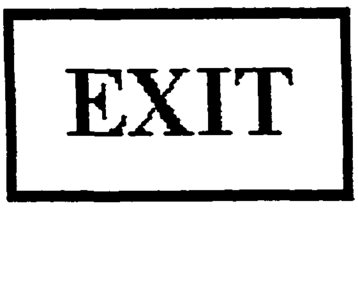
ROADSIGNS

What is the problem?

Slow down and devise a plan



Carry out the plan. Do it!



Done, but check and reflect

SCORER

S = Schedule your time

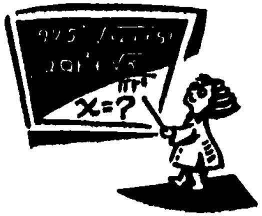
C = look for Clue words

O = Omit the difficult questions

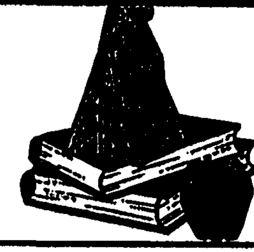
R = Read carefully

E = Estimate your answers

R = Review your work



STRATEGY LOG



Date	Strategy	Subject & When	Effectiveness	Effort	Changes

P Positive	N Negative	I Interesting
		

APPENDIX B

Me and Math
Pilot Copy

Rotated (Quartimax) Principal Axis Loading Matrix for Me and Math Items

Me and Math
Items by Factors

Me and Math

Date:__________________ Class:________________
Grade:_______ Name:________________
School:__________________________ Gender: Female Male
Math Teacher:_______________ (Circle one)

Here are a set of statements that tell how students feel about themselves with reference to **Math**. Read each of the following statements carefully then decide how you feel about it: how much it describes the way you feel. There are no right or wrong answers. Do not spend too much time on any one statement, but give the answer which seems to describe your present feelings best.

Indicate the degree to which you agree or disagree by circling the appropriate numeral to the right of each statement.

SD - Strongly Disagree D - Disagree
U - Undecided
A - Agree SA - Strongly Agree

	SD	D	U	A	SA
1. I know I can improve in math if I need to.	1	2	3	4	5
2. If given a choice, I pick easy math problems to work on.*	1	2	3	4	4
3. If I get an answer wrong I give up.*	1	2	3	4	5
4. When I have a bad day in math I know the next day will be better.	1	2	3	4	5
5. I am not good in math.*	1	2	3	4	5
6. I know math is important and valuable.	1	2	3	4	5
7. When I think to myself, "I can't do this," I quickly say, "I can do this!"	1	2	3	4	5
8. It does not matter what my grade is; my goal in math this year is simply to pass.*	1	2	3	4	5
9. I put a lot of effort/work into math.	1	2	3	4	5
10. The only way I can get better in math is if the questions get easier.*	1	2	3	4	5
11. I like to work on math problems that are not challenging.*	1	2	3	4	5

SD - Strongly Disagree D - Disagree
U - Undecided
A - Agree SA - Strongly Agree

	SD	D	U	A	SD
12. Math is valuable in school.	1	2	3	4	5
13. If I do not get the answer to a question the first try I keep working at it until I get it.	1	2	3	4	5
14. If I want to do well in math it is up to me to do it.	1	2	3	4	5
15. I give myself little pep talks when I am working on difficult math questions to keep me going.	1	2	3	4	5
16. If I do not do well in math it takes me a long time to get over the bad feelings.*	1	2	3	4	5
17. My goal in math this year is to do better than last year.	1	2	3	4	5
18. If I get low grades in math it is my own fault.	1	2	3	4	5
19. When I find questions difficult I know it is because I have not put enough effort into my studying.	1	2	3	4	5
20. It is important to keep trying even if I run into difficulties in math.	1	2	3	4	5
21. If I fail math it is because I am not good in math.*	1	2	3	4	5
22. Poor grades tell me I have not put much effort into my math work.	1	2	3	4	5
23. My goal in math is to pass all my math tests regardless of the marks.	1	2	3	4	5
24. I like to work on challenging math problems.	1	2	3	4	5

SD - Strongly Disagree D - Disagree
U - Undecided
A - Agree SA - Strongly Agree

	SD	D	U	A	SA
25. If a question in math is too hard I do not let it influence my work on the following questions.	1	2	3	4	5
26. If at first I do not succeed I try, try again.	1	2	3	4	5
27. Math does not make sense - it is just something you need to learn.*	1	2	3	4	5
28. When I have trouble with a math question I usually say to myself, "You can't do this stuff. It's too hard."*	1	2	3	4	5
29. I know I will use math when I finish school.	1	2	3	4	5
30. If I fail a math assignment/test I feel bad for a long time.*	1	2	3	4	5
31. When a problem is difficult I say to myself, "There must be some way to figure this out."	1	2	3	4	5
32. If given a choice I like to work on challenging math problems.*	1	2	3	4	5
33. When I pass a test it is because I am lucky.	1	2	3	4	5
34. When I find problems easy I know it is because I have put a lot of effort into studying.	1	2	3	4	5
35. I am good in math.	1	2	3	4	5
36. My goal in math this year is to make my parents happy by simply passing.*	1	2	3	4	5
37. If I do well in math it is because the teacher likes me.*	1	2	3	4	5

* Reverse scoring

Rotated (Quartimax) Principal Axis Loading Matrix for Me and Math Items

	Quartimax Rotated Factors		
	1	2	3
1. I know I can improve in math if I need to.	0	0	0
2. If given a choice, I pick easy math problems to work on.	1	0	0
3. If I get an answer wrong I give up.	1	0	0
4. When I have a bad day in math I know the next day will be better.	1	0	0
5. I am not good in math.	1	0	0
6. I know math is important and valuable.	1	0	0
7. When I think to myself, "I can't do this," I quickly say, "I can do this!"	1	0	0
8. It does not matter what my grade is; my goal in math this year is simply to pass.	1	0	0
9. I put a lot of effort/work into math.	1	0	0
10. The only way I can get better in math is if the questions get easier.	1	0	0
11. I like to work on math problems that are not challenging.	1	0	0
12. Math is valuable in school.	1	0	0
13. If I do not get the answer to a question the first try I keep working at it until I get it.	1	0	0
14. If I want to do well in math it is up to me to do it.	1	1	0
15. I give myself little pep talks when I am working on difficult math questions to keep me going.	0	0	0

16. If I do not do well in math it takes me a long time to get over the bad feelings.	0	0	1
17. My goal in math this year is to do bette than last year.	0	1	0
18. If I get low grades in math it is my own fault.	0	1	0
19. When I find questions difficult I know it is because I have not put enough effort into my studying.	0	1	0
20. It is important to keep trying even if I run into difficulties in math.	1	1	0
21. If I fail math it is because I am not good in math.	1	0	0
22. Poor grades tell me I have not put much effort into my math work.	0	1	0
23. My goal in math is to pass all my math tests regardless of the marks.	0	1	0
24. I like to work on challenging math problems.	1	0	0
25. If a question in math is too hard I do not let it influence my work on the following questions.	1	0	0
26. If at first I do not succeed I try, try again.	1	0	0
27. Math does not make sense - it is just something you need to learn.	1	0	0
28. When I have trouble with a math question I usually say to myself, "You can't do this stuff. It's too hard."	1	0	0
29. I know I will use math when I finish school.	1	0	0
30. If I fail a math assignment/test I feel bad for a long time.	0	0	1
31. When a problem is difficult I say to myself, "There must be some way to figure this out."	1	0	0
32. If given a choice I like to work on challenging math problems.	1	0	0
33. When I pass a test it is because I am lucky.	1	0	0

34. When I find problems easy I know it is because I have put a lot of effort into studying.	0	1	0
35. I am good in math.	1	0	0
36. My goal in math this year is to make my parents happy by simply passing.	1	0	0
37. If I do well in math it is because the teacher likes me	0	0	0

ME AND MATH
(Math Self-Efficacy)
By Factors

Factor 1 Ability

2. I like to work on math problems that are not challengngning.

3. If I get an answer wrong I give up.

4. When I have a bad day in math I know the next day will be better.

5. I am not good in math.

6. I know math is important and valuable.

7. When I think to myself, "I can't do this," I quickly say, "I can do this!"

8. I does not matter what my grade is; my goal in math this year is simply to pass.

9. I put a lot of effort/work into math.

10. The only way I can get better in math is if the questions get easier.

11. I like to work on math problems that are not challenging.

12. Math is valuable in school.

13. If I do not get the answer to a question the first try I keep working at it until I get it.

14. If I want to do well in math it is up to me to do it.

20. It is important to keep trying even if I run into difficulties in math.

21. If I fail math it is because I am not good in math.

24. I like to work on challenging math problems.

25. If a question in math is too hard I do not let it influence my work on the following questions.

26. If at first I do not succeed I try, try again.

27. Math does not make sense - it is just somethin you need to learn.

28. Wehn I have trouble with a math question I usually say to myself, "You can't do this stuff. It's too hard."

29. I know I will use math when I finish school.

31. When a problme is difficult I say to mysel, "There must be some way to figure this out."

32. If given a choice I like to work on challenging math problems.

33. When I pass a test it is becasue I am lucky.

35. I am good in math.

36. My goal in math this year is to make my parents happy by simply passing.

Factor 2 Effort

13. If I do not get the answer to a question the first try I keep working at it until I get it.

14. If I want to do well in math it is up to me to do it.

17. My goal in math this year is to do better than last year.

18. If I get low grades in math it is my own fault.

19. When I find questions difficult I know it is because I have not put enough effort into my studying.

20. It is important to keep trying even if I run into difficulties in math.

22. Poor grades tell me I have not put much effort inot my math work.

23. My goal in math is to pass all my math tests regardless of the marks.

34. When I find problems easy I know it is because I have put a lot of effort into studying.

Factor 3 Resiliency

16. If I do not do well in math it takes me a long time to get over the bad feelings.

30. If I fail a math assignment/test I feel bad for a long time.