2009

Applying social cognitive career theory to college science majors

Leann R. Mills
Iowa State University

Applying social cognitive career theory to college science majors

by

LeAnn R. Mills

A thesis submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Psychology

Program of Study Committee:
Lisa Larson, Major Professor
David Vogel
James Werbel

Iowa State University

Ames, Iowa

2009

TABLE OF CONTENTS

LIST OF TABLES	iii
LIST OF FIGURES	iv
ABSTRACT	v
INTRODUCTION	1
LITERATURE REVIEW	6
METHOD	50
RESULTS	64
DISCUSSION	82
REFERENCES	105
APPENDIX A: INFORMED CONSENT FORM	125
APPENDIX B: SURVEY INSTRUMENT	128

LIST OF TABLES

TABLE 1:	Frequencies, Percentages, Means and Standard Deviations on Demographic Variables	116
TABLE 2:	Internal Consistency Reliability of Sources of Academic Self-Efficacy Subscales	118
TABLE 3:	Means, Standard Deviations, and Intercorrelations for Measured Variables	119
TABLE 4:	Intercorrelations of Measured Variables for Males and Females	120
TABLE 5:	Fit Indices for All Models	121
TABLE 6:	Bootstrap Analysis of Magnitude and Statistical Significance of Indirect Effects	122
TABLE 7:	Bootstrap Analysis of Magnitude and Statistical Significance of Direct Effects	123

LIST OF FIGURES

FIGURE 1: SCCT MODEL PREDICTING GOALS 15

FIGURE 2: MODEL OF HYPOTHESIS 44

FIGURE 3: PATH MODEL RESULTS FOR HYPOTHESIS ONE 68

FIGURE 4: PATH MODEL RESULTS FOR MEN 75

FIGURE 5: PATH MODEL RESULTS FOR WOMEN 76

FIGURE 6: ADDITIONAL ANALYSIS INCLUDING SELF-REPORT PERFORMANCE 78

FIGURE 7: RESULTS OF ABBREVIATED MODEL FOR MEN 80

FIGURE 8: RESULTS OF ABBREVIATED MODEL FOR WOMEN 80

FIGURE 9: PATH MODEL RESULTS WITH SIGNIFICANT PATHS EMPHASIZED 83

ABSTRACT

Although there has been a substantial amount of research done to examine the applicability of social cognitive career theory (SCCT, Lent, Brown, & Hackett, 1994), almost none of this has focused on the prediction of science interests or goals. Additionally, this theory has not been applied to a group of individuals focused on studying science. The present study applies social cognitive career theory to a group of 245 college science majors and pre-medical students at a large Midwestern University. Additionally, this study also expands beyond the core of the theory to more peripheral theorized predictors such as learning experiences, aptitude, and parent support. Structural equation modeling (SEM) was used to assess model fit for the whole sample as well as men and women separately. Results indicated that social cognitive career theory was a good fit for the data with some exceptions; it was also found that background factors such as parent support and aptitude were important contributors to the model. No significant sex differences were found in the models. Discussion emphasizes the good fit of the model as well as the importance of background factors in developing self-efficacy, interests, and goals in science.

INTRODUCTION

Lent, Brown, and Hackett's (1994) social cognitive career theory (SCCT) has motivated substantial research of vocational and academic predictors of interests, performance, and choice goals. This theory has proven helpful in understanding a variety of interest domains, such as Holland's six RIASEC interest themes (realistic, investigative, artistic, social, enterprising, and conventional) (Nauta, Kahn, Angell, & Cantarelli, 2002; Tracey, 2002). Additionally, SCCT has been applied to academic domains such as math, science, and art (Fouad, Smith, & Zao, 2002; Smith & Fouad, 1999), as well as some major choices, especially engineering (Lent et. al., 2005; Lent, Singley, Sheu, Schmidt, & Schmidt, 2007; Leuwerke, Robbins, Sawyer, & Hovland, 2004). Despite the popularity of this theory, SCCT has never been applied to a group of individuals focused primarily on science. Because of the historically male-dominated reputation of the science field as well as the high rate of major-change for both genders in pre-medicine and women in science fields (Farenga & Joyce, 1999; Kilminster et al., 2007), a study applying SCCT to men and women invested in science and/or medicine would be a valuable contribution to the existing vocational literature. Additionally, there is very little literature specifically examining the prediction of science interests and goals; most of the existing research is on math or math/science combined interests and goals (Young et al., 2004).

Social cognitive career theory (SCCT, Lent et al., 1994) developed from Bandura's social cognitive theory (1986). The authors of SCCT theorize that a person's self-efficacy, or confidence that they can successfully perform a task, has a mutual relation with outcome expectations, or the consequences people anticipate resulting from a particular behavior. These two constructs then influence a person's level and type of interests. Many different activities are attempted through a person's educational career, but generally a persistent interest is only developed in activities in which the person expects to be successful and in which a positive outcome is anticipated (Lent et al., 1994). Interests are thought to predict the goals a person has and therefore often behaviors that are pursued. Finally, performance is predicted by these behaviors and a person's self-efficacy beliefs. These experiences of success or failure (combined with other factors), then contribute to a person's future self-efficacy and the cycle begins again.

An enormous amount of research has examined the construct of self-efficacy and many researchers have used SCCT as a basis for their studies. Additionally, because self-efficacy is domain-specific (e.g., writing self-efficacy, parenting self-efficacy), the information we have on self-efficacy has been spread through many different topics. Much of the literature on academic self-efficacy uses elementary and secondary students as participants, thus making generalization to a college population difficult (e.g., Britner & Pajares, 2005; Klassen, 2004; Usher & Pajares, 2005).

Although empirical information regarding constructs in SCCT does exist, according to a meta-analysis done by Rottinghaus, Larson, and Borgen (2002) to examine the correlation between self-efficacy and interests, much of the literature focuses on RIASEC self-efficacy. The authors of this meta-analysis were able to locate only seven studies that investigated math self-efficacy, and just three that looked at science self-efficacy, showing that there is a need for further examination of these two types of academic self-efficacy.

Additionally, the authors of SCCT (Lent et al., 1994) theorize that person factors also contribute to the development of interests and goals. Parent support is one large factor in an individual’s development, however this factor has rarely been researched in relation to SCCT constructs (e.g., Ferry, Fouad, & Smith, 2000; Scott & Mallinckrodt, 2005). Additional research about how this background variable relates with self-efficacy and the four theorized sources of self-efficacy would provide valuable information. Another background factor that has been applied to core SCCT constructs is aptitude. While there is substantial literature examining the relation between aptitude and performance, only one study was found that examined this relation in the context of SCCT (Lent, Lopez, & Bieschke, 1993). When searching the SCCT literature, no research was found exploring the relation between aptitude and the four theorized sources of self-efficacy. As these four sources were theorized to be the primary predictors of self-efficacy (Bandura, 1986), it follows that aptitude may impact self-efficacy and the rest of the SCCT model through one or more of these four sources.

It is well documented that there is an underrepresentation of women in the science fields (Miller et al., 2006; Stake, 2006). It has been shown that girls demonstrate fewer choice goals and choice intentions in science than boys as early as grade school (Farenga & Joyce, 1999) and that women are more likely than men to leave the science fields at each academic stage (Farenga & Joyce, 1999). Even women who have demonstrated superior science aptitude have been less likely to pursue a science career than men (Steele, 1997). Hartman and Hartman (2008) found that both men and women perceive that women will struggle more (with social support, value conflicts, commitment, etc) in science and engineering fields than men.

While no literature can be found applying SCCT to college science majors, some research has been done examining the career development of engineering students. Like the physical sciences and medicine, engineering requires math/science classes and is generally considered a male-dominated field. Particularly because of the low percentage of women in this major, social cognitive career theory researchers have focused on the engineering field (Hackett, Betz, Casas, & Rocha-Singh, 1992; Lent et al., 2007; Leuwerke et. al., 2004).

Examining sex differences in this population would also contribute to the existing literature. Because very little research has been done with a group of individuals studying science and no vocational research has been done with pre-medical students, there is obviously no information on how (or if) women and men differ regarding the sources and amount of self-efficacy preparing for a science career. While both science and medicine have historically been considered a male dominated field, this perception has been changing. The percentage of men applying to medical school has decreased, while the percentage of women applying has increased (Kilminster, et. al, 2007). Nonetheless, women continue to be underrepresented in physical science fields (Miller et al., 2006).

Even with the increasing encouragement and support for women to enter science fields, the societal messages about women's ability (or inability) to succeed in science fields and in the future as science professionals are clear. Although social persuasion is not theorized to be the strongest source of self-efficacy, these internalized messages likely influence a young woman's self-efficacy regarding her ability to succeed in a science major. A better understanding of women's and men's most influential sources of self-efficacy could be used to encourage women to pursue less traditional fields of study. Additionally, examining the differences in other SCCT constructs (particularly interests and outcome expectations) between men and non-women in science majors will add to the field's understanding of career choices for these students.

LITERATURE REVIEW

In this chapter I will discuss the development of social cognitive career theory (Lent et al. 1994), an application of Bandura's (1977, 1982, 1986) social cognitive theory to vocational work. Lent and colleagues set out to use SCT to predict and link interest development, choice of academic and career options, and performance and persistence in academic and occupational domains. After discussing the theoretical development of SCCT I will review empirical studies predicting each SCCT construct. Finally I will discuss empirical studies of constructs related to vocational development that are not in the SCCT model.

Theory

This section will include the historical development of social cognitive career theory (SCCT, Lent et al., 1994) beginning with Bandura's social learning and social cognitive theory (SCT, Bandura, 1977, 1982, 1986). After discussing Bandura's social cognitive theory, I will discuss the application of this theory to vocational work using a 1981 article by Betz and Hackett. Then I will discuss social cognitive career theory, an application of SCT to vocational work, theorized to predict and link interest development, choice of academic and career options, and performance and persistence in academic and occupational domains (Lent et al., 1994).

Social cognitive career theory (Lent et al., 1994) was developed in response to (and as an extension of) other vocational research on self-efficacy. In a 1977 article, Albert Bandura discusses social learning theory: people learn behaviors by observing others and continue a behavior if they are rewarded. In his article, Bandura also posits that self-referent thought about one's abilities (self-efficacy) influences an individual's behavior (Bandura, 1977).

Bandura continued exploring behavior development and in 1986 wrote a landmark book introducing a social cognitive theory of behavior. This theory was designed to explain how people learn new types of behaviors. Betz and Hackett's (1981) research regarding the dearth of women in science and engineering majors was the first to apply Bandura's social learning theory (Bandura, 1977) to vocational research and consider the effects of self-efficacy on women's academic experiences. Lent and colleagues continued to explore the application of Bandura's theory (Bandura, 1977, 1982, 1986) to vocational research and modified the theory to focus on constructs that were theorized to be more influential in vocational research. The authors presented a framework for understanding interest development, academic and career choices, and performance.

Social Cognitive Theory

Albert Bandura presented social learning theory in a 1977 article (Bandura, 1977). This theory stresses the importance of cognitive-mediational factors of behavior, specifically self-referent thought about one's abilities. Social learning theory had been successfully applied to several clinical issues including phobias (Bandura, Adams, & Beyer, 1977), smoking behavior (Condiotte & Lichtenstein, 1981), and assertiveness (Kazdin, 1979).

Continuing to explore the effects of self-referent thought, Bandura proposed a social-cognitive theory of behavior (Bandura, 1986). This theory was developed to understand how people learn new behaviors and suggests that three factors (personal agency, external environmental factors, and overt behavior) reciprocally influence each other. In social cognitive theory, Bandura states that self-referent thought, generally discussed here specifically as self-efficacy, mediates the relation between knowledge and action. Additionally, beliefs about one's efficacy influence a person's motivation and behaviors, their interest in a particular task, and expected outcomes of a certain behavior. One's environment affects how this process occurs as well as the outcome. The strong influence of self-efficacy was posited to be due to its influence on a person's intention to persevere or to give up, thus influencing future behaviors by increasing or decreasing exposure to (or experiences with) new and challenging tasks.

Self-efficacy has been defined as "people's judgments of their capabilities to organize and execute courses of action required to attain designated types of performances" (Bandura, 1986, pg 391). Self-efficacy beliefs are about what one can do with the abilities they have, and are beliefs about specific tasks. For example, an individual may have high self-efficacy beliefs about his or her ability to solve a math problem but have very low self-efficacy beliefs about his or her ability to create a piece of art. Unlike relatively stable traits such as self-esteem, a person's self-efficacy beliefs may vary significantly depending upon the task (Lent & Brown, 2006).

One's beliefs about their efficacy in a particular realm may or may not be accurate (Bandura, 1986). Bandura theorized four sources of self-efficacy: mastery, modeling, social persuasion, and anxiety. The first three sources are listed in expected strength of influence; anxiety was theorized to be independent of the other sources.

Mastery is defined as a person's actual successes and failures, and is expected to have the strongest impact on a person's self-efficacy beliefs (Bandura, 1986). When a person is successful at a task, their confidence to perform another similar task is thought to increase. Additionally, if the person fails, their self-efficacy is thought to decrease. Failures are considered to be particularly influential if they are repeated, occur early in the individual's experience with a task, and cannot be attributed to external circumstances, because these all would decrease the likelihood of the individual trying the behavior again (Bandura, 1986). Once a person has a strong belief in their efficacy at a particular task, they will be influenced less by a failure. Additional effort (leading to success) can substantially strengthen a person's efficacy for a particular task, as the individual sees they can overcome a very challenging obstacle. Once a strong self-efficacy is developed in a particular domain, an individual's efficacy beliefs in other similar domains may also increase (Bandura, 1986) (for example, earning an A in a challenging English class may lead to increased efficacy for success in a challenging psychology class).

The second source of self-efficacy, modeling, is defined as an individual watching a peer (someone the individual feels similar to in this particular task) succeed or fail. This contributor to self-efficacy is theorized to be quite strong, but assumed to be weaker than actual mastery experiences. Bandura posits that when an individual watches a peer succeed, she/he is likely to believe that she/he, too, can accomplish this task. Conversely, if the individual watches a peer fail, especially after investing a substantial amount of effort, the individual's beliefs about their own efficacy is theorized to decrease (Bandura, 1986). Bandura discussed several situations in which one's self-efficacy beliefs are especially influenced by modeling. When one has less experience in a particular task and therefore less stable beliefs about their self-efficacy, Bandura theorizes that modeling can have a larger effect. Additionally, an individual who has had much mixed experience with a task will likely have more self-doubt and therefore place a higher value on modeling (Bandura, 1986). Learning from peers new ways of performing tasks is also theorized to increase the self-efficacy of struggling (as well as successful) individuals. Another use of modeling is social comparison to gauge success and failure (Bandura, 1986). For example, receiving a B in a class means one thing if much of the class received a C and something very different if most of the class received an A. In this way, it is theorized that we judge our efficacy in relation to other people's abilities. While modeling is expected to influence self-efficacy less than personal mastery experiences, this construct can influence a person to avoid tasks that would provide information about personal performance. If this avoidance happens, the individual will likely maintain low self-efficacy for a particular task without having actually tried it (Bandura, 1986).

When a peer or superior expresses an opinion to the person about his or her ability to perform a specific task this is referred to as social persuasion, the third source of self-efficacy. As discussed above regarding modeling, social persuasion has greatest impact when it can encourage or discourage an individual from attempting a particular task (Bandura, 1986). While someone's self-efficacy is in an early stage of development, it can be easily influenced. Social persuasion can move someone towards attempting a task and obtaining personal mastery evidence for their efficacy. Additionally, when someone is unsure of his or her efficacy (for example, because they have had both successes and failures at a task), verbal encouragement can serve as a motivator (Bandura, 1986). Once someone has an established level of self-efficacy for a task, however, Bandura posits that social persuasion has much less influence. It is theorized that social persuasion has more strength to decrease one's self-efficacy than to increase it. Additionally, if an individual has been motivated through social persuasion to attempt a task and then fails, the 'persuader' may be discredited. In this way it is clear that one's own mastery experiences should be a much stronger source of self-efficacy (Bandura, 1986).

The final source of self-efficacy is physiological state. This is defined as the amount of anxiety an individual experiences while performing a specific task. People read their anxiety in difficult situations as signs of their ability or lack of ability to succeed (Bandura, 1986). Specifically, people interpret their arousal in new or stressful situations as a sign that they are struggling. This agitation can lead to more anxiety and spiral upwards in a distracting way. This anxiety caused by the individual's physical state can easily become a self-fulfilling prophesy, as their preoccupation with worry makes them unable to perform the task as successfully as if they had not been distracted. If an individual is able to attribute their anxiety to an external source ("I had a lot of caffeine," "I'm tired," etc.) the agitation is less likely to influence their self-efficacy beliefs (Bandura, 1986).

The degree to which an individual processes and thinks about these four sources affects the strength of the individual's self-efficacy beliefs (Bandura, 1986). When a person has a well-established efficacy belief (whether it is for success or failure) the following constructs in the model will remain more stable. However, Bandura posits that the effects of one's self-efficacy will influence a person's behavior even when their efficacy beliefs are developmentally young and unsteady. Even as these four sources influence the creation of a person's self-efficacy, this self-efficacy influences their expectations and behaviors (Bandura, 1986).

Outcome expectations are influenced by self-efficacy and, along with self-efficacy, are thought to predict behavior. Bandura (1986) defines an outcome expectation as "a judgment of the likely consequence a behavior will produce." This is not the same as completion of an act; instead it is what one expects to happen after a completed act. For example, if one studies hard for a test, the completion of the act is a good grade on the test. The potential outcome expectations are praise from the individual's parents and friends, individual pride, and a higher likelihood of getting accepted at a prestigious college. People also have outcome expectations for failure at a specific task; in this example, the student's expectations may include punishment from parents and feelings of disappointment. Bandura asserts that self-efficacy beliefs and outcome expectations must be separated because a person can believe that there will be certain positive outcomes to a behavior, but not attempt the behavior due to a belief that they would not be successful. For example, a student who has outcome expectations that good grades will get him into a prestigious college and that with a prestigious degree he would be financially successful would still not have this prestigious college as a goal if he does not have the self-efficacy that he can get the necessary good grades (Bandura, 1986). In this way, self-efficacy beliefs influence outcome expectations. If someone believes they will be successful at a specific task, they will hold positive outcome expectations. However, if someone anticipates failure at a task, their outcome expectations will be the consequences of failure. Because of this connection it is not possible to separate one's outcome expectations from his/her self-efficacy beliefs, as one is dependent upon the other (Bandura, 1986).

Behaviors, the criterion variable in Bandura's (1986) social cognitive theory model, are predicted by both self-efficacy beliefs and outcome expectations. The dependence of these constructs on one another is what functions to influence behavior. Bandura posits that people make decisions about courses of action based on what they believe the consequences of these actions are. If an individual has low self-efficacy and thus expects failure and negative consequences, he or she will not attempt the behavior. In contrast, if someone has high self-efficacy for a task he or she is likely to expect positive outcomes and will also be more willing to exert effort in order to assure success. Accurately high self-efficacy for a task or set of tasks will lead an individual toward more challenging and enriching environments; a belief in one's inefficacy will lead to an individual pulling away when they begin to struggle, thus inhibiting their growth; inaccurate beliefs about one's efficacy will lead to failure (Bandura, 1986).

Self-efficacy also has other benefits. Bandura suggests that people with strong self-efficacy beliefs are more likely to persist longer and expend more effort on a challenging task than people who believe they are inefficacious. However, overly strong self-efficacy can lead a person to prepare insufficiently (for an exam or class presentation, for example). Someone's beliefs about their self-efficacy also influence other self-referent thoughts. People who perceive themselves as unable to perform tasks successfully dwell on their deficiencies and construct challenges as more difficult than they actually are. In this way, their attention is drawn away from the task at hand to their self-doubt. Self-efficacious people, conversely, put all of their energy into the current task and invest more energy when challenged (Bandura, 1986).

Bandura (1986) developed the social cognitive theory model to explain how people learn and persist with new behaviors. This theory has been applied to understand behaviors and choices in many different psychological domains. This paper focuses on the vocational psychology applications of Bandura's social cognitive theory.

Applying Social Cognitive Theory to Vocational Research

The seminal work done to examine the influence of self-efficacy in the vocational psychology field began in 1981 with Betz and Hackett. These researchers recognized the differences in the vocational development of men and women as well as the problems encountered in applying career theories developed for men to women. While most of the work on women's career development at the time involved applying existing theories to women, Betz and Hackett (1981) suggested applying a more general theory of predicting how people learn behavior. The authors based their hypotheses on social learning theory, developed by Bandura in 1977. Betz and Hackett hypothesized that self-efficacy would be particularly useful in understanding and advancing women's vocational development.

Betz and Hackett (1981) explored the relation between vocational self-efficacy and the nature and range of perceived occupational alternatives for men and women. They also explored sex differences in self-efficacy regarding educational requirements and job tasks of certain traditionally female careers and non-traditionally female careers. Traditional careers were defined as occupations in which at least 70% of the members were women; non-traditional careers were defined as occupations in which 30% or fewer of the members were women (Betz & Hackett, 1981). The research confirmed the authors' hypotheses: there were significant sex differences in reported self-efficacy in gender-traditional and non-traditional careers. Interestingly, while males reported overall equivalent self-efficacy in traditional and non-traditional occupations, women reported lower self-efficacy for non-traditional (vs. traditional) occupations even though the men and women had equivalent abilities. The authors also found a connection between self-efficacy beliefs and perceived career options such that women who reported lower self-efficacy for non-traditional occupations also reported a smaller range of career options (Betz & Hackett, 1981). With the research done in this article, Betz and Hackett introduced a new focus for understanding women's career development: self-efficacy beliefs.

Social Cognitive Career Theory

In their 1994 article, Lent, Brown, and Hackett applied Bandura's social cognitive theory (1977, 1982, and 1986) to career and academic outcomes (see Fig 1). This model attempts to use social cognitive mechanisms to explain why people become interested in different academic and vocational domains, why they experience success or failure, and why they eventually choose particular academic or career behaviors. Certain constructs in SCCT lend themselves to predicting academic outcomes (for example, performance). Other constructs, particularly interests, have proven useful in better understanding individual's career outcomes. The social cognitive career theory (SCCT) is similar to Bandura's theory. In social cognitive career theory, the authors posit that self-efficacy is predicted by the same four sources career theory, the authors posit that self-efficacy is predicted by the same

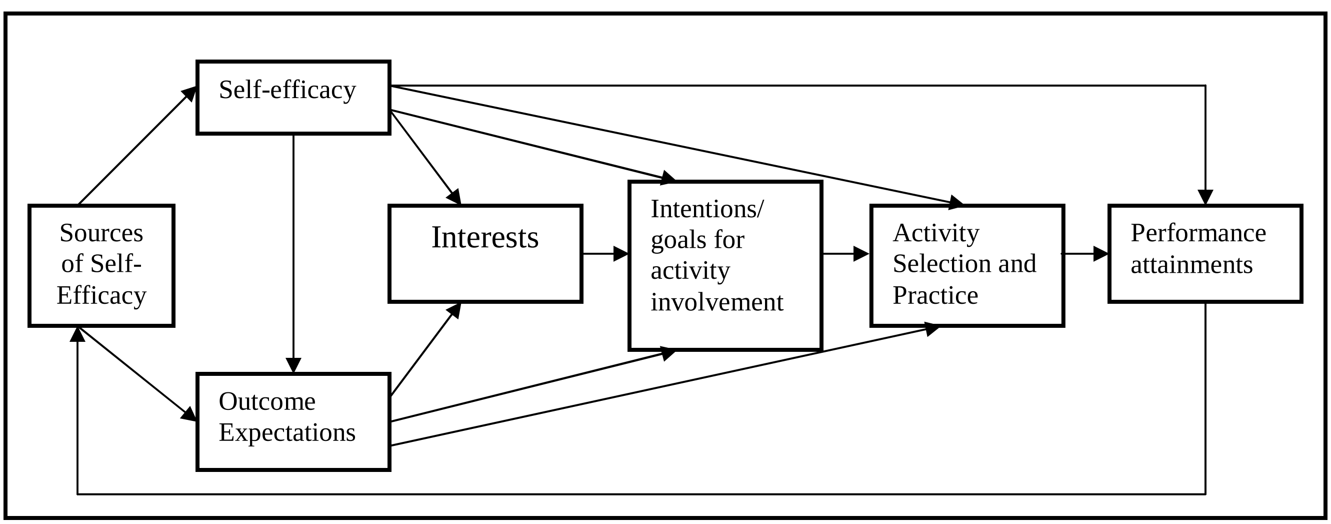

Figure 1. Social cognitive career theory model of development of interests.

four sources (mastery, modeling, social persuasion, and anxiety), that self-efficacy influences outcome expectations and that (eventually) these constructs predict behaviors. However, while Bandura stated that self-efficacy and outcome expectations together directly predict choice behaviors, SCCT states that self-efficacy and outcome expectations directly predict interests. Interests, self-efficacy, and outcome expectations are thought to directly predict goals. Finally, goals, self-efficacy, and outcome expectations are theorized to directly predict actions while interests indirectly predict actions through an individual's goals. Additionally, SCCT more clearly theorized that self-efficacy directly influences performance of a task (Lent et al., 1994).

In an effort to explain interest development, performance, and academic and career choice options, social cognitive career theory (Lent et al., 1994) expands on the constructs introduced in Bandura's theory (1977, 1982, 1986). Lent and colleagues predict that self-efficacy plays a very important role in eventually determining behavior. In defining self-efficacy, they explicitly state that this construct is not the same thing as actual ability; one's beliefs about their ability have been found to only moderately correlate with objective ability indices (Lent et al., 1994). Additionally, the authors emphasized that self-efficacy is a constantly changing set of beliefs about one's ability to succeed at a specific task; these beliefs are shaped by many other environmental and person factors. The authors of SCCT suggest that the model provides a framework for understanding these factors by offering central pathways through which these factors affect outcomes.

Outcome expectations refer to the consequences of succeeding or failing at a particular task. Three types of outcome expectations may influence a person's vocational behavior: physical (ex: money), societal (ex: approval or acceptance), and self-evaluative (ex: pride or a positive self-concept). In addition to the valence of the outcome expectation, individuals are also influenced by the importance they place on a particular outcome. In career decision-making, people often are forced to choose between two (or more) appealing choices. Especially when this is the case, individuals are influenced by how important different positive outcome expectations are for them (Lent et al., 1994). Additionally, while self-efficacy and outcome expectations are theorized to be strongly correlated, certain situations may decrease this relation. In many academic settings, performance is only vaguely connected with outcome. As an example, many factors influence one's acceptance or rejection from a prestigious graduate school; grades are only one part. Other influences of outcome include essay-writing ability (which may or may not be a relevant task once in the program), letters of recommendation, networking, and "match" with the program. In this situation, self-efficacy may have a weaker effect on outcome expectations than in other situations due to the lack of control the individual may perceive. Self-efficacy and outcome expectations are both theorized to directly predict interests.

Social cognitive career theory places quite a bit of importance on interests, and in fact, predicting this construct is one of the three main goals of SCCT. Lent and colleagues (1994) define vocational interests as "patterns of likes, dislikes, and indifferences regarding career-relevant activities and occupations" (Lent et al., 1994, pg 88). Throughout development, an individual is exposed to a myriad of activities and experiences. Sometimes effort is met with success, other times with failure. Additionally, some behavior is rewarded and other behavior is punished. Individuals use this information (essentially self-efficacy and outcome expectations) to form their interests. Said another way, one is more likely to form an enduring interest in an activity where they have found success and rewards than in an activity where they have experienced failure and punishment. While many different career paths are tried out throughout childhood and adolescence, SCCT states that people tend to eventually develop a relatively stable pattern of interests.

It is further theorized that the level of interest a person has in a particular activity or subject area, as well as their self-efficacy for that task and the outcome expectations they have for performing the task, will influence their future goals, thus influencing their involvement and skill attainment in a particular domain. For example, a person who has high math interests is likely to plan to seek out math activities, like a club or honors class (referred to in the model as intentions/goals for activity involvement). When a person has a strong interest in an activity (and thus has experienced success and other rewards for pursuing this activity), continuation and expansion in that domain is a logical results. Continuing the example, participation in these math activities will then help the individual acquire more practice and math skills (activity selection and practice). This becomes an ever-growing cycle: success leads to interest, which leads to practice and then further success. If a person has little interest in math however, he or she is unlikely to seek out math-related experiences. The amount of exposure and practice an individual receives regarding a particular subject area influences their level of success. This experience of success or failure is one of the theorized sources of self-efficacy, starting the cycle back at the beginning.

Empirical Studies of SCCT

PsychInfo was the primary search index used for finding relevant articles. Search terms entered include social cognitive career theory or SCCT, math and/or science, self-efficacy, outcome expectations or outcome expectations, and/or interests. Additionally, several prominent social cognitive career theory researchers were searched for including

Lent, Fouad, Betz, and Hackett. PsychInfo and PubMed were the primary search indices used to find information about the career development of the participants in this study, science majors and pre-medicine students. Search terms entered included pre-medicine or pre-med, science, and career or vocational.

In this section, empirical studies predicting each SCCT construct will be reviewed in their hypothesized order of prediction: demographic variables, sources of self-efficacy, self-efficacy, outcome expectations, interests, goals, and performance. For each construct, math, science, and math/science studies will be discussed. Additionally, when applicable, studies examining SCCT constructs in RIASEC domains will be discussed. Finally, non-SCCT constructs will be reviewed including parent support, pre-medicine majors, and sex differences in RIASEC interest domains. As the present study focuses on a group of participants who have rarely been sampled, it seems important to explore what little is known about pre-medical students and science majors.

Predictors of Self-Efficacy

Math Self-Efficacy

Seven peer-reviewed journal articles (with nine studies/populations) were located which discussed predictors of math self-efficacy in the context of social cognitive career theory. These articles were written between 1990 and 2005 and all of these articles examined the four hypothesized source of self-efficacy (mastery, modeling, social persuasion, and anxiety). Participant ages ranged from 7th grade through college-aged (11-23 years old) and sample size ranged from 50 to 590 participants. All studies included both sexes, however most samples included more females than males, especially when the studies were done with college populations.

Measurement of the sources of math self-efficacy was not consistent within these seven articles. Three out of the four studies done by Lent and co-authors (Lent, Lopez, & Bieschke, 1991; Lent, Lopez, Brown, & Gore, 1996; and Lopez & Lent, 1992) used a perceived sources of self-efficacy measure from Lent and colleagues (1991). Authors of the fourth study (Lent, Brown, Gover, & Nijjer, 1996) measured sources of math self-efficacy with thought listing, asking participants to write out all factors that had contributed to how they rated their self-efficacy in earlier measures. Two studies (Matsui, Matsui, & Ohnishi, 1990; Klassen, 2004) measured sources of math self-efficacy with a measure created by Matsui and colleagues in 1990. Finally, a study performed in Turkey in 2005 by Ozyurek used math self-efficacy and sources of self-efficacy measures published by Ozyurek (2001, 2002).

The criterion variable, math self-efficacy was measured in two Lent articles with a scale published by Betz and Hackett (1983), in another article with a scale published by Lent and colleagues (1991), and in the final article with a measure created with the schoolteacher for specific participants. Authors of two studies (Matsui et al., 1990; Klassen 2004) used a math self-efficacy measure developed by Matsui and colleagues in 1990.

Four theorized sources. Six studies (containing eight samples) were located in which researchers explored the correlation between the four theorized sources of self-efficacy and math self-efficacy (Klassen, 2004; Lent et al., 1991; Lent, Lopez et al., 1996; Lopez & Lent, 1992; Matsui, et. al, 2005; Ozyurek, 2005). Results from these articles are not entirely consistent, however some patterns are visible. In all studies, math perceived mastery experiences were the strongest predictor of math self-efficacy. Reported correlations between perceived mastery experiences and math self-efficacy ranged from .28 to .63. Additionally, modeling was significantly correlated (although modestly) with math self-efficacy in all except two samples with reported correlations between .15 and .19 (Klassen, 2004; Lent et al., 1991; Lent, Lopez et al., 1996; Matsui, et. al, 2005). Researchers in six out of the eight samples found that social persuasion significantly predicted math self-efficacy; the reported correlations range was large, from .15 to .54 (Klassen, 2004; Lent et al., 1991; Lent, Lopez et al., 1996; Lopez & Lent, 1992; Ozyurek, 2005). Finally, anxiety significantly predicted math self-efficacy in five out of the eight samples with reported correlations ranging from -.17 to -.49 (Klassen, 2004; Lent et al., 1991; Lent, Lopez et al., 1996; Matsui, et. al, 2005; Ozyurek, 2005).

While not included in the correlational results because statistical correlations could not be done, a thought-listing study (Lent, Brown et al., 1996) of 103 college students provided interesting qualitative information. Specifically, 65 participants (63%) indicated that mastery experiences most influenced ratings of their math self-efficacy, 18 participants (17%) listed interests as most important, four participants (4%) ranked modeling as the most influential source of math self-efficacy and one participant (1%) ranked anxiety as the strongest source. No participants mentioned social persuasion.

Sex. Five studies that included information about the effect of sex on math self-efficacy were examined. One of these (Ozyurek, 2005) reported no significant sex differences. Lent, Lopez, and colleagues (1996), when examining math self-efficacy, indicated that in college students, there was a small correlation of sex to perceived mastery experiences (r = -.12, p <.05) and positive emotional arousal (r = -.12, p <.05), conceptualized as low anxiety and positive affect. Men reported more perceived mastery experiences and more favorable affect than women. In high school students, sex was significantly correlated with vicarious learning (*r* =.13, *p* <.01) and social persuasion (*r* = .10, *p* <.05) such that girls reported more experiences with modeling and social persuasion than men. Additionally, in a study validating multiple self-efficacy measures using 339 college students, Gwilliam and Betz (2001) found that men had significantly higher math self-efficacy (using two measures) than women, [F= 15.43 (2, 355), *p* < .001].

With a sample of 11th grade students, Lopez and Lent (1992), using a two-way MANOVA, indicated a main effect of sex [Wilks's F(9, 33) = 2.72, *p* < .05] such that girls reported higher math self-efficacy than boys. These girls also reported receiving more social persuasion support regarding math than boys [F(1, 41) = 4.32, *p* < .05]. In another study, Lent and colleagues (1991) used multiple regression to examine the effects of sex on math self-efficacy and it's sources. They discovered that sex accounted for 22% of the variance in math self-efficacy. Additionally, the four sources of self-efficacy and ACT score were used to predict math self-efficacy; the model accounted for 73% of the variance in males and 62% of the variance in females.

Multiple predictor models. One study tested a multiple-predictor model, putting all four sources of self-efficacy into a regression model to predict math self-efficacy (Lent, et al., 1991). It was found that after self-report mastery was accounted for, none of the other sources contributed significant variance to the model.

Science Self-Efficacy

Only one study was located which examined the sources of science self-efficacy alone. Britner and Pajares (2006) surveyed 319 (155 boys, 164 girls) in grades 5-8. Students attended one middle school, which was chosen due to its rate of high student science achievement. The investigators measured sources of science self-efficacy with an adapted math sources of self-efficacy inventory published by Lent, Lopez and colleagues in 1996. Additionally, science self-efficacy was assessed by asking students how confident they were they could earn an A, B, C, or D in their current science class.

Four theorized sources. Britner and Pajares (2005) indicated that all four sources significantly predicted science self-efficacy. Reported correlations with self-efficacy are as follows: perceived mastery experiences $r = .55$, modeling $r = .34$, social persuasion $r = .42$, and anxiety $r = -.40$.

Demographic variables. These authors (Britner & Pajares, 2005) discovered that while girls had higher science grades than boys, their science self-efficacy scale scores were equal. Additionally, boys reported more perceived mastery experiences and girls reported more anxiety experiences (Britner & Pajares, 2005).

Math/Science Self-Efficacy

Three articles were located which measured predictors of science and math self-efficacy together (Ferry, Fouad, & Smith, 2000; Fouad & Smith, 1996; Fouad et al., 2002). Fouad has chosen to measure math/science self-efficacy together (often also measuring other school subject categories like English, social studies, and art). These authors did not measure the theorized four sources of self-efficacy (mastery, modeling, social persuasion, and anxiety), but instead measured mastery alone as well as demographic factors such as sex and parent support. Subjects were seventh and eighth grade students in one study and college students in the other two; sample size ranged from 380 to 932 participants.

Measurement of self-efficacy among the three articles was not consistent. The earliest article used a measure published by Fouad, Smith, and Enochs in 1997, which was developed to measure multiple theoretical constructs (math/science self-efficacy, outcome expectations, and intentions). The second article used a measure developed by Betz and Hackett in 1983 to measure math self-efficacy. Science items were added to the scale through an iterative process and the original six-point Likert scale was retained. The final article used a measure developed in 1999 by Smith and Fouad. This scale included 153 six-point Likert items measuring four SCCT constructs in four academic domains. Of these 153 items, seven items specifically measured math/science self-efficacy. Additionally, parent support was measured with a parent involvement scale developed by the authors of the study (Ferry et al., 2000). This measure included three subscales: role modeling, parent expectations, and parent encouragement. (*rs* =.35, .53)

Four theorized sources. Authors of two studies measured performance in college students (operationalized as grades or general and subject-specific GPA) and found that this construct was significantly related to math/science self-efficacy (Ferry, et al., 2000; Fouad et al., 2002). Using structural equation modeling, Fouad and colleagues (2002) found significant paths between math/science self-efficacy and general GPA ($\beta = .47$) and math/science GPA ($\beta = .53$) in a model where the only other predictors of self-efficacy were parent education and gender. In a separate study (Ferry et al., 2000), it was found that math/science grades were related to math/science self-efficacy ($\beta = .35$). These two studies indicate that grades predicted a significant unique portion of the variance in math/science self-efficacy, however no other theorized source of self-efficacy was included in either of these models

Demographic variables. Three studies were located in which the authors explored the effects of sex on math/science self-efficacy measured together (Ferry et al., 2000; Fouad et al., 2002; Fouad & Smith, 1996). None of these found significant sex effects. Additionally, Ferry and colleagues (2000) explored the relation of three aspects of parent support to math/science self-efficacy. These researchers reported a significant correlation between parent encouragement and math/science self-efficacy (r = .25). Neither role modeling nor parent expectations were significantly correlated with math/science self-efficacy.

Academic Self-Efficacy

Authors of two articles investigated the effects of sex on academic (not specifically math or science) self-efficacy. Usher and Pajares (2005) surveyed 263 sixth graders regarding the four theorized sources of self-efficacy. They indicated that girls reported more modeling and social persuasion experiences than boys and that these accounted for 17% and 4% of the variance in these girls' academic self-efficacy respectively. Additionally, these two were the only sources that significantly predicted academic self-efficacy for girls. For boys, however, self-report mastery experiences accounted for 27% of the variance in academic self-efficacy. Modeling and anxiety significantly contributed to this model, and social persuasion (the strongest source for girls) did not significantly predict academic self-efficacy for boys. Additionally, Lent, Brown, and colleagues (1996) used a thought-listing measure to examine the academic self-efficacy of 103 college-aged participants. The authors demonstrated that women were more likely than men to mention anxiety as a source of academic self-efficacy (14% to 2%)

Career Decision-Making Self-Efficacy

One article was located which discussed the effects of parent support on career decision-making self-efficacy (Nota, Ferrari, Solberg, & Soresi, 2007). The researchers surveyed 253 Italian high school students with seven items from the Social Provisions Scale

(Russell & Cutrona, 1984), a measure assessing general family social support. These authors hypothesized that self-efficacy mediated the relationship between family support and career indecision. Results showed that family support had a significant relation with career decision-making self-efficacy in both males and females (β = .28, .21, respectively).

Summary

Overall, these studies confirm that the sources of self-efficacy posited by Lent and colleagues (1994) significantly predict self-efficacy. Mastery significantly predicted self-efficacy in all studies. The other three sources significantly predicted self-efficacy in most cases; social persuasion and anxiety were correlated with self-efficacy in all except one study each and vicarious learning was correlated with self-efficacy in all except two studies. Additionally, while it is theorized that the relative strength of each source is consistent (mastery > modeling > social persuasion; anxiety) this was found to fluctuate throughout the studies.

Additionally, it is uncertain whether sex has an effect on self-efficacy and its sources. Eleven studies were located which included information about sex differences in self-efficacy; seven of these reported significant sex differences. When there was an overall difference in self-efficacy reported, the direction of this difference depended on the age of the participants. In college samples, males generally had higher self-efficacy; however in junior high and high school samples, girls generally had higher self-efficacy. Additionally, a theme emerged of men relying on their own performance and their interpretations of these experiences to determine their self-efficacy and women relying on relational sources and anxiety to assess their abilities.

Predictors of Outcome Expectations

Math Outcome Expectations

Four published articles (Lopez & Lent, 1992; Lent et al., 1991; Lent, Lopez, & Bieschke, 1993; Waller, 2006) and one meta-analysis were located which included information on predictors of math outcome expectations. Lopez and Lent surveyed a sample of 50 eleventh grade students; 62% of the students were female, 90% were Caucasian, and their mean GPA was 2.68. These authors as well as Waller (2006) measured outcome expectations with the Usefulness of Math Scale, a 10-item inventory developed by Fennema and Sherman in 1976 and revised by Betz in 1977.

In a meta-analytic study, Young and colleagues (2004) located 10 samples in 9 studies that examined correlations of math or math/science outcome expectations with other relevant constructs. Most of the samples in the meta-analysis were undergraduate college students, however two samples were high school students and two samples were middle school students.

Sources of self-efficacy. In their meta-analysis, Young and colleagues (2004) examined the correlation between sources of math self-efficacy and math outcome expectations. The authors reported an average weighted mean effect size for the correlations between the sources of math self-efficacy and math outcome expectations for perceived mastery experiences (.48 in three studies), modeling (.41 in three studies), anxiety (-.47 in four studies), and social persuasion (.50 in seven studies).

Self-efficacy. Young and colleagues (2004) reported an average weighted mean effect size for the correlation between math self-efficacy and math outcome expectations of .45 across seven studies. Additionally, Waller (2006) examined a sample of 156 African-

American college students at a predominantly African-American University and confirmed a significant correlation between math self-efficacy and math outcome expectations (*r* = .44) and a significant path coefficient between these two constructs (β = .44). Finally, Lopez and Lent (1992) discovered that math self-efficacy significantly predicted math outcome expectations but that this effect was largely mediated by math/science interests. This finding is inconsistent with the theorized relations between these constructs; Lent and colleagues (1994) posit that in any domain, self-efficacy predicts outcome expectations and that these two constructs together predict interests.

No articles were located which examined predictors of science outcome expectations alone. Many studies looked at combined math/science self-efficacy.

Math/Science Outcome Expectations

One meta-analysis (Young et al., 2004) and one article (Fouad, Smith, & Zao, 2002) were located that measured predictors of combined math/science outcome expectations. Fouad and colleagues measured a sample of 952 college-aged participants.

Authors of this study (Fouad et al., 2002) used a measure that was developed and validated by Smith and Fouad (1999). This measure contains 153 items, which are rated on a six-point Likert scale. The items measure self-efficacy, outcome expectations, interests, and goals in four areas of academic study: math/science, art, English and social studies. The four constructs are crossed with the four subject areas to create 16 subscales.

Math/science self-efficacy. In their meta-analytic study, Young and colleagues (2004) collected information about studies that explored relations between math/science outcome expectations and other constructs. Based on four studies, the authors found an average weighted mean effect size for the correlation between math/science self-efficacy and math/science outcome expectations to be .41.

Parent support. Ferry and colleagues (2000) also investigated the relation of three subscales of parent support (role modeling, parent encouragement, and parent expectations) to math/science outcome expectations. These researchers reported a significant correlation between math/science outcome expectations and parent encouragement (r = .38) as well as parent expectations (r = .22). Role modeling was not significantly correlated with math/science self-efficacy.

Multiple-predictor models. Authors of three studies used structural equation modeling (SEM) to assess predictors of math/science outcome expectations. Fouad and colleagues (2002) found significant predictors of math/science outcome expectations to be sex (path coefficient theta = -.12, males coded lower) and math/science self-efficacy (path coefficient theta = .29). Ferry and colleagues (2000), in their most parsimonious SEM model indicated that grades (path coefficient theta =.07), math/science self-efficacy (path coefficient theta =.20) and parent encouragement (path coefficient theta =.23) significantly directly predicted math/science outcome expectations. Finally, in a path analysis, Fouad and Smith (1996) discovered a significant relation between math/science outcome expectations and math/science self-efficacy (β = .55) as well as sex (β = -.18) in a model that also included age as a predictor of math/science outcome expectations.

Predictors of Interests

Math Interests

Four peer-reviewed articles and one meta-analysis were located in which authors examined predictors of math interests. In three studies researchers used slightly revised measures developed by Betz and Hackett in 1983 (Lent et al., 1991; Lent et al., 1993; Waller, 2005). Additionally, Waller used a math outcome expectancy scale developed by Fennema and Sherman in 1976 and measured math/science interests with a measure developed in 2000 by Lent, Brown, and Hackett. The author of the final article (Ozyruek, 2005) used measures developed by the author for that study. Sample sizes ranged from 138 to 590, two studies used primarily Caucasian college students, Waller (2005) used only African-American college students, and Ozyurek (2005) used Turkish high school students.

Sources of self-efficacy. Ozyurek (2005) discovered that all four sources of self-efficacy were significantly correlated with math interests. Correlations with math interests were as follows: perceived mastery and social persuasion were measured together (r = .74), modeling (r = .22), and anxiety (r = -.42).

Self-efficacy. As posited by Lent, Brown and Hackett (1994), math self-efficacy was reported to be significantly and strongly correlated with math interests (rs =.53-.63) in four studies (Lent et al., 1991; Lent et al., 1993; Ozyurek, 2005; Waller, 2005).

Outcome expectations. A meta-analysis (Young et al., 2004) found an average weighted mean effect size for the correlation between math outcome expectations and math interests of .56 using two samples. Additionally, math outcome expectations were significantly correlated with math interests (.55-.67) in two additional studies (Lent et al., 1993; Waller, 2005).

Multiple-predictor models. Using hierarchical regression to predict math interests, Lent and colleagues (1993) indicated that sex accounted for 8% of the variance in math interests (R^2=.08), math ACT score accounted for an additional 7% (ΔR^2 =.07), math self-efficacy accounted for an additional 24% of the variance (ΔR^2 =.24), and math outcome expectations accounted for an additional 16% (ΔR^2 =.16). All constructs significantly contributed to the model, which accounted for 55% of the variance in math interests. In the final two articles, researchers used structural equation modeling (Ozyurek, 2005; Waller, 2005). Authors of both of these articles confirmed that math self-efficacy significantly directly predicted math interests (path coefficient theta = .48 and .78). Additionally, Waller (2005) reported that math outcome expectations significantly directly predicted math interests (path coefficient theta = .33).

Math/Science Interests

Although no studies were found which examined correlates of only science interests, four articles and one meta-analysis were located which examined math/science interests together. All four articles were authored by Fouad and colleagues; the meta-analysis has been discussed above (Young et al., 2004) and included three out of the four individual studies discussed in this section (Ferry et al., 2000; Fouad & Smith, 1996; Smith & Fouad, 1999). Two of the four articles (Ferry et al., 2000; Fouad & Smith, 1996) used a 24-item measure developed by Fouad and colleagues (1997). Authors of the other two articles, analyzing the same sample, (Fouad et al., 2002; Smith & Fouad, 1999) used a 153-item measure developed in Smith and Fouad (1999) to measure multiple SCCT constructs in four academic domains. Sample sizes ranged from 380 to 952 participants; two samples included college students and one included junior high students.

Self-efficacy. It was confirmed in three articles (Ferry et al., 1999; Fouad & Smith, 1996; Smith & Fouad, 1999) that math/science self-efficacy predicted math/science interests (*rs* = .29 - .53).

Outcome expectations. In a meta-analysis, Young and colleagues (2004) found that solely math outcome expectations were significantly correlated (.54) with math/science interests in eight samples.

Parent support. Ferry and colleagues (2000) also investigated the relation of three aspects of parent support to math/science interests. These researchers reported a significant correlation between math/science interests and parent encouragement ($r = .28$). Role modeling and parent expectations subscales were not significantly correlated with math/science interests.

Multiple-predictor models. In addition to determining these correlations, two articles reported path coefficients for a structural equation model (Ferry et al., 1999; Fouad et al., 2002). In both of these studies math/science self-efficacy significantly uniquely directly predicted math/science interests (path coefficient theta = .40, .51) and math/science outcome expectations significantly directly predicted math/science interests (path coefficient theta = .33, .47).

Six Holland Domains

Two articles were located that examined predictors of all RIASEC interests. The author of one study (Tracey, 2002) sampled children in elementary school and middle school twice over one year. This researcher used the Inventory of Children's Activities – Revised (ICA-R), a 60-item measure, which uses a five-point Likert scale to measure both interests and self-efficacy. Tracey (2002) discovered that sex, time, and interests predicted individual RIASEC domain self-efficacy. Specifically, girls reported higher self-efficacy than boys in artistic, social, and conventional tasks while boys reported higher self-efficacy than girls for realistic and investigative tasks.

In the second study, the investigators (Nauta et al., 2002) also examined interests and self-efficacy, but used a sample of 104 college students. Additionally, the authors measured these constructs with the General Occupational Themes (GOTs) of the Strong Interest Inventory (Harmon, Hansen, Borgen, & Hammer, 1994) and the Skills Confidence Inventory (Betz, Borgen, & Harmon, 1996).

Authors of both studies determined that the relation between interests and self-efficacy is reciprocal and Tracey (2002) specified that the two constructs predicted each other equally. This is in conflict with the relation theorized by Lent, and colleagues (1994) in social cognitive career theory. While the authors proposed a unidirectional relation where self-efficacy precedes and predicts interests, these two studies suggest that the relation is bi-directional.

RIASEC Self-efficacy and RIASEC Interests

The two studies discussed above (Nauta et al., 2002; Tracey, 2002) discovered that when studying RIASEC domains, self-efficacy and interests have a reciprocal relation. Rottinghaus, and colleagues (2002) performed a meta-analysis using 60 independent samples in which the relation between interests and self-efficacy were examined. The authors used both published and unpublished studies and found a total *N* of 37,829 for the core analysis. These 60 samples examined both RIASEC and academic (art, math, science, math/science) domains.

Based on this collection of studies, the authors reported an average weighted mean effect size for the correlation between self-efficacy and interests to be .59 when including all RIASEC and academic domains. When looking specifically at science self-efficacy and interests, Rottinghaus and colleagues (2002) found an average weighted mean effect size of

.69 in three samples. Additionally, when analyzing only math self-efficacy and interests, an average weighted mean effect size of the correlation between these constructs was .73 across seven samples. Finally, when both math/science were measured together, an average weighted mean effect size of the correlation between math/science self-efficacy and math/science interests was .51 across four samples.

In their review of interests, Rottinghaus and colleagues (2002) cited results from three studies that ran counter to social cognitive theory. In one study, researchers (Lenox & Subich, 1994) discovered that at low levels of self-efficacy, interest scores stay constant, but that at increasingly higher levels of self-efficacy, interests increase linearly. While this fits with Bandura's (1986) hypothesized lower-bound threshold (that a certain amount of self-efficacy is necessary to influence interests) it does not fit his upper-bound threshold theory that at a certain high level of self-efficacy, further increases would no longer affect interests. Additionally, Rottinghaus and colleagues cited the two studies discussed above (Nauta et al., 2002; Tracey, 2002) as the only two longitudinal studies located and reported that both articles concluded that self-efficacy and interests have a reciprocal relation.

Predictors of Goals

Math Goals

Two peer-reviewed studies were located that explored predictors of goals (also called choice intentions). Authors of both studies used college students, however in one study the researchers (Lent et al., 1993) examined a sample of 166 primarily Caucasian students and in the other study the researcher (Waller, 2002) measured a sample of 156 African-American students. The authors of both studies used measures originally developed by Betz and

Hackett in 1983; Waller used additional measures developed by Fennema and Sherman in 1976 and Lent and colleagues in 2000.

Authors of both studies (Lent et al., 1993; Waller, 2002) demonstrated similar relations between previously identified SCCT constructs and math goals. The correlation between math self-efficacy and math goals was found to be significant in both articles (*rs* =.46, .63); the correlation between math outcome expectations and math goals was found to be significant in both articles (*rs* = .42, .52); and the correlation between math interests and math goals was found to be significant in both articles (*rs* = .68, .71). These researchers also reported additional analyses. Waller (2002) reported that the most parsimonious model predicting math goals included math self-efficacy (path coefficient of .38) and math interests (path coefficient of .51). Additionally, Lent and colleagues (1993) found the most parsimonious hierarchical regression model to predict math goals (operationalized as course intentions) included sex (R^2 =.16), math ACT (ΔR^2=.03), math self-efficacy (ΔR^2=.08), and outcome expectations (ΔR^2=.11). All additions to the variance were significant at p <.001 except math ACT which was significant at p =.05. This model accounted for 38% of the variance in math goals.

Science Goals

One article was located that examined the predictors of science goals. Lent and colleagues (1991) hypothesized that math self-efficacy is related to science-based career choices. The authors sampled 138 primarily Caucasian college students and used a 40-item measure developed by Betz and Hackett (1983) to collect information about participants' math self-efficacy, math interests, math outcome expectations, and science intentions/goals. The authors operationalized the strength of the science occupational choice by asking participants about their intended career choice; researchers then rated the amount of science required in this field. A significant multiple regression model predicting occupational choice included math self-efficacy (β=.27) and math outcome expectations (β=.21); both constructs significantly contributed to the model.

Math/Science Goals

One meta-analysis (Young et al., 2004) and four peer-reviewed journal articles all authored by Fouad and colleagues were found which discussed math/science goals together. Two of the four articles (Ferry et al., 2000; Fouad & Smith, 1996) used a 24-item measure developed in Fouad, and colleagues (1997). The other two articles, performing different analyses on the same sample, (Fouad et al., 2002; Smith and Fouad, 1999) used a 153-item measure developed in Smith and Fouad (1999) to measure multiple SCCT constructs in four academic domains. Sample sizes ranged from 380 to 952 participants; two samples included college students and one sample was junior high students.

Self-efficacy. Authors of three studies (Ferry et al., 2000; Fouad & Smith, 1996; Smith & Fouad, 1999) reported that math/science self-efficacy was significantly correlated math/science goals (*r*s = .41 to .45).

Outcome expectations. A meta-analysis (Young et al., 2004) reported an average weighted mean effect size for the correlations between math/science outcome expectations and math/science goals of .50 in 18 samples.

Interests. Authors of three studies (Ferry et al., 2000; Fouad & Smith, 1996; Smith & Fouad, 1999) reported that math/science interests were significantly correlated with math/science goals (*r*s = .45-.66).

Parent support. Ferry and colleagues (2000) investigated the relation of three aspects of parent support (encouragement, role modeling, and expectations) to math/science goals. These researchers reported a significant correlation between math/science goals and parent encouragement (r = .39). Neither role modeling nor parent expectations were significantly correlated with math/science goals.

Multiple-predictor models. In three articles, investigators (Ferry et al., 2000; Fouad & Smith, 1996; Fouad et al., 2002) used structural equation modeling (SEM) to examine these relations further. Two out of the three studies (Ferry et al., 2000; Fouad & Smith, 1996). reported that path coefficients directly from math/science self-efficacy to math/science goals were significant (β = .08, .13) in samples of 380 and 791 respectively. The third study (Fouad et al., 2002) did not find a significant path directly from math/science self-efficacy to math/science goals with a sample of 932 students; in this study, the relation between math/science self-efficacy and math/science goals was completely mediated by math/science interests and math/science outcome expectations. The authors of these same three studies also reported SEM path coefficients directly from math/science outcome expectations to math/science goals of .43, .39, and .34 respectively; all of these were statistically significant and also much larger than the reported path coefficients between math/science self-efficacy and math/science goals. Finally, these same authors reported path coefficients directly from math/science interests to math/science goals (.28, .44, and .47); all of these were statistically significant.

Math/Science Major Choice or Career Choice

When searching the literature for information about goals, two articles were located that examined the relation between relevant SCCT constructs and *actual* major choice (as opposed to future intentions). Lapan, Schaughnessy, and Boggs (1996) sampled 101 students the summer after they graduated from high school and then obtained a list of their current majors after the students' junior year in college. At the first time point, the authors collected information about math self-efficacy (using a scale from Betz & Hackett, 1983) and math interests using the math Basic Interest Scale of the Strong Interest Inventory (Harmon et al., 1994). Additionally, three years later, the authors collected information about each student's current major and categorized it into one of five categories on Goldman and Hewitt's (1976) math/science college major continuum. Significant correlations were discovered between sex and level of math/science in college major ($r = -.27$ such that males had majors which involved more math/science), math self-efficacy and amount of math/science in college major ($r = .24$), and math interests and amount of math/science in college major ($r = .36$). This study demonstrates that reported math self-efficacy and interests may significantly predict actual behavior several years later.

Authors of another study (Scott & Mallinckodt, 2005) examined the relation between two aspects of math/science self-efficacy and reported major. Forty-one female participants were recruited from three cohorts of a high school National Science Foundation-funded summer enrichment program and were measured at one time point, two to four years after they completed the program. Researchers used the Self-Efficacy for Technical/Scientific Fields measure developed by Lent and colleagues in 1984. This measure listed 15 scientific/technical occupations and asked participants a yes/no question as well as a rating (from 1-10) question about their ability to complete education for each occupation. The authors found that women in science and engineering majors reported significantly higher self-efficacy in both the yes/no rating as well as the 10-point Likert scale rating of occupation self-efficacy than women in other majors.

Predictors of Performance

Math Grades

Two studies (Klassen, 2005; Lent et al., 1993) and one meta-analysis (Young et al., 2004) were located that provide information about predictors of performance. Klassen's article (2005) was excluded because in his study performance was measured as past grades; SCCT theory would state, then, that these grades predicted the other constructs and not vice-versa. Lent and colleagues (1993) collected demographic information and math self-efficacy, outcome expectations, and interests measures from 166 college students. Lent and colleagues (1993) found correlations between math grades and [1] math self-efficacy (.39), [2] math ACT score (.36), [3] math interests (.28) and [4] math intentions (.06). The authors also performed a hierarchical regression to predict college grades and found significant predictors to be math ACT (R^2 =.15) and math self-efficacy (ΔR^2 = .08). The interaction between self-efficacy and outcome expectations did not significantly contribute to the model (ΔR^2 = .03, p =.09); sex and outcome expectations did not explain any of the variance in math grades. The entire model explained 26% of the variance in math performance.

Additionally, authors of the meta-analysis (Young et al., 2004) reported an average weighted mean effect size for the correlation between math outcome expectations and subsequent grades to be .24 (in three samples, one of which is Lent et al., 1993, discussed above).

Science Grades

Two studies were located in which investigators measured the predictors of science performance. Lent, Brown, and Larkin's article (1987) was excluded because they measured performance with high school class rank, PSAT score, and prior college grades; SCCT theory would state that because this performance preceded measurement of other constructs, these indicators of performance should predict the subsequent constructs, not vice-versa. Brittner and Pajares (2005) surveyed 319 students in grades 5-8 in schools that had earned recognition for high student science achievement. The sources of science self-efficacy were measured using an adapted measure for sources of math self-efficacy published in 1996 by Lent, Lopez and colleagues. Additionally, science self-efficacy was measured by asking students what grade they expected to get in their current science class. Performance was operationalized as the student's grade at the end of the semester. It was discovered that all four sources of science self-efficacy were significantly correlated with science performance (rs = .26-.48) and that science self-efficacy predicted science performance (r = .60). Additionally, sex was correlated with science performance (r = -.14) such that girls had higher grades than boys.

Graduation

Wintre and Bowers (2007) explored the relationship between parent support and college graduation. The authors sampled 944 undergraduate students at a large, commuter Canadian University using the Social Provisions Scale-Parent version (SPS-P, Cutrona, 1989), a 12-item scale measuring level of parent social support. Authors found that parent support significantly contributed to a model (including sex, depression, high school GPA, stress, and first-year GPA) predicting whether a student graduates or not.

Summary of Empirical Studies of SCCT

In general, the literature supports the theorized correlations between constructs in social cognitive career theory as well as the order in which constructs predict each other. Mastery experiences predicted math and/or science self-efficacy in all studies. The other three sources were found to significantly predict math and/or science self-efficacy in most cases; social persuasion and anxiety were correlated with math and/or science self-efficacy in all but two samples each and vicarious learning was correlated with math and/or science self-efficacy in all but three samples. However, while it is theorized that relative strength of each source is consistent (mastery > modeling > social persuasion; anxiety) this strength was found to fluctuate throughout the studies.

Additionally, sex appears to have an inconsistent relation with math and/or science self-efficacy and its sources. Eleven studies were located that included information about sex differences in math and/or science self-efficacy; seven of these reported significant sex differences. When there was an overall difference in math and/or science self-efficacy reported, the direction of this difference depended on the age of the participants. In college samples, males generally had higher math and/or science self-efficacy; however in junior high and high school samples, girls generally had higher math and/or science self-efficacy. Other studies demonstrate that the experience with and the strength of each of the four sources vary depending on sex (men tend to rely more on their own performance while women tend to rely on experience and statements from other people). Another demographic variable, parent support, was shown to predict self-efficacy in two studies (Ferry et al., 2000; Nota et al., 2007).

Science and/or math self-efficacy seems to predict science and/or math outcome expectations in all studies examined (*rs* = .33-.55). Additionally, authors of one meta-analysis found that the four sources of self-efficacy also significantly predict math outcome expectations (Young et al., 2004). Authors of another study reported that the significant correlation between math self-efficacy and math outcome expectations was largely mediated by interests (Lopez & Lent, 1992).

Math and/or science interests were predicted by both math and/or science self-efficacy (*rs* = .18 to .63) and math and/or science outcome expectations (average weighted mean effect size of .56 in a meta-analysis) (Young et al., 2004). Additionally, sex and ACT scores were found to explain significant variance in math and/or science interests scores. While it was theorized that the relation between self-efficacy and interests is unidirectional, two longitudinal studies have found that the relation is bi-directional. Interests and self-efficacy likely influence each other over time.

By using regression as well as correlations, several studies confirmed that math and/or science self-efficacy, outcome expectations, and interests all significantly (and uniquely) predict math and/or science goals. Predictors of performance were consistent with SCCT; math/science self-efficacy, outcome expectations, interests, and goals were found to predict several domains of performance in at least one study each.

Sex differences in RIASEC Interests

There have been consistent sex differences in RIASEC interests along the people/things dimension (or Social/Realistic interests). The most recent Strong Interest Inventory manual (Donnay, Morris, Schaubhut, & Thompson, 2005) reports significant sex differences in the realistic General Occupational Theme (GOT) and military, mechanical, and computer hardware Basic Interest Scales (BISs); males score significantly higher than females in these areas. In a 1998 article, Lippa reported results of three studies examining sex differences in those interests. He found that the relation between sex and sex-related individual differences were correlated with the people-things dimension of Holland's RIASEC interest theory. The author gave 289 college students a measure of occupational interest including 131 items measured on a five-point Likert scale. Using this interest information, Lippa calculated the number of men and women that reported more people-related interests and things-related interests. In a contingency table, Lippa reported that there were 20 men in the people category and 83 men in the things category; conversely there were 130 women in the people category and 56 in the things category.

Williams and Subich (2006) sampled 319 college students using the Learning Experiences Questionnaire developed by Schaub and Tokar in 2005. This self-report measure asked about the four sources of self-efficacy regarding each of the six Holland interest types; the authors also measured self-efficacy in each of these six interest types with a measure developed by Lenox and Subich in 1994. The authors indicated that men reported significantly more experiences with mastery, social persuasion, and anxiety in the realistic category than women. Additionally men reported more experiences with mastery experiences, modeling, and anxiety in the investigative domain than women. Finally, the authors found that women reported more experiences with mastery, modeling, and social persuasion in the social domain than men.

Hypotheses

1. a) Parent support (mother's and father's) and aptitude will significantly directly predict the four theorized sources of self-efficacy [mastery (high school math GPA and high school science GPA), modeling, social persuasion, and anxiety] and will indirectly predict math/science self-efficacy and math/science outcome expectations through these four sources. See Figure 2 for model of hypothesis 1a – 1g

b) Aptitude will directly predict number of prior learning experiences (measured here as high school math/science courses taken) and indirectly predict math/science self-efficacy and math/science outcome expectations through prior experience.

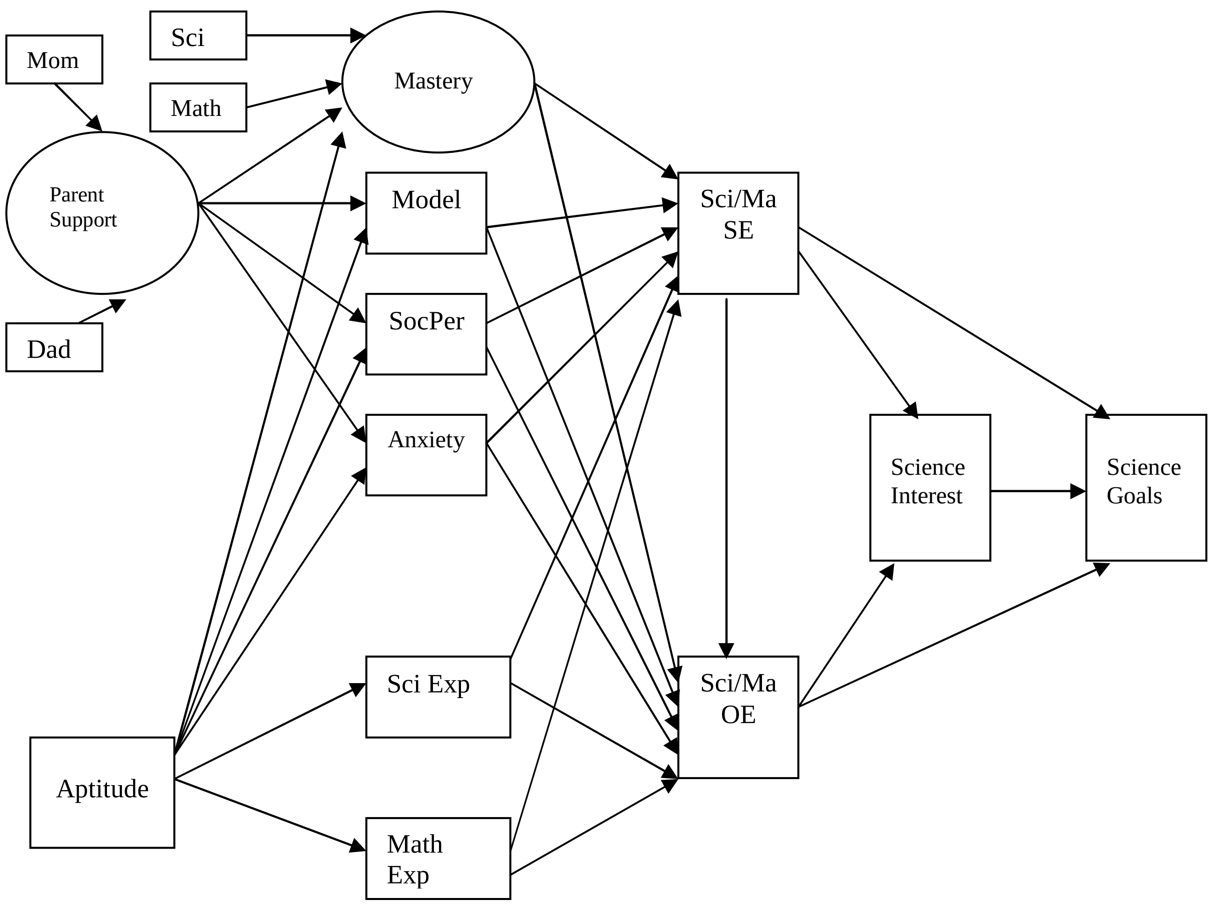

Figure 2. Hypotheses 1a – 1g.

c) The four sources of academic self-efficacy (mastery, modeling, social persuasion, and anxiety) will significantly predict math/science self-efficacy and math/science outcome expectations. Additionally, the four sources of academic self-efficacy will indirectly predict science interests through math/science self-efficacy and math/science outcome expectations and will indirectly predict goals through math/science self-efficacy, math/science outcome expectations, and science interests.

d) Number of prior learning experiences will significantly directly predict math/science self-efficacy and math/science outcome expectations. Additionally, prior number of prior learning experiences will significantly indirectly predict science interests through math/science self-efficacy and math/science outcome expectations and will indirectly predict science goals through math/science self-efficacy, math/science outcome expectations, and science interests.

e) Math/science self-efficacy will directly predict math/science outcome expectations, science interests, and science goals and will indirectly predict science goals through science interests and science interests through math/science outcome expectations.

f) Math/science outcome expectations will directly predict science interests and science goals and will indirectly predict science goals through science interests.

g) Science interests will directly predict science goals.

2. There may be significant differences in the fit of this model for men and women. The literature inconsistently demonstrates significant difference between men and women on level of reported self-efficacy and sources of self-efficacy (Britner & Pajares, 2006; Gwilliam & Betz, 2001; Lent, Lopez, et al., 1996; Lopez & Lent, 1992). Although there is

evidence that men's and women's experience related to SCCT may differ, there is not currently any literature indicating how the theory model may vary for men and women.

Rationale

Hypothesis 1a: Exogenous Variables - Parent Support and ACT Composite Score

The authors of social cognitive career theory (SCCT, Lent et al., 1994) posit that background and person factors impact self-efficacy. One significant background variable to consider is the role of parents. Parent support has been shown to have a relation with self-efficacy in two studies (Ferry et al., 2000; Nota et al., 2007). Bandura (1986) hypothesized four sources of self-efficacy, one of which is mastery. Strong predictors of science GPA and math GPA are aptitude, measured here by ACT composite scores.

Hypothesis 1b: Background Factors' Impact on Prior Learning Experiences

The authors of SCCT (Lent et al., 1994) state that person factors have a role in their theorized model. Aptitude is one important person factor to consider. As students must be successful in prerequisite math/science classes to move on to advanced classes in high school, and as these advanced classes must be in addition to required classes, it follows that aptitude predicts number of high school math/science courses.

1c. Relation of the four sources of self-efficacy with self-efficacy and outcome expectations

Bandura (1977, 1982, 1986) theorized four sources of self-efficacy: mastery experiences, modeling, social persuasion, and anxiety. He also hypothesized that mastery experiences would be the strongest predictor of self-efficacy. Additionally, researchers have explored the relation between the four sources of self-efficacy and reported self-efficacy in math, where (in eight studies reported in 6 articles) it was found that self-reported mastery was significantly correlated with self-efficacy in all studies, modeling and social persuasion were significantly correlated with self-efficacy in six out of eight studies, and anxiety was significantly correlated with self-efficacy in five out of eight studies. (Lent et al., 1991; Lent et al., 1993; Lopez & Lent, 1992; Lent, Lopez et al., 1996; Klassen, 2004; Ozyurek, 2005). Additionally, it was found that all four sources of self-efficacy were significantly correlated with science self-efficacy (Britner & Pajares, 2005). Finally, when examining math/science together, it was found that mastery (operationalized similarly to the current study as grades and GPA) significantly predicted math/science self-efficacy in two studies (Ferry et al., 2000; Fouad et al., 2002).

Researchers have also found that these four sources of self-efficacy play a role in predicting outcome expectations. Specifically, Young and colleagues (2004) reported average weighted mean effect sizes for the correlations between math outcome expectations and mastery (.48 in three studies), modeling (.41 in three studies), social persuasion (.50 in seven studies) and anxiety (-.47 in four studies).

1d. Number of Semesters of High School Math and Semesters of High School Science Taken

Several researchers have found that self-report prior performance is moderately to strongly correlated with math self-efficacy (*r*s = .28-.63) (Lent et al., 1991; Lopez & Lent, 1992; Klassen, 2004; Britner & Pajares, 2005). Additionally, Young and colleagues (2004) demonstrated that self-reported prior mastery experiences have a significant relation with math outcome expectations; the authors reported an average weighted mean effect size for this correlation to be .48 across three studies. This study is examining the effect of number of prior learning experiences (operationalized as number of semesters of high school math and number of semesters of high school science taken). There is no empirical evidence about the relation between number of prior learning experiences and self-efficacy, however the authors of SCCT (Lent, et al., 1994) theorize that learning experiences play an important role in an individual's development of self-efficacy and outcome expectations.

1e. Relation of Self-Efficacy with Outcome Expectations, Interests, and Goals

In social cognitive career theory, Lent and colleagues (1994) posited that self-efficacy directly predicts outcome expectations, interests, and goals. This has been supported by many studies, reporting strong correlations (*r*s = .53-.63) between math self-efficacy and interests, an average weighted mean effect size of the correlation between math/science self-efficacy and math/science outcome expectations to be .41 and significant correlations (.46, .63) between math self-efficacy and math goals (Lent et al., 1991; Lent et al., 1993; Ozyurek, 2005; Rottinghaus, et al., 2003; Waller, 2005; Young et al., 2004). While most studies found that self-efficacy had a significant relation with goals, one study using structural equation modeling (SEM) found that math/science self-efficacy did not significantly predict math/science goals (Fouad, Smith, & Zao, 2002). Additionally, the authors of SCCT posit that self-efficacy predicts goals indirectly through interests and outcome expectations.

1f. Relation of Outcome Expectations with Interests and Goals

The authors of social cognitive career theory (SCCT, Lent et al., 1994) posit that outcome expectations directly predict interests and this has been supported by research (Lent et al., 1991; Lent et al., 1993; Young et al., 2004). Specifically, using meta-analysis, Young and colleagues (2004) found an average weighted mean effect size of the correlation between math outcome expectations and math interests (.56 in two samples) and between math/science outcome expectations and math/science interests (.54 in eight samples). Additionally, Lent and colleagues suggest that outcome expectations have a direct effect on goals; this has been supported by several studies. An average weighted mean effect size of the correlation between math/science outcome expectations and math/science goals was found to be .50 in 18 samples (Young, et al., 2004)

1g. Relation of Science Interest with Science Goals

Finally, the authors of SCCT (Lent et al., 1994) theorize that interests directly predict goals. Research has demonstrated that math interests and math goals correlate strongly (r = .71) and that math/science interests and math/science goals correlate strongly (rs = .45, .66) (Fouad & Smith, 1996; Smith & Fouad, 1999; Waller, 2005).

Hypothesis 2

Level of reported self-efficacy has been shown to differ by sex; in junior high and high school populations girls tend to report equal or higher math/science self-efficacy than boys (Britner & Pajares, 2005; Tracey, 2002), however in college populations men tend to report higher math/science self-efficacy than women (Gwilliam & Betz, 2001; Lent et al., 1991). Additionally, it has been found that men and women have differing amounts of experience with the four sources of self-efficacy (Britner & Pajares, 2005; Lent, Brown et al., 1996; Lent, Lopez et al., 1996; Usher & Pajares, 2005). Specifically, women tend to report higher levels of anxiety and social persuasion, while men report higher levels of mastery. Because of these differences, exploratory analysis will be conducted to gain a better understanding of how SCCT may impact women and men differently. Therefore, it is hypothesized that there may be significant differences in how this model fits the data for men and for women.

METHOD

I will structure this section of the paper by first discussing procedures, including information about how participants were recruited and the measures they completed. Next, I will discuss the participants in detail including general demographics as well as specifics regarding their academic history and future plans. Then I will discuss the measures in detail including information about reliability, validity, and item examples. Finally, the hypotheses of the study will be discussed and operationalized.

Procedures

Students from biology, biochemistry, genetics, and human performance courses were asked at the beginning of a class period to participate in a survey to learn more about science majors. The classes were selected based on the large percentage of students who considered themselves to be premed students. The present study does not specifically examine differences between pre-medical and non-pre-medical students, however other studies will be done with the present data that will focus on this population. The students were given an informed consent sheet (see Appendix A) including permission to access high school transcripts (to gather both number of classes taken and grades earned in these classes) and ACT/SAT scores, a demographic sheet, and the following measures: Sources of Academic Self-Efficacy Expectations (SASE), Fouad-Smith Scales For Subject Matter Specific Social-Cognitive Constructs (FSS subscales, including math/science self-efficacy and outcome expectations, and science goals, science interests, math goals, and math interests, as well as art, English, and social studies interests), the Social Provisions Scale (SPS-P) (Cutrona, 1989), an emotional intelligence scale (Wong & Law, 2002), and a career commitment scale (Carson & Bedeian, 1994). See Appendix B for measures. The emotional intelligence and career commitment scales, as well as the FSS math, art, English, and social studies interest subscales will not be used in the present study.

Some instructors allowed the students to take the survey during the class period and other instructors had the students take the packets with them and return them the next class period. For all classes, a script was read asking for their participation. The University Internal Review Board approved this collection of measures, the consent form, and the procedures.

Participants

This study used preexisting data collected across three fall semesters from 2005-2007 consisting of responses from 245 students at a large Upper Midwestern University. See Table 1 for descriptive statistics. These students were recruited from introductory science classes including biology, biochemistry, genetics, and human performance. No incentive was given to participate in the study. About half (46%) of the students identified as pre-med majors. The remaining students are predominantly science majors. Participants were an average of 18.5 years old when they completed the study with an age range of 18-22 years. Most students (98%) were under the age of 20 at time of assessment. There are more women (61%) than men (36%) in the sample; 3% of participants did not report their sex. Most students described their marital status as single (99%) although a small percentage defined themselves as married (0.8%) or divorced/separated (0.4%). Additionally, students reported their ethnicity as White (84.1%), African-American (3.7%), Hispanic (3.7%), Asian-American (4.1%), International student (1.2%) or other (ex: biracial) (2.9%) This breakdown is similar to that of undergraduates in the University as a whole.

In addition to general demographic data, students provided consent for researchers to access information about their academic history. Students took an average of 8.5 semester-long math classes (SD = 1.57, range 5-14 classes) and 9 semester-long science classes (SD = 1.84, range 4-16 classes) in high school. Grade Point Averages (GPA, using a 4.0 scale) were calculated separately for high school math and high school science classes. Average high school math GPA was 3.31 (SD=.60, range 1.34-4.0) and average science GPA was 3.46 (SD=.50 range 1.73-4.0). Overall mean high school GPA was 3.61 (SD = .38, range 2.31-4.48). Students had taken an average of 0.16 college math classes (SD = .47, range 0-3) and 0.31 college science classes (SD = .90, range 0-6) before taking the inventory. Average ACT composite score was 23.93 (SD=3.99, range 13-34) with a math subtest score of 23.76 (SD=4.33, range 12-35) and a science subtest score of 23.73 (SD=4.096, range 15-35).

Measures

Prior Academic Experiences

High School Math/science Grade Point Average (GPA)

As an objective measure of prior performance, high school math GPA and high school science GPA, were used as two measured variables that form a latent variable, mastery. See Table 1 for means and standard deviations. Students' high school transcripts were examined and all math course grades and science course grades were recorded. Next, each letter grade was assigned a point value on a 4.0 scale. The point system used matched the point system used by the University and a majority of high schools in the Midwest, where the letter grade equals an even number (A=4.0, B=3.0, etc), a letter-plus grade equals one-third above the even number (B+ = 3.33, C+ = 2.33), and a letter-minus grade equals one-third below the even number (A- = 3.67, B- = 2.67). A+ grades were computed as an A (A+ = 4.0). All grade points were summed. Next, the mean GPA was computed for science classes and for math classes separately.

Number of High School Math/science Courses Taken

The number of semesters of high school math and number of semesters of high school science taken were defined as how many semester courses of math and semester courses of science each student took in high school. See Table 1 for means and standard deviations. In order to keep this consistent throughout the sample (as one high school's science or math curriculum may differ from another school's), researchers requested and used the University's count of high school math/science courses.

To calculate number of semesters of high school math and number of semesters of high school science taken, the University examined the content of each science and math course offered by each high school and determined whether this curriculum warranted credit as a math or science course. As an example, one high school's health course curriculum may include substantial amounts of biology and anatomy (which would count as a science course) while another high school's health course curriculum may include only basic information about the body and focus more on the health benefits of exercise, healthy diet, etc (which would not count as a science course).

ACT Composite Score

The ACT test-battery was developed to assess high school student's aptitude for college-level work and general educational development (ACT, Inc., 2007). It includes four subscales: math (60 items), science (40 items), English (75 items), and reading (40 items); all items are multiple choice (ACT, Inc., 2007). Including breaks, the test takes participants about four hours to complete. The test has a range of 0-36 and the national mean ACT score in 2008 was 21.1 (in a sample of 1.4 million students) (ACT, Inc, 2009). See Table 1 for means and standard deviations.

Sources of Academic Self-efficacy Expectations Scale

The Sources of Academic Self-efficacy Expectations (SASE, adapted from the Sources of Social Self-Efficacy of an individual's sources of academic self-efficacy (see Table 2). This 38-item measure includes four subscales: mastery experiences (ten items), modeling (nine items), anxiety (nine items), and social persuasion (nine items).

Anderson and Betz (2001) created the Sources of Social Self-Efficacy Expectations measure to assess people's experience with these four sources in social situations. This original 40-item measure included four equal subscales; participants responded on a five-point Likert scale. The current study modified the items to measure student's sources of academic self-efficacy (SASE, Werbel, personal communication, 2008). See Table 2 for examples and reliability. Example items include "People have told me I'm a good student" (original "People have told me I'm easy to talk to") and "My favorite teachers are strong academically" (original "My favorite teachers had good social skills"). Additionally, one item was cut from the SASE modeling subscale and the SASE anxiety subscale because of redundancy in the items. The SASE modeling and anxiety subscales each contained nine items; the SASE performance and social persuasion subscales each contained ten items. Participants responded using a six-point Likert scale ranging from 1 (very strongly disagree) to 6 (very strongly agree). Scores were calculated by totaling responses on all items and dividing by the total number of items, thus resulting in a score range of one to six with high scores indicating a greater perceived level of experience with academic efficacy information.

Cronbach's alpha coefficients (see Table 2) were reported by Anderson and Betz (2001) (mastery [α = .80], modeling [α = .77], social persuasion [α = .87], and anxiety [α

= .91]). Cronbach's alpha coefficients for subscales in the current study are as follows: mastery (α = .82), modeling (α = .71), social persuasion (α = .83), and anxiety (α = .79).

Convergent validity estimates show that the original subscales correlated with social self-efficacy measured by the Skills Confidence Inventory (Betz, Borgen, & Harmon, 1996) (SCI social confidence with mastery r = .52, modeling r = .36, social persuasion r = .65, and anxiety r = .55) and self-efficacy more generally as measured by the Self-Efficacy scale (Sherer et al., 1982) (SES social self-efficacy with mastery r = .70, modeling r = .46, social persuasion r = .65, and anxiety r = .69) (Anderson & Betz, 2001). Additionally, the original measure's subscales negatively correlated with the Beck Depression Inventory (BDI, Beck, et al., 1961) (BDI with mastery r = -.34, modeling r = -.23, social persuasion r = -.17, and anxiety r = -.27), with the Social Anxiety subscale of the Self-Consciousness Scale (Fenigstein, Scheier, & Buss, 1975) (Social Anxiety subscale with mastery r = -.55, modeling r = -.36, social persuasion r = -.50, and anxiety r = -.62) and with the Revised Cheek and Buss Shyness Scale (Cheek & Buss, 1981) (Shyness with mastery r = -.74, modeling r = -.46, social persuasion r = -.67, and anxiety r = -.81) (Anderson & Betz, 2001).

Fouad-Smith Scales for Subject Matter Specific Social-Cognitive Constructs

The Fouad-Smith Scales for Subject Matter Specific Social-Cognitive Constructs (FSS, Smith & Fouad, 1999) were developed to assess four SCCT constructs (self-efficacy, outcome expectations, interests, and goals) across four academic domains (math/science, art, social studies, and English). Selected subscales are used including math/science self-efficacy, math/science outcome expectations, science interests, and science goals.

Smith and Fouad (1999) used confirmatory factor analysis (CFA) to examine the discriminant validity of the FSS subscales. This analysis yielded the following fit indices: X^2 = 3411.39, Nonnormed Fit Index (NNFI) = .914, and Comparative Fit Index (CFI) = .927. Results of this analysis indicate that the best model fit includes all four construct factors (self-efficacy, outcome expectations, interests, and goals) as well as all four subject-matter factors (math/science, art, English, and social studies). This indicates discriminant validity in that the four construct factors are independent and the four subject-matter factors are independent.

Math/Science Self-efficacy

The math/science self-efficacy subscale of the measure (FSS math/science self-efficacy, Smith & Fouad, 1999) was developed to look at student's self-efficacy regarding math/science tasks. The subscale included nine items (four measuring science self-efficacy and five measuring math self-efficacy). The measure used a six-point Likert scale where 1 indicated "very strongly disagree" and 6 indicated "very strongly agree." Example items include "I feel confident that with the proper training I could classify animals that I observe" and "I feel confident that with the proper training I could earn an A in an advanced calculus course." Subscale scores were calculated by averaging the responses, resulting in a response range of 1 to 6 where high scores indicated higher math/science self-efficacy.

The Cronbach's alpha estimate for the FSS math/science self-efficacy subscale was .85 (Smith & Fouad, 1999). The Cronbach's alpha coefficient in this study for the subscale (α = .89) was acceptable. We chose to keep the math/science items combined in one subscale because, when separated, the math/science self-efficacy subscales correlated highly (r = .80).

Smith and Fouad (1999) also reported correlations between math/science self-efficacy and (a) math/science outcome expectations (r = .33), (b) math/science goals (r = .41) and (c) math/science interests (r = .53) demonstrating acceptable convergent validity.

Math/science Outcome Expectations

The math/science outcome expectations subscale of the measure (FSS math/science outcome expectations, Smith and Fouad, 1999) was developed to assess student's outcome expectations in two academic domains: math/science. This subscale included nine items (four measuring science outcome expectations and five measuring math outcome expectations). The measure used a six-point Likert scale where 1 indicated "very strongly disagree" and 6 indicated "very strongly agree." Example items include "If I get good grades in chemistry, then my friends will approve of me" and "If I take a lot of math classes, then I will be better able to achieve my future goals." Subscale scores were calculated by averaging the responses resulting in a response range of 1 to 6 where higher scores indicate more positive outcome expectations.

The Cronbach's alpha estimate for the FSS math/science outcome expectation subscale was .81 (Smith & Fouad, 1999). The Cronbach's alpha coefficient found in this study was .81. We chose to keep the math/science items together in one subscale because, when separated, the FSS math/science outcome expectations subscales were highly correlated (r = .72).

Smith and Fouad (1999) reported correlations between math/science outcome expectations and (a) math/science self-efficacy (r = .33), (b) math/science interests (r = .45), and (c) math/science goals (r = .58) demonstrating acceptable convergent validity.

Science Interests

The science interests subscale of the FSS measure (FSS science interests, Smith & Fouad, 1999) was taken from a larger interests measure which was developed to look at student's interests in four academic domains: math, science, art, social studies, and English. Only the science subscale was used in this study. The original subscale included 19 items – 15 that measured science interests and 4 that measured math interests. For this reason, all existing validity and reliability information is for the combined math/science interests subscale. Participants indicated their responses using a six-point Likert scale where 1 indicated "very strongly dislike" and 6 indicated "very strongly like." Example items include "Indicate the extent to which you like or dislike working in a science laboratory" and "Indicate the extent to which you like or dislike watching a science program on TV." Scale scores were calculated by averaging the responses in each domain, resulting in a total score range from 1 to 6 where higher scores indicated greater interests.

Reported internal reliability coefficients for math/science interests ($\alpha = .94$) were acceptable (Smith & Fouad, 1999). In this study, the math/science interests items were separated to form two independent subscales; only the science subscale is used. For the present study, the Cronbach's alpha coefficient for the FSS science interests subscale was adequate ($\alpha = .89$).

Smith and Fouad (1999) also reported correlations between math/science interests and (a) math/science self-efficacy ($r = .53$), (b) math/science outcome expectations ($r = .45$), and (c) math/science goals ($r = .66$) indicating acceptable convergent validity. Additionally, the authors reported correlations between math/science interests and other domain interests including (a) social studies (*r* = .38), (b) English (*r* = .20), and (c) art (*r* = 24).

Science Goals

The science goals subscale of the measure (FSS science goals, Smith and Fouad, 1999) was taken from a larger subscale that was developed to assess student's goals in two academic domains: math/science. The original math/science subscale included seven items (four measuring science goals and three measuring math goals). The present study will only use the FSS science goals subscale. The items were measured using a six-point Likert scale where 1 indicated "very strongly disagree" and 6 indicated "very strongly agree." Example items include "I intend to enter a career that will use science," and "I plan to take more science courses at ISU than are required of me." Scale scores were calculated by averaging the responses, resulting in a total score range from 1 to 6, where higher scores indicated more science related goals.

The Cronbach's alpha estimate for the math/science goals items together is .87 (Smith & Fouad, 1999). In this study, only the FSS science goals subscale was used; the Cronbach's alpha coefficient for this subscale was acceptable (α = .82). Smith and Fouad reported correlations between math/science goals and (a) math/science self-efficacy (*r* = .41), (b) math/science outcome expectations (*r* = .58) and (c) math/science interests (*r* = .66).

Social Provisions Scale: Mother and Father Subscales

The Social Provisions Scale – Parent version includes a subscale to assess mother's support and father's support (SPSM and SPSF, Cutrona, 1989) and was developed to measure the amount of support an individual receives from both parent in order to better understand the relation between social support and health. In the original study, the measure included six items and participants responded on a three-point Likert scale where 1 indicated "no," 2 indicated "sometimes," and 3 indicated "yes." In the present study, the measure included 12-items (6 items to measure mother support and 6 to measure father support) and participants responded on a six-point Likert scale where 1 indicated "very strongly disagree" and 6 indicated "very strongly agree." Example items include "I can depend on my mother to help me if I really need it," and "My father recognizes my competence and skill." Each item was designed to measure a different factor of social provisions: attachment, social integration, reassurance of worth, reliable alliance, guidance, and opportunity for nurturance. Scores were calculated by finding averages of subscales and ranged from 1 to 6; higher scores indicate greater parent support. In previous studies, the SPSM and SPSF subscales have been combined to form one parent-support scale. Reliability information for this scale (6 items, measuring both parents together) reported by the developing author was acceptable (α = .69, Cutrona, 1989). Additional reliability information was reported (using a 12-item version, where mother support and father support were measured separately, but combined to form one scale) with a sample of 944 Canadian college students (α = .81) (Wintre & Bowers, 2007). The present study found reliability estimates for mother's support (α = .89), father's support (α = .92) and combined parent support (α = .92). In this study, the SPSM and SPSF subscales were used as measured variables to predict a latent variable, parent support.

Hypotheses

1. a) Mother's support and father's support as measured by the SPSM and SPSF, used as two indicators of the latent variable parent support, and aptitude, operationalized as ACT score, will significantly directly predict the four theorized sources of self-efficacy as measured by three SASE subscales (modeling, social persuasion, and anxiety) and high school science GPA and math GPA (mastery) and will indirectly predict math/science self-efficacy as measured by the FSS math/science self-efficacy subscale and math/science outcome expectations as measured by the FSS math/science outcome expectations subscale through these four sources. See Figure 2 for a diagram of the hypothesized model.

b) Aptitude, operationalized as ACT score, will directly predict number of prior learning experiences, operationalized as number of semesters of high school math and number of semesters of science taken, and indirectly predict math/science self-efficacy, as measured by the FSS math/science self-efficacy subscale and math/science outcome expectations, as measured by the FSS math/science outcome expectations subscale through prior learning experiences.

c) The four sources of academic self-efficacy as measured by SASE subscales (modeling, social persuasion, and anxiety) and high school science and math GPAs (mastery) will significantly predict math/science self-efficacy, as measured by the FSS math/science self-efficacy subscale and math/science outcome expectations, as measured by the FSS math/science outcome expectations subscale.

d) Number of prior learning experiences, operationalized as number of semesters of high school math and number of semesters of high school science taken will significantly predict math/science self-efficacy as measured by the FSS math/science self-efficacy subscale and math/science outcome expectations, as measured by the FSS math/science outcome expectations subscale.

e) Math/science self-efficacy, as measured by the FSS math/science self-efficacy subscale will directly predict math/science outcome expectations, as measured by the FSS math/science outcome expectations subscale, science interests, as measured by the FSS science interests subscale, and science goals, as measured by the FSS science goals subscale. Math/science self-efficacy, as measured by the FSS math/science self-efficacy subscale will also indirectly predict science goals, as measured by the FSS science goals subscale through science interests, as measured by the FSS science interest subscale, and math/science outcome expectations, as measured by the FSS math/science outcome expectations subscale and science interests, as measured by the FSS science interests subscale through math/science outcome expectations, as measured by the FSS math/science outcome expectations subscale.

f) Math/science outcome expectations, as measured by the FSS math/science outcome expectations subscale, will directly predict science interests, as measured by the FSS science interest subscale, and science goals, as measured by the FSS science goals subscale, and will indirectly predict science goals, as measured by the FSS science goals subscale, through science interests, as measured by the FSS science interests subscale.

g) Science interests, as measured by the FSS science interests subscale, will directly predict science goals, as measured by the FSS science goals subscale.

2. Using the same model as Hypothesis 1, it is hypothesized that there will be significant differences in the way this model fits the data from men and from women. Exploratory analysis will be conducted on men and women separately, using the same hypotheses and measures as in Hypothesis 1.

RESULTS

In this section, I will discuss the statistical results of the analyses. First, I will talk about the descriptive statistics and preliminary analyses performed to better understand the data. Next, I will explain the process of how I tested each hypothesis using path analysis. Then, I will discuss the results of these analyses. Finally, I will discuss the tests of indirect effects.

Descriptive Statistics and Preliminary Analyses

Hatcher (1994) recommended that a minimum of 200 participants (and 5 participants per parameter estimated) be included when using path analysis. For the proposed models, a sample of 245 students was used. The data were checked for multivariate normality and found not to be normal χ^2 (1, N = 245) = 278.491, p < .001). The scaled chi-square statistic developed by Satorra and Bentler (1988) was therefore used to adjust for the impact of non-normality on the results. Means, standard deviations, and zero-order correlations for the 14 measured variables (i.e., mother and father support, high school science and math grades, number of semesters of high school math and number of semesters of high school science taken, ACT score, sources of self-efficacy, self-efficacy, outcome expectations, interests, and goals) are shown in Table 3. Because so many correlations were calculated, only correlations significant at the p < .01 level will be discussed

Three of the four subscales of the SASE (perceived mastery, social persuasion, and anxiety) and high school math GPA were significantly correlated with the FSS math/science self-efficacy subscale (rs ranged from .19 to .26). The FSS math/science self-efficacy subscale was not significantly correlated with high school science GPA or the SASE subscale modeling. These six measures of the four theorized sources of self-efficacy were also significantly correlated with each other (*r*s ranged from │ .24 to .73│) except for anxiety, which was not correlated with (a) social persuasion (*r* = -.11), (b) high school math GPA (*r* = -.07), or (c) high school science GPA (*r* = -.11). All of the primary SCCT model variables (FSS math/science self-efficacy, FSS math/science outcome expectations, FSS science interests, and FSS science goals) were significantly correlated (*r*s ranged from .28 - .70).

As shown in Table 3, all collected measures of high school academic experience and success (number of semesters of high school math and number of semesters of high school science taken, ACT composite score, and high school math GPA and science GPA) were significantly correlated (*r*s ranged from .18 to .76) except for ACT composite score and number of semesters of high school science taken (*r* = .13). The SPSM subscale was correlated with two of the five measured variables contributing to the four sources of self-efficacy (modeling *r* = .39, and social persuasion *r* = .49). The SPSF subscale was also correlated with two of the five measured variables contributing to the four theorized sources of self-efficacy (modeling *r* = .38, social persuasion *r* = .40). Neither the SPSM or SPSF subscales were significantly correlated with the SASE anxiety subscale, ACT composite score, number semesters of high school math taken, or number of semesters of high school science taken.

In addition to correlations, I performed a one-way analysis of variance (ANOVA) to assess for any mean differences between men and women on the measured and collected variables. There were significant differences on four out of fourteen variables. These included modeling [$F(1,235)=11.871$, $p=.001$], social persuasion [$F(1,235)=12.666$, *p*

<.0001], anxiety [F(1,235)=10.903], p =.001 and science interest [F(1,235)=16.93, p <.0001]. Women reported higher means in social persuasion, modeling, and anxiety than men. Men reported a greater interest in science than women. Means are reported in Table 4. In addition, I calculated correlations between the measured and collected variables separately for men and women; these results are reported in Table 4. There were two correlations that were significantly different for men and women. The correlation between ACT composite score and the SASE modeling subscale was larger for men (r =.39) than for women (r = .12). Additionally, the correlation between high school math GPA and the FSS science goals subscale was larger for men (r =.31) than for women (r = -.01).

Path Analyses

All hypotheses were tested using one path model. This model was calculated using the entire sample and also with men and women separately, to compare the effects of sex on these variables. Path analysis was used to estimate, analyze, and test theorized relations between the latent constructs and the measured variables that make up the model. The maximum-likelihood method in LISREL 8.50 was used to conduct the analysis. Hu and Bentler (1999) recommend assessing the goodness-of-fit of the model by evaluating the comparative fit index (CFI; acceptable model fit is indicated by CFI values greater than or equal to .95) and the root-mean-square error of approximation (RMSEA; acceptable model fit is indicated by RMSEA values less than or equal to .08). The fit indices of all models are shown in Table 5.

Hypothesis 1

Hypotheses 1a, - 1g were tested using path analysis (LISREL 8.50). See Figure 3. The criterion variable is science goals as measured by the FSS science goals scale. Core SCCT predictor variables include the four theorized sources of self-efficacy, operationalized as high school math GPA and science GPA (mastery) and participants scores on the sources of academic self-efficacy measure (SASE; modeling, social persuasion, and anxiety), math/science self-efficacy, as measured by the FSS math/science self-efficacy subscale, math/science outcome expectations as measured by the FSS math/science outcome expectations subscale, and science interests, operationalized as participants' scores on the FSS science interests subscale. Additional background predictor variables include parent support, a latent variable operationalized as participants' scores on the SPSF and SPSM scales, aptitude, operationalized as ACT composite score, and prior learning experiences, operationalized as number of semesters of high school math and number of semesters of high school science taken.

Exogenous variables include the SPSF and SPSM subscales, and ACT composite score. Endogenous variables include the three SASE subscales, the latent variable mastery, number of semesters of high school math and number of semesters of high school science taken, the FSS math/science self-efficacy subscale, the FSS math/science outcome expectations subscale, the FSS science interests subscale, and the FSS science goals subscale.

The initial test of this model resulted in a good fit to the data: standard χ^2 (53, N = 245) = 142.84, $p < .001$, scaled χ^2(53, N = 245) = 124.98, $p < .001$, CFI = .95, RMSEA =.075 (CI=.058; .092), standardized RMR = .078. Significant paths included those from

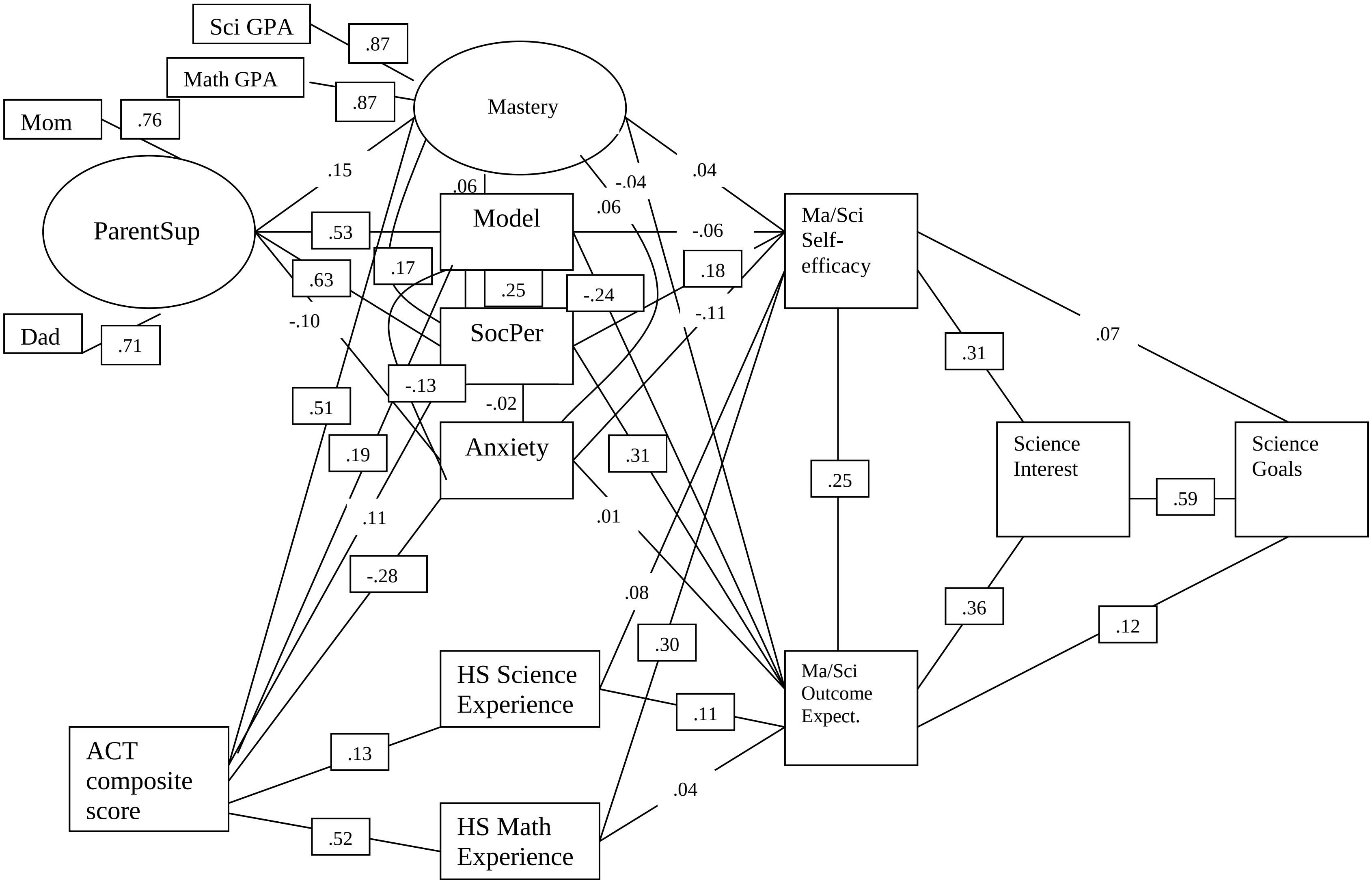

Figure 3. Path model results for Hypothesis 1. *Note: coefficients surrounded by a box are significant at $p < .05$.*

SPSF and SPSM to the latent variable parent support, high school science GPA and high school math GPA to the latent variable mastery, parent support to the SASE modeling and social persuasion subscales, ACT composite score to mastery, the SASE modeling and anxiety subscales, and number of high school semesters of math and number of high school semesters of science taken. Additional significant paths included those from the SASE social persuasion subscale to the FSS math/science self-efficacy subscale, the SASE modeling and social persusasion subscales to the FSS math/science outcome expectations subscale, number of semesters of high school math to the FSS math/science self-efficacy subscale, number of semesters of high school science to the FSS math/science outcome expectations subscale. Finally, significant paths between the core SCCT measures included those from the FSS math/science self-efficacy subscale to (a) the FSS math/science outcome expectations subscale and (b) the FSS science interests subscale, from the FSS math/science outcome expectations subscale to (a) the FSS science interests subscale and (b) the FSS science goals subscale, and from the FSS science interests subscale to the FSS science goals subscale. See Figure 3 for significant and non-significant path coefficients.

1a. Exogenous Variables - Parent Support and ACT Composite Score

The first section of hypothesis 1 posits that parent support and ACT composite score significantly and uniquely directly predict the three SASE subscales (modeling, social persuasion, and anxiety) and the latent variable mastery (high school science GPA and math GPA) and indirectly predict scores on the FSS math/science self-efficacy subscale and FSS math/science outcome expectations subscale through these four sources. This hypothesis is both supported and refuted. Parent support did significantly uniquely predict two of the three

SASE subscales (modeling β =.53, social persuasion β =.63). Parent support did not significantly predict anxiety (β=-.10) or mastery (β =.15). ACT composite score significantly uniquely predicted two of the three SASE subscales (modeling β = .19, anxiety β = -.28) and the latent variable mastery (β =.51). ACT composite score did not significantly predict the SASE subscale social persuasion (β =.11) (see Figure 3).

1b: Background Factors' Relation with Prior Learning Experiences

It was hypothesized that ACT composite score would significantly and uniquely predict prior learning experiences (number of semesters of high school math and number of semesters of high school science taken). It was found that the path from ACT composite score to number of high school math courses was significant (β =.52), as was the path from ACT composite score to number of high school science courses (β =.13).

1c. Relation of the four sources of self-efficacy with self-efficacy and outcome expectations

The third part of hypothesis 1 states that the three SASE subscales (modeling, social persuasion, and anxiety) and the latent variable mastery (measured by high school science GPA and high school math GPA) will significantly uniquely predict both the FSS math/science self-efficacy subscale score and the FSS math/science outcome expectations subscale score. Much of this hypothesis was refuted (see Figure 3), as the only significant paths were from the SASE subscale modeling to FSS math/science outcome expectations (β = -.24), the SASE subscale social persuasion to FSS math/science outcome expectations (β =.31), and the SASE subscale social persuasion to FSS math/science self-efficacy (β = .18).

1d. Number of Semesters of High School Math and Semesters of High School Science Taken

It was hypothesized that number of semesters of high school math and number of semesters of high school science taken would significantly uniquely predict the FSS math/science self-efficacy subscale score and the FSS math/science outcome expectations subscale score. Results showed that the number semesters of high school math taken significantly uniquely predicted the FSS math/science self-efficacy subscale score (β =.30) but that number of semesters of high school science taken did not (β = .08). Additionally, number of semesters of high school science taken did significantly uniquely predict the FSS math/science outcome expectations score (β = .11) but the number of semesters of high school math taken did not significantly predict the FSS math/science outcome expectations score (β = .04)

1e. Relation of Self-Efficacy with Outcome Expectations, Interests, and Goals

It was hypothesized that the FSS math/science self-efficacy subscale score would significantly uniquely directly predict the FSS math/science outcome expectations subscale score, the FSS science interests subscale score, and the FSS science goals subscale score as well as indirectly predict the FSS science interests subscale score through math/science outcome expectations and the FSS science goals subscale score through science interests. Results show that the FSS math/science self-efficacy subscale score significantly uniquely predicted both the FSS math/science outcome expectations score (β =.25) and the FSS science interest score (β =.31). The FSS math/science self-efficacy subscale score did not significantly predict the FSS science goals subscale score (β =.07). Because the path between the FSS math/science self-efficacy subscale score and the FSS science goals subscale score is not significant, the only effect the FSS math/science self-efficacy subscale score has on the FSS science goals subscale score is through the significant path between the FSS math/science self-efficacy subscale score and the FSS science interests subscale score.

1f. Relation of Outcome Expectations with Interests and Goals

This section of hypothesis one states that the FSS math/science outcome expectations subscale score would significantly and uniquely directly predict the FSS science interests subscale score and the FSS science goals subscale score as well as indirectly predict science goals through science interests. This hypothesis was supported, in that the FSS math/science outcome expectations subscale score significantly uniquely predicted the FSS science interests subscale score (β =.36) and significantly uniquely predicted the FSS science goals subscale score (β =.12). Additionally, the FSS math/science outcome expectations subscale score indirectly predicted the FSS science goals subscale score through the FSS science interests subscale.

1g. Relation of Science Interest with Science Goals

The final section of this hypothesis states that the FSS science interest subscale score would significantly predict the FSS science goals subscale score. The results supported this hypothesis; the FSS science interests subscale score strongly uniquely predicted the FSS science goals subscale score (β =.59). Because this path from the FSS science interests subscale score to the FSS science goals subscale score is significant, the hypotheses about both the FSS math/science self-efficacy subscale score and the FSS math/science outcome expectations subscale score indirectly predicting the FSS science goals subscale score through the FSS science interests subscale score was supported.

Testing the Significant Levels of Indirect Effects

Finally, levels of indirect effects were testing using the bootstrap procedure (MacKinnon et. al., 2002; Shrout & Bolger, 2002). This procedure is an empirical method used to test the significance level of indirect effects in the model. In the bootstrap procedure (Shrout & Bolger, 2002), 1,000 samples of participants are created by randomly sampling (with replacement) the original sample. Each of these 1,000 samples is the same size as the original sample (N = 245). After these samples have been created, the model is tested with the bootstrap samples, producing 1,000 different estimates of each path coefficient in the model. Next, indirect effects estimates were computed from the resulting output by multiplying the path coefficients of (1) the independent/exogenous variable to the mediator variable and (2) the mediator variable to the dependent variable. Finally, a 95% confidence interval is found to provide evidence that the indirect effects results are significant.

The results of the bootstrap procedure are shown in Table 6. Many indirect effects were hypothesized, however only indirect effects comprised of two significant paths were tested, as it can be assumed that if one path is non-significant, the indirect effect would also not be significant. Eight indirect paths were tested; seven of these were found to be significant (confidence interval does not include zero). Specifically, the paths from the FSS math/science self-efficacy subscale and FSS math/science outcome expectations subscale through the FSS science interests subscale to the FSS science goals subscale were both significant. Additionally the indirect paths from the SASE subscale of social persuasion and number of high school math courses taken through the FSS math/science self-efficacy subscale to the FSS science interests subscale was significant. The path from number of semesters of high school science taken through the FSS math/science outcome expectations subscale to the FSS science interests subscale was also significant, as was the indirect path from the SASE subscale social persuasion through FSS math/science outcome expectations subscale to FSS science interests subscale. The final significant indirect path was from ACT composite score through number of semesters of high school science taken to FSS math/science outcome expectations subscale. The only insignificant path tested was from the SASE subscale modeling through the FSS math/science outcome expectations subscale to the FSS science interests subscale.

Hypothesis 2

Hypothesis 2 was also tested using path analysis (LISREL 8.50). The model described in Hypothesis 1 remains the same, but was applied to men and women separately (see Figures 4 and 5). It was hypothesized that there would be significant differences between the model fit for men and for women. The initial test of the model with men resulted in a moderate fit to the data: standard χ^2 (53, N = 88) = 93.03, $p < .001$, scaled χ^2 (53, N = 88) = 91.63, $p < .001$, CFI = .92, RMSEA = .092 (CI=.059; .12), standardized RMR = .11. The initial test of this same model with women also resulted in a moderate fit to the data: standard χ^2 (53, N = 149) = 105.88, $p < .001$, scaled χ^2 (53, N = 149) = 101.25, $p < .001$, CFI = .93, RMSEA = .078 (CI=.055; .10), standardized RMR = .084.

To determine whether the data from men and women fit the models differently, several analyses were done. First, the two models were constrained such that the women's data was forced to fit the model in the same way that the men's data fit. The result of this analysis was χ^2 (136, N=245) = 243.23, p < .001, scaled χ^2 (136, N=245) = 212.23, p < .001 Next, the models were tested again, but this time the women's data was freed to fit the model

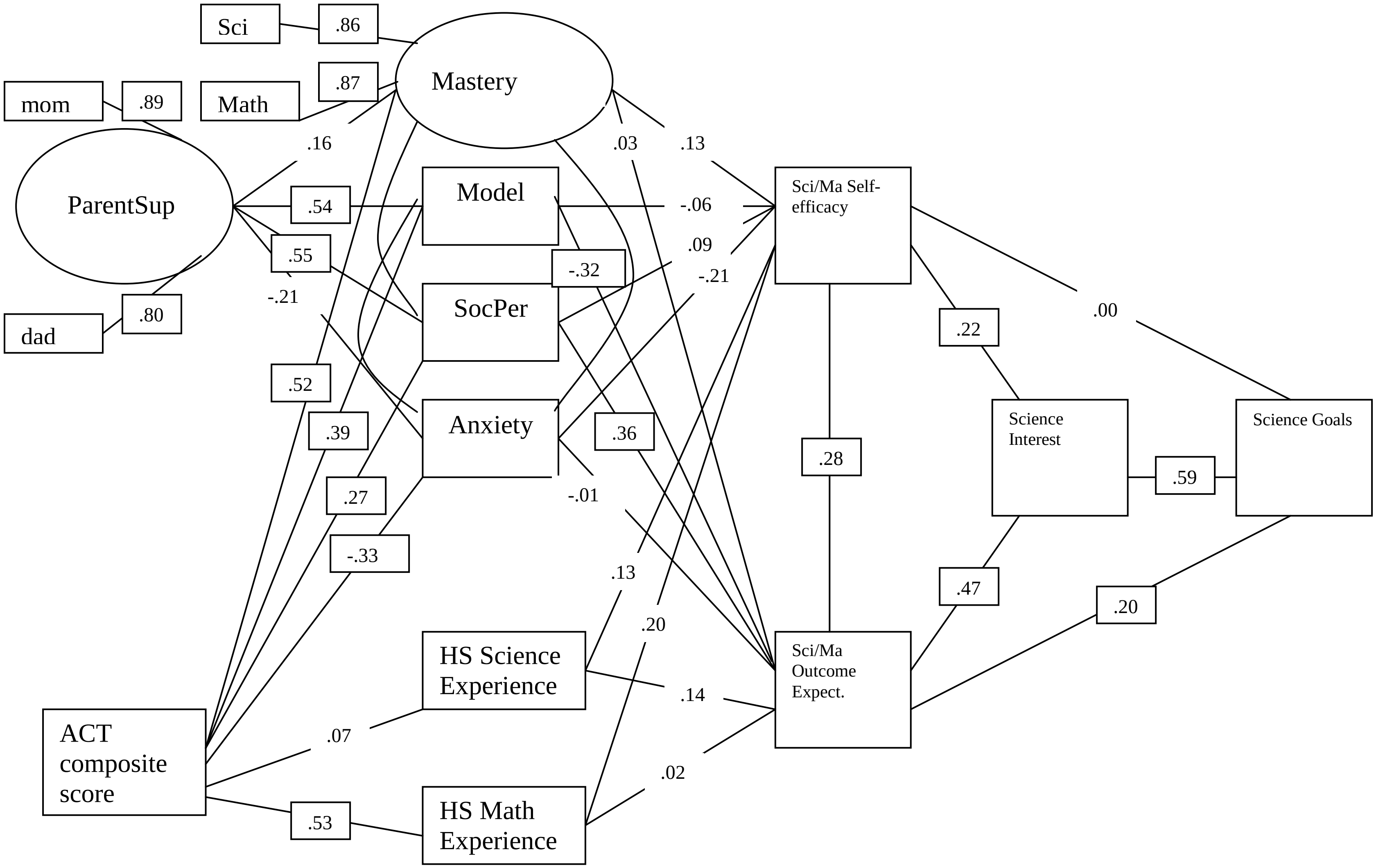

Figure 4. Path model results for men only. *Note: path coefficients surrounded by a box are significant at p < .05.*

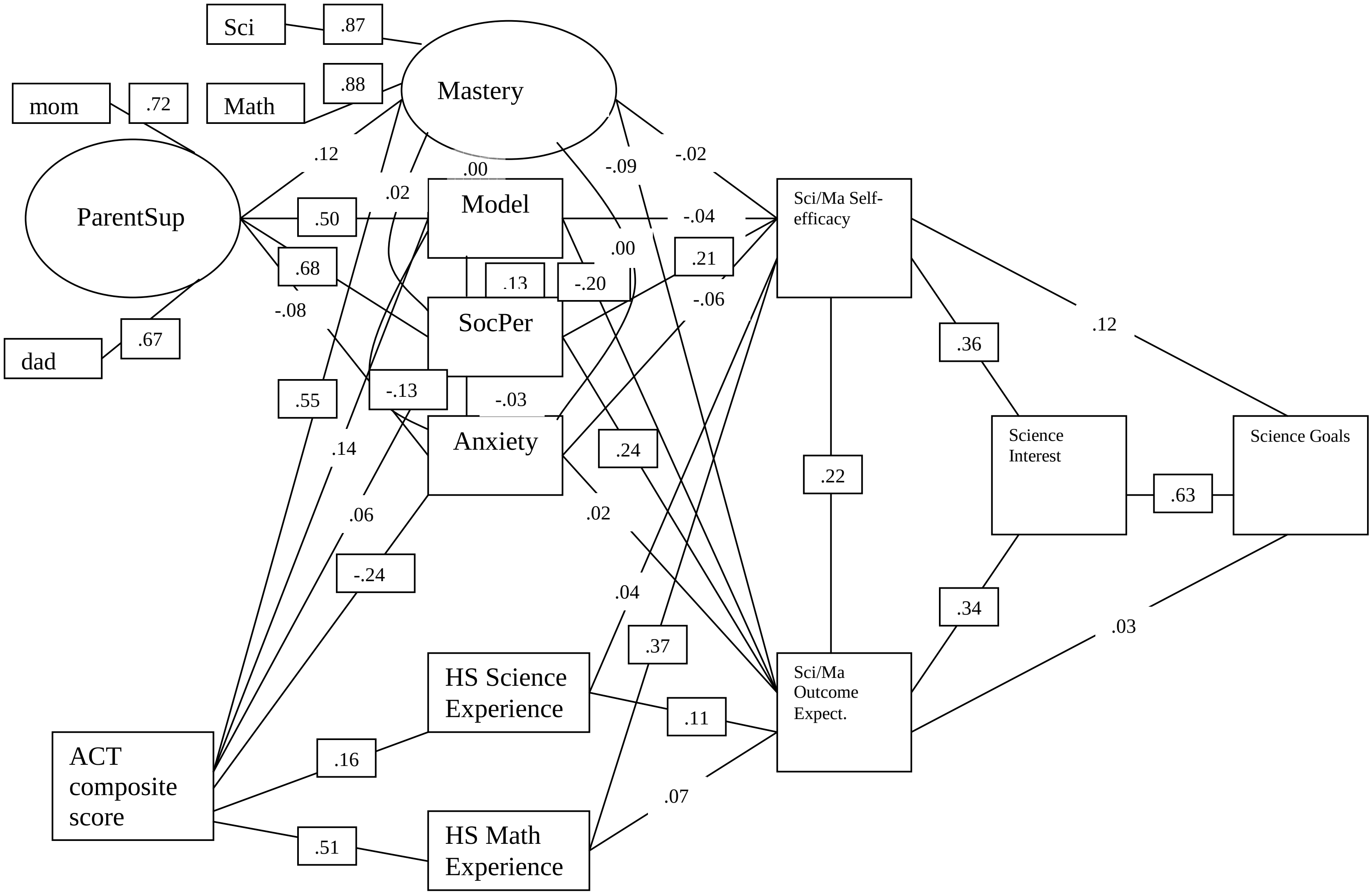

Figure 5. Path model results for women only. Note: path coefficients surrounded by a box are significant at $p < .05$

independently from the men's data. The result of this analysis was χ^2 (108, N=245) = 220.81, p < .001, scaled χ^2 (108, N=245) = 196.37. Finally, the chi-square results from both of these analyses were compared to determine if they were significantly different (Crawford & Henry, 2003; Satorra & Benlter, 2001). Based on the results (scaled χ^2 [28, N=245] = 18.24, p = .92) the constrained and freed models were not significantly different. This indicates that there was no significant difference in how the data for men and data for women fit this model; hypothesis 2 is refuted.

Additional Analyses

Results from testing the first two hypotheses indicated that there was need for additional exploration of the data. I will first discuss an additional analysis where self-reported performance was included in the model for hypothesis 1. Next, I will discuss an additional analysis where data from men and women were compared separately with an abbreviated model.

Including Self-Report Performance in the Existing Model

The first need for additional analysis arose around the present study's use of an objective measure of mastery. In the present study I chose to use an objective measure of mastery (high school science GPA and math GPA), as a source of self-efficacy. Some prior researchers have used self-report performance measures instead. Because objective mastery was not related to the SPSF or SPSM subscales or the FSS math/science self-efficacy subscale in the hypothesized model, I thought it was important to look at a model that included both objective mastery and self-report performance. Results of this path model can e found in Figure 6.

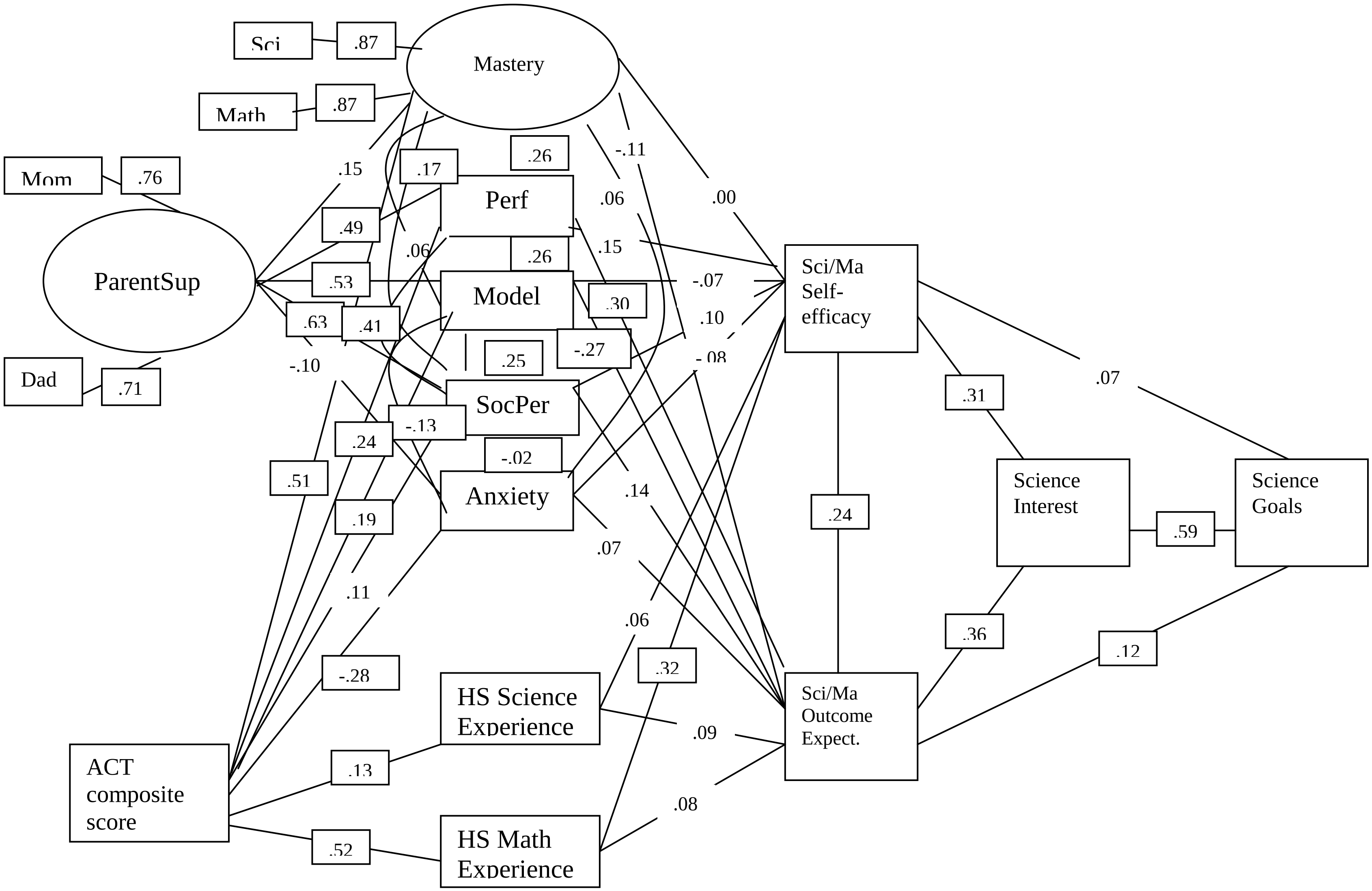

Figure 6. Path model results including self-report performance. *Note: Path coefficients surrounded by a box are significant at the p < .05 level*

Results demonstrated that the goodness of fit statistics remained nearly the same for this model as they were for the originally hypothesized model χ^2 (59, N = 245) = 157.50, $p <$ .001, scaled χ^2 (59, N = 245) = 148.41, $p <$ .001, CFI = .96, RMSEA = .079 (CI=.063; .095), standardized RMR = .084. It was found that the SASE performance subscale was significantly uniquely predicted by parent support (β = .49) and ACT composite score (β = .24) and significantly uniquely predicted the FSS math/science outcome expectations subscale score (β = .30) but did not significantly predict the FSS math/science self-efficacy subscale score. Additionally, results indicated that the SASE performance subscale was significantly related with the objective mastery latent variable and the SASE social persuasion subscale. After adding self-report performance to the model, the SASE social persuasion subscale was no longer significantly related with the FSS math/science self-efficacy or outcome expectation subscales.

Comparing Data from Men and Women Using an Abbreviated Model

It also seemed important to further explore any sex differences between men and women in an abbreviated model. Although there were not significant differences between the sexes in the original model, visual inspection suggested that there may be significant differences in relations between parent support, the three SASE subscales and mastery, and the FSS math/science self-efficacy subscale. This abbreviated model was run for each sex separately (see Figures 8 and 9).

The initial test of the model with men resulted in a good fit to the data: standard χ^2 (10, N = 88) = 9.57, p =.48, scaled χ^2 (10, N = 88) = 9.89, p =.45, CFI = 1.00, RMSEA = .00, standardized RMR = .027. The initial test of this same model with women also resulted

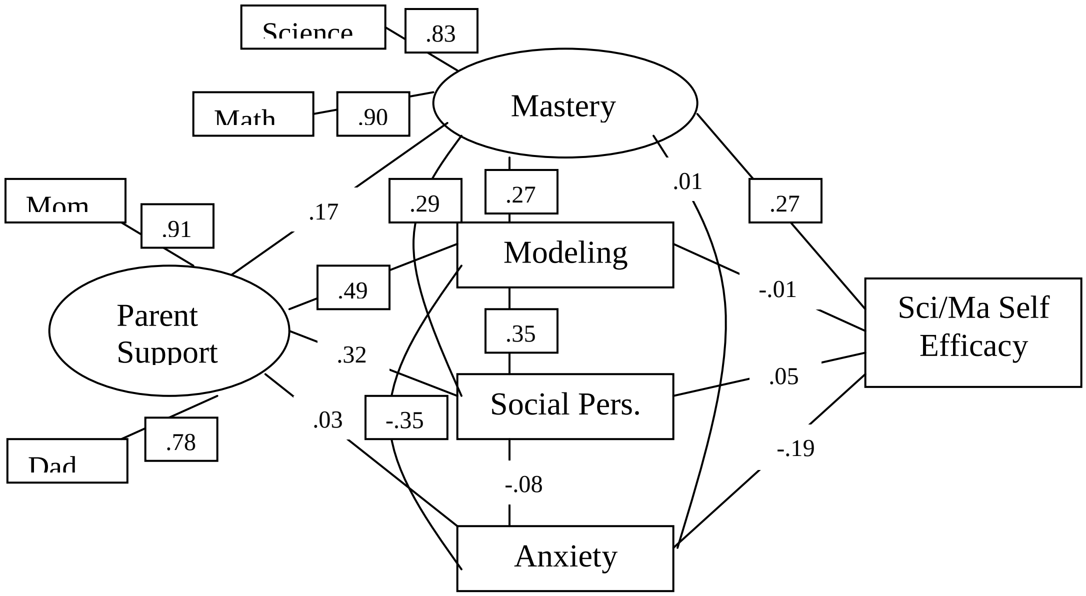

Figure 7. Results of abbreviated model for men. *Note: path coefficients surrounded by a box are significant at p < .05.*

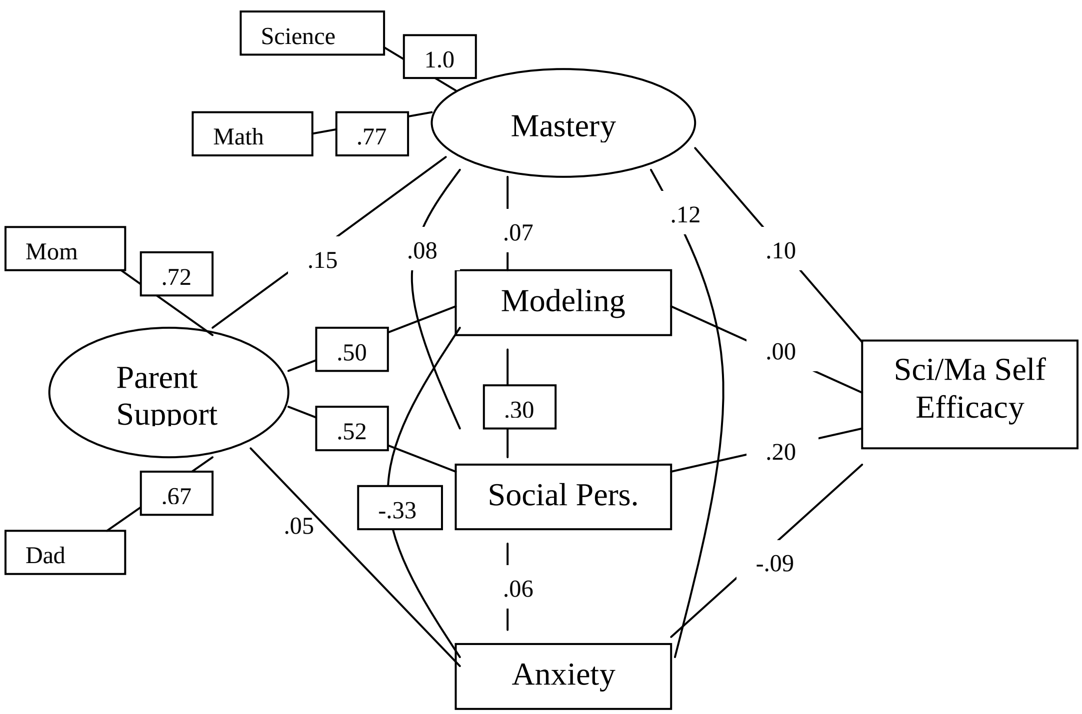

Figure 8. Results of abbreviated model for women. *Note: path coefficients surrounded by a box are significant at p < .05.*

in a good fit to the data: standard χ^2 (10, N = 149) = 17.29, p =.068, scaled χ^2 (10, N = 149) = 14.30, p =.16, CFI = 1.00, RMSEA = .00, standardized RMR = .029. See Appendix D for results of these path analyses.

To determine whether the data from men and women fit the models differently, several analyses were done. First, the two models were constrained such that the men's data was forced to fit the model in the same way that the women's data fit. The result of this analysis was χ^2 (30, N=245) = 27.95, p < .001, scaled χ^2 (30, N=245) = 18.19, p < .001. Next, the models were tested again, but this time the men's data was freed to fit the model independently from the women's data. The result of this analysis was χ^2 (22, N=245) = 24.17, p < .001, scaled χ^2 (22, N=245) = 14.71, p < .001. Finally, the chi-square results from both of these analyses were compared to determine if they were significantly different (Crawford & Henry, 2003; Satorra & Benlter, 2001). Based on the results (scaled χ^2 [8, N=245] = 3.528, p = .90) the constrained and freed models were not significantly different. This indicates that there was no significant difference in how the data for men and data for women fit this model.

DISCUSSION

I will first discuss, interpret, and evaluate the results of the present study, beginning with the full model and continuing to the models comparing men and women. Within each of these models I will discuss each hypothesis as well as additional information gained from analysis that was not originally hypothesized. Next, I will discuss the results of additional analyses performed including a model where self-report performance is added and comparing men and women with an abbreviated model. After this, I will discuss limitations of this study including recommendations for future research. I will also explore the implications of the results of this study on vocational counseling and discuss possible applications of this information.

Hypothesis 1

The first hypothesis analyzed the application of social cognitive career theory to a group of college students including primarily science majors and pre-medical students. The data fit the model well, so overall the hypothesis is supported. When the hypothesis is broken down into sections, however, we see that the data fit some parts of the model better than other parts. See Figure 9 for significant and nonsignificant paths.

Parent Support

It was expected that parent support would predict all four sources of self-efficacy, however it only significantly predicted modeling and social persuasion. See Table 3 for these results. Parent support has been shown to have a relation with self-efficacy in two studies (Ferry et al., 2000; Nota et al., 2007). Specifically, Ferry and colleagues (2000) found that parent encouragement and math/science self-efficacy were correlated, but that parent

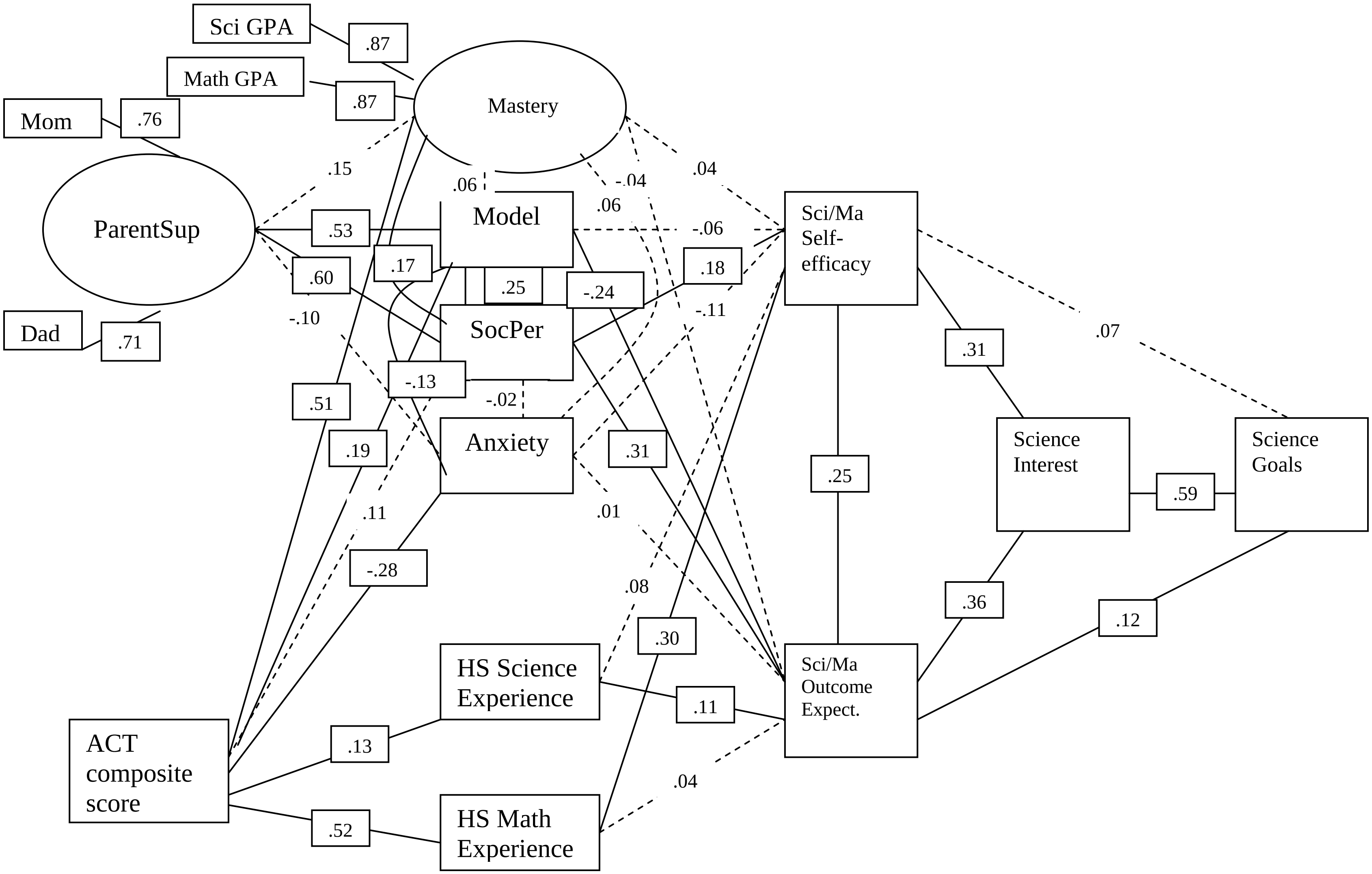

Figure 9. Path model results for Hypothesis 1 with significant paths emphasized. *Note: dashed lines indicate nonsignificant paths, coefficients surrounded by a box are significant at p < .05.*

role modeling and parent expectations were not significantly correlated with math/science self-efficacy.

Bandura (1986) theorized that there are four sources of self-efficacy. It may follow then, that the effect parent support has on self-efficacy is through one (or all) of these sources. Based on the results of the current study, it seems that mother support and father support affect math/science self-efficacy through modeling and social persuasion. The mother support and father support measures used in the present study addressed primarily emotional support and acceptance; the subscales did not specifically focus on academic issues. It makes sense that parents who are more emotionally supportive also give more academic praise (social persuasion). It also follows that the types of students who perceive their parents as supportive and accepting are more likely to see them as positive academic role models and spend time with other positive/supportive academic influences (modeling).

Contrary to our hypothesis, mastery measures were not significantly uniquely predicted by parent support. While there is no literature that examines the relations between each of the four sources of self-efficacy and parent support, findings in one study demonstrate that parent support is a significant contributor to a regression model predicting graduation (Wintre & Bowers, 2007). In the present study, actual mastery (high school math/science grades) were not significantly related with parent support, however self-report performance was significantly correlated with parent support (r = .41). What this likely means is that parent support affects self-evaluation of academic performance, but not actual grades in math/science. It seems, then, that other factors are more important in predicting actual performance; specifically, aptitude did significantly predict mastery as measured by high school math GPA and high school science GPA. Because both aptitude and parent support were included in the model, the path coefficients between each of them and mastery only indicate their unique predictive ability.

Additionally, parent support did not significantly predict the fourth source of self-efficacy, anxiety, nor were these two variables correlated. It was hypothesized that there would be a significant relation here, however there no prior literature was found indicating whether a statistical relationship is to be expected between these two variables. In prior studies examining the sources of self-efficacy, anxiety was the least-robust source of self-efficacy, as it only predicted math self-efficacy in five out of eight samples (Lent et al., 1991; Lent et al., 1993; Lopez & Lent, 1992; Lent, Lopez et al., 1996; Klassen, 2004; Ozyurek, 2005). Both of these observations (that anxiety did not significantly predict self-efficacy in three out of eight samples and that parent support did not predict anxiety in the current study) may indicate that anxiety is a source of self-efficacy that does not function in the model quite as it was theorized to do.

Aptitude

It was also hypothesized that aptitude would predict all four sources of self-efficacy as well as number of science and math learning experiences. Results showed that aptitude significantly predicted mastery, modeling, anxiety (negatively), and number of semesters of high school math and number of semesters of high school science taken. Aptitude did not significantly predict social persuasion. The authors of SCCT (Lent et al., 1994) posited that person-factors would contribute to self-efficacy, but did not elaborate about the path of this contribution. Additionally, the when searching the literature for the present study, it was found that ACT composite score was significantly correlated with grades (r = .36) (Lent et al., 1993). It is possible that self-efficacy may have served as a proxy for aptitude and/or objective mastery in previous studies. No articles were found that examined the relation of aptitude with the other three sources of self-efficacy.

It seems reasonable that aptitude (operationalized as ACT composite score) significantly predicted actual mastery, as it was designed to predict performance. Additionally, individuals who have a high aptitude for academic success may be likely to seek out modeling experiences and may perceive everyday occurrences as modeling experiences because of their academic aptitude. Students who have the aptitude to generally be successful would have less reason to experience anxiety in their academic work; a significant, negative path coefficient here is fitting.

It was expected that aptitude would predict prior math/science learning experiences, however it was unexpected that these path coefficients would be of such different magnitudes (science experience β =.13, math experience β =.52). The operationalization of aptitude as ACT composite score may help to explain this. While the ACT contains a math subscale and science subscale, these subscales do not measure math aptitude and science aptitude in the same way. Most of the items in the math subscale are math problems that were covered in high school math classes. If a student takes quite a few math classes in high school, it would be expected that they learned how to do these math tasks. The science subscale of the ACT, however, primarily measures a student's ability to read and understand charts, graphs, and diagrams. While these are important science tasks to master, they are not taught as explicitly in high school science classes as math problem solving is taught in high school math classes.

The indirect effect of aptitude on math/science self-efficacy. An interesting result of this study is related to how aptitude indirectly predicts math/science self-efficacy (see Figure 3). Aptitude indirectly predicts math/science self-efficacy through number of semesters of high school math taken but does not indirectly predict math/science self-efficacy through number of semesters of high school science taken. What this indicates is that for this population, an individual's aptitude for academic success leads to greater self-efficacy when they take more math classes in high school. Perhaps this is because math classes are perceived to be more challenging than science classes.

The indirect effect of aptitude on math/science outcome expectations. It was also found that aptitude indirectly predicted outcome expectations through number of semesters of high school science taken. What this indicates is that an individual's aptitude for academic success leads to greater expectation of positive outcomes in math/science when they taken an above average number of science courses in high school. This is likely because taking an above average number of science course in high school provides an individual with more opportunities to gain information about the topic of science and how science can be used in future careers.

Relation of the Four Sources of Self-Efficacy and Self-Efficacy

The next section of the model examines the connections between the four sources of self-efficacy and self-efficacy. Although it was hypothesized that all four sources of self-efficacy would significantly uniquely predict self-efficacy, results showed that only social persuasion was a unique predictor of math/science self-efficacy. Authors of one article reported a regression analysis that, after self-report performance was accounted for, none of the other four sources of self-efficacy significantly contributed to the model (Lent, Lopez, & Bieschke, 1991). No other multiple-predictor models were found, however, many correlational studies were found. These studies indicated that all four sources generally were correlated with self-efficacy, but the results were not entirely consistent.

Specifically, in predicting math/science self-efficacy, two studies found that mastery (operationalized similarly to the present study, as overall or subject-specific GPA) was significantly correlated (r = .35, .53) (Ferry, Fouad, & Smith, 2000; Fouad et al., 2002). The correlations found in the present study were also significant, but smaller (math GPA r = .23, science GPA = .17). The sample used in both of the prior studies were college students, which matched our sample, however the current study included only science majors, while the previous samples included a range of majors. Perhaps mastery affects math/science self-efficacy less for individuals who are specifically pursuing science careers, as their investment may change how they perceive the connection between their demonstrated mastery and their beliefs about their abilities. Additionally, because prior studies did not include aptitude in the predictive model, self-efficacy may have served as a proxy for this construct.

Additionally, researchers have explored the relation between self-efficacy and the three self-report sources of self-efficacy examined in the present study. These researchers reported results regarding self-efficacy in math, where (in eight studies reported in six articles) it was found that modeling and social persuasion were significantly correlated with self-efficacy in six out of eight studies, and anxiety was significantly correlated with self-efficacy in five out of eight studies. (Lent et al., 1991; Lent et al., 1993; Lopez & Lent, 1992; Lent, Lopez et al., 1996; Klassen, 2004; Ozyurek, 2005). Additionally, it was found that all three of these self-report sources of self-efficacy were significantly correlated with science self-efficacy (Britner & Pajares, 2005). Results of the present study match the majority of these results, as the three self-report sources of self-efficacy were significantly correlated in the present sample and were found to correlate in a majority of the previous studies. The only multiple-predictor model (Lent et al., 1991) demonstrated that modeling, social persuasion, and anxiety did not significantly contribute to a regression model predicting math self-efficacy once self-report mastery was accounted for. Because this regression study was hierarchical, it is uncertain the unique variance each of these four sources of self-efficacy contributed to the model.

The unexpected relation between math/science self-efficacy and its four sources. Regarding the path model, it at first seems a bit unexpected that all five contributors to the four sources of self-efficacy are significantly correlated with self-efficacy, but that only one of these four sources uniquely contributes to the model. What this likely indicates is that the four sources are highly intercorrelated; since we controlled for these correlations, only unique predictive validity is accounted for in the path coefficients. When examining the model, this explanation seems to fit well. All zero-order correlations among these variables are significant except for the correlations between social persuasion and anxiety and the two measures of mastery and anxiety (see Table 3). Additionally, three of the six paths between these four variables were significant in the path model (see Figure 3).

Social persuasion was the only variable that significantly uniquely predicted math/science self-efficacy in the model. It may be that social persuasion is getting extra unique predictive ability from the high correlation between social persuasion and self-report performance (r = .73). Self-report performance was not included in the model because I had access to an objective measure of mastery. While all shared variance between the sources included in the model were controlled for, the effect of self-report performance (not controlled for) was perhaps expressed through social persuasion.

Relation of the Four Sources of Self-Efficacy and Outcome Expectations

It was also hypothesized that the four sources of self-efficacy would significantly predict outcome expectations. This hypothesis was partially supported, as modeling and social persuasion significantly contributed to the model but mastery and anxiety did not. Only partial support of the hypothesis was not expected based on the literature, as a meta-analysis found moderate to strong correlations between all four sources of self-efficacy and outcome expectations (Young, et al., 2004). Another study found explored the relation between mastery (operationalized as both high school GPA and subject-specific GPA) and math/science outcome expectations. Using SEM, the authors found that there was a significant relation between subject-specific GPA and math/science outcome expectations (β = -.12), but that the path from overall high school GPA to math/science outcome expectations was nonsignificant (Fouad, Smith, & Zao, 2002).

Samples in the meta-analysis included four samples from high schools or middle schools and six samples of general undergraduates; the sample used in the SEM study was a group of undergraduate students in intro psychology classes. None of these samples matched the science focus of the present sample. Additionally, it is important to note that the Sources of Academic Self-Efficacy scale measured academic self-efficacy as a broad construct; it did not measure only math and/or science sources of self-efficacy. If we had measured only the sources of math/science self-efficacy, we may have found that these subscales had greater predictive power.

Additionally, it can be noted in the model that the significant relation between social persuasion and outcome expectations is positive, and the significant relation between modeling and outcome expectations is negative (see Figure 3). No prior studies have found a negative relation between modeling and science and/or math outcome expectations. Again, this could perhaps be due to the unique sample in the present study or could be related to an unexpected adjustment due to the multicollinearity between modeling and social persuasion or modeling and anxiety (see Figure 3).

Relation Between Prior Learning Experiences and Self-Efficacy and Outcome Expectations

Number of high school math learning experiences and science learning experiences were hypothesized to significantly uniquely predict both math/science self-efficacy and math/science outcome expectations. Results showed that the paths from number of math learning experiences to math/science self-efficacy and from number of science learning experiences to math/science outcome expectations were significant. The other two paths were not significant (see Figure 3).

There was no precedent found in the literature for understanding this pattern. The students included in this sample are all very invested in science, as they are science majors and/or pre-medical students. That their expectations about future outcomes would stem primarily from prior science classes (and not prior math classes) fits well with their probable career goals. Understanding the relation between math learning experiences and self-efficacy is less simple. Perhaps the type of person who would take additional math classes in high school is different from the type of person who would take additional science classes in high school and the type of person who takes additional math classes also reports higher math/science self-efficacy. Another option is that math classes are seen as more challenging than science classes and thus increase math/science self-efficacy more. Although number of semesters of high school math and number of semesters of high school science taken are significantly correlated, the correlation is small (r =.18). Additionally, the correlation between number of semesters of high school math taken and math/science self-efficacy (r =.36) is larger than the correlation between number of semesters of high school science taken and math/science self-efficacy (r =.14).

Relations between Self-Efficacy, Outcome Expectations, Interests, and Goals

Finally, it was hypothesized that math/science self-efficacy would directly predict math/science outcome expectations, science interests, and science goals; that math/science outcome expectations would directly predict science interests and science goals; and that science interests would directly predict science goals. Results showed that all of these paths were significant except the path from math/science self-efficacy to science goals. The strongest paths (those significant at the $p < .01$ level) were from self-efficacy and outcome expectations to interests and from interests to goals. This likely indicates that self-efficacy and outcome expectations primarily affect goals through interests.

The relations found in the present study generally fit well within the existing body of SCCT literature. The significant relation between self-efficacy and interests was found in a multitude of other studies (Ferry et al., 1999; Fouad & Smith, 1996; Lent et al., 1991; Lent et al., 1993; Ozyurek, 2005; Smith & Fouad, 1999; Waller, 2005). None of these seven studies examined science interests alone; these authors either looked at math interests or math/science interests. The fact that the results of the present study line up with results from previous studies indicates that science interests can likely be predicted in a similar fashion to math interests or combined math/science interests.

Additionally, the significant relation between outcome expectations and interests is well documented in the literature (Lent et al., 1993; Waller, 2005; Young et al., 2004). Young and colleagues (2004) performed a meta-analysis where they found an average weighted mean effect size of the correlation between math outcome expectations and math interests to be .56 in two samples and between math outcome expectations and math/science interests to be .54 in eight samples. Additionally, SEM was used in three studies (Ferry, Fouad, & Smith, 1999; Fouad & Smith, 1996; Fouad, Smith & Zao, 2002) to explore the relation between math/science outcome expectations and math/science goals. This path was significant in all three studies. As would be predicted based on these previous studies, math/science outcome expectations significantly predicted science interests. As none of the prior research examined science interests alone, the results of the current study likely indicate that science interests can be predicted in a similar way to math or math/science interests.

These same three studies discussed above (Ferry, Fouad, & Smith, 1999; Fouad & Smith, 1996; Fouad, Smith & Zao, 2002) also reported path coefficients for the relation between math/science outcome expectations and math/science goals (β = .34, .39, .43). All three of these studies found this path to be significant. The beta-weight in the present study is smaller (β = .12) but is also significant. The different magnitude could be due in part to the size of the model in the present study. While the three studies discussed above included only math/science self-efficacy, outcome expectations, interests, and goals, the present study included these variables and eight additional predictor variables. These results suggest that math/science outcome expectations predict science goals directly as well as indirectly through interests.

The present study tested the relation of science interests and science goals. As hypothesized, this path was significant; it was also quite large (β = .59). Three studies were found which used structural equation modeling to predict the relation of math/science interests on math/science goals (Ferry, Fouad, & Smith, 1999; Fouad & Smith, 1996; Fouad, Smith & Zao, 2002). Results from all three studies indicated a significant path between these two variables (β = .28, .44, .47). Results from the present study fit well into the existing literature.

The theoretically unexpected relation of math/science self-efficacy and science goals. The relation between self-efficacy and goals is less conclusive in the literature than other SCCT construct relations. In all simple-correlation studies, math and/or science self-efficacy has consistently been found to significantly correlate with math and/or science goals (Lent et al., 1991; Lent et al., 1993; Waller, 2002). In addition to these correlational studies, three articles that used structural equation modeling were found (Ferry, Fouad, & Smith, 1999; Fouad & Smith, 1996; Fouad, Smith & Zao, 2002). Math/science self-efficacy was found to uniquely predict math/science goals in two of the models (β = .08, .13); the path was insignificant (β = .02) in the third study. The beta-weight from the present study (β = .07) as well as the insignificant effect are not entirely unexpected based on prior literature. What this indicates is that the effect of self-efficacy on science goals is almost entirely mediated by science interests. This difference in significance may be due to sample size, as all beta-weights were small.

Overall Conclusions from Hypothesis 1

Overall, most results of this study fit well with prior research. Almost all paths in the core section of the SCCT model (self-efficacy, outcome expectations, interests, and goals) were significant. Additionally, prior research had shown that the one non-significant path (from math/science self-efficacy to science goals) was either non-significant or significant but small in three previous studies. Theoretically it was unexpected that only one of the four theorized sources of self-efficacy would predict self-efficacy. In prior research, a regression model demonstrated that after accounting for self-report mastery, the other three sources (modeling, social persuasion, and anxiety) did not contribute additional variance to the model.

A pattern that became clear in the results is the importance of modeling and social persuasion in the model. These two variables were predicted by parent support and were related to outcome expectations. Additionally, social persuasion was the only theorized source of self-efficacy to significantly predict self-efficacy. This likely indicates that social persuasion and modeling are stronger (and more unique) contributors to the SCCT model than performance and anxiety, which is counter to SCCT theory (Lent et al., 1994).

Results from the present study as indicated that the contribution of math/science self-efficacy to the model is less significant than theorized. Several hypothesized paths to or from math/science self-efficacy were nonsignificant. Only one of the four theorized sources of self-efficacy significantly uniquely predicted self-efficacy. Additionally, number of semesters of high school science taken did not significantly uniquely predict math/science self-efficacy and math/science self-efficacy did not significantly uniquely predict science goals. While self-efficacy is a core construct in SCCT, the results of this study demonstrate that it may not have the effect it was theorized to have.

This study also examined the relation of certain background variables on the core SCCT constructs. Very little to no research has been done to examine the influence of parent support and aptitude on SCCT constructs. Results of the present study indicate that parent support had a significant relation with two of the four sources of self-efficacy (modeling and social persuasion). Additionally, ACT composite score had a significant relation with three of the four sources of self-efficacy (mastery, modeling, and anxiety) and number of prior math/science learning experiences (number of semesters of high school math and number of semesters of high school science). Indirect effects of the ACT composite score were also interesting, as ACT composite score had an indirect effect on math/science self-efficacy through number of semesters of high school math, and had an indirect effect on math/science outcome expectations through number of semesters of high school science. These results are a new and valuable addition to the existing literature.

Hypothesis 2

It was hypothesized that there would be significant differences between the fit of the model for men and for women. Specifically, it was hypothesized that the paths between the four sources of self-efficacy and self-efficacy would differ for men and women (anxiety and social persuasion would be stronger for women, mastery stronger for men) and that the path between actual mastery and self-efficacy would be stronger for men than women. Because the models were not found to differ significantly, these hypotheses must be rejected.

Previous literature indicates that sex differences in the model may have been expected. Authors of one study found that college men reported significantly higher means on mastery and positive emotional experience than women; another sample in the same article found that high school girls reported significantly higher means on modeling and social persuasion than boys (Lent, Lopez et al., 1996). In another study, Lent and colleagues (1991) used multiple regression to examine the effects of sex on math self-efficacy and it's sources. The authors found that sex accounted for 22% of the variance in math self-efficacy and that the full model (including the four theorized sources of self-efficacy and ACT scores) accounted for 73% of the variance in math self-efficacy for men and 62% of the variance in math self-efficacy for women (Lent et al., 1991). While this appears to be a substantial difference in variance explained, the authors did not indicate whether the models were significantly different. The present study did not find a significant difference in the fit of the model for men and women. This could indicate that no difference exists. This null finding could also be related to the small sample size used in this study.

Additional Analyses

Throughout the process of testing hypotheses in the present study, two additional opportunities for exploration became apparent. The first was regarding the effect of self-report performance, measured as the SASE performance subscale. Mastery has been measured in the literature as past grades (as this study measured it) and as a self-report measure. Because I had access to both an objective and self-report measure of performance/mastery I had the opportunity to see how these two measures fit in a model together. Results demonstrate that adding self-report performance did not have a substantial effect on fit the model, however the self-report measure was related to several other variables in the model.

It was found that parent support significantly predicted self-report performance, although parent support did not predict the objective measure of support used in the original model. In the original literature search for the present study, no research was found with which to compare these findings. It seems reasonable, though, that subjective experience of parent support (as measured by a self-report) would also be correlated with an individual's subjective experience of his or her own successes and failures. What this likely indicates is that parent support does not affect actual mastery (measured here by math GPA and science GPA), but *does* affect how good an individual feels about their performance. This is a clear path for how parent support relates with self-efficacy, as affecting how good a person feels about their performance is substantial factor in self-efficacy. Additionally, results indicated that aptitude (measured as ACT composite score) significantly predicted self-report performance. Although no literature was found in the original literature search for the present study with which to compare these findings, it makes sense that an individual who has a higher academic aptitude is also more likely to report successful performance.

Finally, it was found that self-report performance significantly uniquely predicted math/science outcome expectations and did not uniquely predict math/science self-efficacy. In the original model (as well as this additional model) the objective measure of mastery did not significantly uniquely predict outcome expectations or self-efficacy. The finding that self-report performance significantly uniquely predicted math/science outcome expectations fits well with other empirical studies. In a meta-analysis, Young and colleagues (2004) reported an average weighted mean effect size for the correlation between self-report performance and math self-efficacy to be .48 in three studies.

It is surprising that self-report performance did not have a significant unique relation with self-efficacy, as this path (generally measured as a zero-order correlation) has been found to be significant in all prior published research found (Lent et al., 1991; Lent et al., 1993; Lopez & Lent, 1992; Lent, Lopez et al., 1996; Klassen, 2004; Ozyurek, 2005). Additionally, Lent and colleagues (1991) reported that self-report performance was the only significant predictor of math self-efficacy when put in a hierarchical regression model; after variance due to self-report performance was accounted for, the other three sources of self-efficacy did not significantly predict math self-efficacy. The divergence of the present study from the literature could be explained in three different ways. First, the self-report measure of performance was a general academic measure, while the self-efficacy measure was related specifically to math/science. The differences in topic may have had an impact. Another explanation is that this study included parent support and aptitude in the model, where prior studies have not. These two background factors took some of the variance that had previously been attributed to other constructs in the model. Finally, it could be that self-report performance and the other four sources of self-efficacy included in this model (objective performance, modeling, social persuasion, and anxiety) share a substantial part of the variance, and that the unique predictive power of performance is small. As much of the prior research was correlational in nature, the second explanation seems most likely.

Also of note, the SASE social support subscale significantly predicted the FSS math/science outcome expectations subscale in the original model, however these two variables did not have a significant relation in the model that included self-report performance. Additionally, social persuasion and self-report performance are significantly related to each other. What this likely indicates is that adding self-report performance to the model decreased some of the unique predictive power of social persuasion, as the two constructs share a substantial amount of the variance.

Although there was no significant difference between the fit of the original model for men and women, there is literature stating the relations among the four sources of self-efficacy and self-efficacy may differ for men and women. Upon visual inspection of this abbreviated section of the model, it appeared that there might be significant differences in this smaller model. Structural equation modeling was used to test this exploratory hypothesis (see Figures 8 and 9 in Appendix D). There was not a significant difference found between the fit of this abbreviated model for men and women.

Limitations

This study has several limitations. The first is the small sample size. Although over 320 responses were gathered, only 245 of these provided complete data. This limitation is even more impactful when using a statistical procedure like structural equation modeling, as the number of parameters that can be assessed is dependent upon the sample size. Some of the incomplete data can be traced to not gaining access to some of the students' academic history measures (like high school transcript or ACT composite score). These measures had not been used before to examine the relations between person factors, prior learning, experiences, self-efficacy, interests, and goals, however this additional information about participants came at a cost. In the future it would be recommended to have a larger sample size so as to be able to adjust or add to the model freely, without concern for number of parameters. The particular sample in this study is also a limitation. Because all participants were college students and many were in a competitive field, there is less variation in their responses than would be found in a more diverse sample. This restricted range makes it more difficult to find significant statistical differences.

Another limitation of this study is related to the measures used. The Sources of Academic Self-Efficacy scale asked questions about general academic experiences, not experiences related specifically to math and/or science. Perhaps we would have found stronger relationships between the three self-report sources of self-efficacy had we used a sources of math/science self-efficacy scale.

Future Research

The results of the present study suggest several interesting directions for future research. One unexpected and important finding of the present study is that three of the four sources of self-efficacy were not found to significantly uniquely predict self-efficacy. Another important finding was the importance of aptitude and prior learning experiences; these predictors have not before been used in the application of SCCT.

Specifically, the study found several unexpected non-significant effects; further exploration of the paths between math/science self-efficacy and three of the four sources of self-efficacy (mastery, modeling, and anxiety) is important. The path between math/science self-efficacy and science goals was also unexpectedly nonsignificant. These hypotheses were theoretically based (Lent et al., 1994) and were supported by existing correlational studies (Lent et al., 1991; Lent et al., 1993; Lopez & Lent, 1992; Lent, Lopez et al., 1996; Klassen, 2004; Ozyurek, 2005). Exploring the relations and interrelations of these variables in more detail, and perhaps measuring specifically math/science sources of self-efficacy, would be an important addition to the existing body of literature.

Additionally, there were a few differences found between men and women (mean differences in modeling, social persuasion, anxiety and science interest and differences between the correlations of ACT composite score and modeling and science goals and math GPA). However, there were no significant differences found in either the full or abbreviated models. While there has been a substantial amount of research done to examine mean differences in these scales between men and women, there has been very little research done comparing larger models between men and women. Although the primary sex-related hypothesis of this study was refuted there is certainly the possibility that a dynamic difference exists in the way men and women develop self-efficacy, outcome expectations, interests, and goals. Using a larger sample size would make any existing sex differences easier to detect.

Finally, the pattern of results found regarding how the four theorized sources of self-efficacy interrelated with each other and related to self-efficacy is something to consider for future research. It is uncertain what the driving factor is (or if there is a driving factor) behind all four of these sources. Parent support appears to be one factor, as it predicted two of the sources and aptitude appears to be another factor, as it predicted three of the four sources of self-efficacy. However, it is likely there are other factors that contribute to predicting these variables. Gaining a better understanding of what these other factors are will provide us with more information about how self-efficacy develops as well as how it can be bolstered.

Implications and Application

The results of this study have several implications for the way we understand how college students choose future goals. We see that the core of social cognitive career theory (SCCT, Lent et al., 1994) generally fits well for predicting science goals, except that math/science self-efficacy did not directly predict science goals. This theory has been well-supported in the literature, and the present study successfully applies much of the theory both to science interests and goals as well as to a sample of science majors.

Additionally, this study demonstrates that there are significant intercorrelations between the four theorized sources of self-efficacy when they are used to predict self-efficacy. While the literature has demonstrated these correlations, there has been no research showing how these variables interact when placed in a path model together. It was demonstrated that parent support plays a role in developing these sources of self-efficacy and may be a link between these four sources. This study demonstrates the importance in a child's academic life of having emotionally supportive and available parents.

The present study also demonstrates the importance of having substantial course experience in high school – particularly math course experience, as this was related to higher math/science self-efficacy. Encouraging students to take additional challenging courses in high school is likely to lead to greater self-efficacy in these fields, and thus greater interests and goals to pursue these fields. Finally, the results of this study demonstrate the importance of interests in the development of goals. Self-efficacy was shown to only significantly relate with science goals through science interests. Therefore, this link is important to foster.

REFERENCES

ACT, Inc. (2007). *The ACT Technical Manual.* Retrieved May 2, 2009 from ACT.org website: http://www.act.org/research/researchers/index.html.

ACT, Inc. (2009). *Facts About the ACT.* Retrieved May 2, 2009 from ACT.org website: http://www.act.org/news/aapfacts.html.

Anderson, S. L., & Betz, N. E. (2001). Sources of self-efficacy expectations: Their measurement and relation to career development. *Journal of Vocational Behavior, 58,* 98-117.

Association of American Medical Colleges. (2007, Sept. 25). Table 7: Applicants, first-time applicants, acceptees, and matriculants to U.S. medical schools by sex, 1996-2007. Retrieved April 19, 2008, from the World Wide Web: http://www.aamc .org/data/facts/2007/2007summary2.htm

Baker, D., & Leary, R. (2003). Letting girls speak out about science. *Journal of Research in Science Teaching*, *40*, S176-S200.

Bandura, A. (1977). *Social learning theory.* Englewood Cliffs, N.J.: Prentice-Hall.

Bandura, A. (1982). The assessment and predictive generality of self-percepts of efficacy. *Journal of Behavior Therapy and Experimental Psychiatry*, *13*, 195-199.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall.

Bandura, A., Adams, N. E., & Beyer, J. (1977). Cognitive processes mediating behavioral change. *Journal of Personality and Social Psychology, 35,* 125-139.

Beck, A. T., Ward, C. H., Mendelson, M., Mock, J., Erbaugh, J. (1961). An inventory for measuring depression. *Archives of General Psychiatry, 4,* 561-571.

Betz, N. E. (1977, August). *Math anxiety: What is it?* Paper presented at the meeting of the American Psychological Association, San Francisco.

Betz, N. E., Borgen, F. H., & Harmon, L. W. (1996). *Skills confidence inventory: Applications and technical guide.* Palo Alto, CA: Consulting Psychologists Press.

Betz, N. E., & Hackett, G. (1981). The relationship of career-related self-efficacy expectations to perceived career options in college women and men. *Journal of Counseling Psychology, 28,* 399-410.

Betz, N. E., & Hackett, G. (1983). The relationship of math self-efficacy expectations to the selection of science-based college majors. *Journal of Vocational Behavior, 23,* 329-345.

Bourne, P. G., & Wikler, N. J. (1978). Commitment and the cultural mandate: Women in medicine. *Social Problems*, *25*, 430-440.

Britner, S. L., & Pajares, F. (2005). Sources of science self-efficacy beliefs of middle school students. *Journal of Research in Science Teaching*, *43*, 485-499.

Carson, K. D. & Bedeian, A. G. (1994). Career commitment: Construction of a measure and examination of its psychometric properties. *Journal of Vocational Behavior, 44*, 237-262.

Cheek, J. M. & Buss, A. H. (1981). Shyness and sociability. *Journal of Personality and Social Psychology*, *41*, 330-339.

Condiotte, M. M., & Lichtenstein, E. (1981). Self-efficacy and relapse in smoking cessation programs. *Journal of Consulting and Clinical Psychology, 49*, 648-658.

Crawfrod, J. R. & Henry, J. D. (2003). The Depression Anxiety Stress Scales: Normative data and latent structure in a large non-clinical sample. *British Journal of Clinical Psychology, 42*, 111-131.

Cutrona, C. E. (1989). Ratings of social support by adolescents and adult informants: Degree of correspondence and prediction of depressive symptoms. *Journal of Personality and Social Psychology, 57*, 723-732.

Cutrona, C. E., & Russell, D. W. (1987). The provisions of social relationships and adaptation to stress. *Advances in Personal Relationships, 1*, 37-67.

Donnay, D. A. C., Morris, M., Schaubhut, N., & Thompson, R. (2005). *Strong interest inventory manual: research, development, and strategies for interpretation*. Mountain View, CA: CPP.

Farenga, S. J., & Joyce, B. A. (1999). Intentions of young students to enroll in science courses in the future: An examination of gender differences. *Science and Education, 83*, 55-75.

Fenigstein, A., Scheier, M., & Buss, A. H. (1975). Public and private self-consciousness: Assessment and theory. *Journal of Consulting and Clinical Psychology, 43*, 522-527.

Fennema, E., & Sherman, J. A. (1976). Fennema-Sherman Math Attitudes Scales: Instruments designed to measure attitudes toward the learning of math by females and males. *Journal for Research in Math Education, 7*, 324-326.

Ferry, T. R., Fouad, N. A., & Smith, P. L. (2000). The role of family context in a social cognitive model for career-related choice behavior: A math/science perspective. *Journal of Vocational Behavior, 57*, 348-364.

Fouad, N. A., & Smith, P. L. (1996). A test of a social cognitive model for middle school students: Math/science. *Journal of Counseling Psychology, 43,* 338-346.

Fouad, N. A., Smith, P. L., & Enochs, L. (1997). Reliability and validity of the Middle School Self-Efficacy Scale. *Measurement and Evaluation in Counseling and Development, 30*, 17-31.

Fouad, N. A., Smith, P. L., & Zao, K. E. (2002). Across academic domains: Extensions of the social-cognitive career model. *Journal of Counseling Psychology, 49*, 164-171.

Gainor, K. A. (2006). Twenty-five years of self-efficacy in career assessment and practice. *Journal of Career Assessment, 14*, 161-178.

Goldman, R. D., & Hewitt, B. N. (1976). The scholastic aptitude test "explains" why college men major in schience more often than college women. *Journal of Counseling Psychology, 23*, 50-54.

Gwilliam, L. R., & Betz, N. E. (2001). Validity of measures of math- and science-related self-efficacy for African Americans and European Americans. *Journal of Career Assessment, 9*, 261-281.

Hackett, G., Betz, N. E., Casas, J. M., & Rocha-Singh, I. A. (1992). Gender, ethnicity and social-cognitive factors predicting the academic achievement of students in engineering. *Journal of Counseling Psychology, 39*, 527-538.

Harmon, L. W., Hansen, J. C., Borgen, F. H., & Hammer, A. L. (1994). *Strong interest inventory: Applications and technical guide*. Palo Alto, CA: Consulting Psychologists Press, Inc.

Hartman, H., & Hartman, M. (2007). How undergraduate engineering students perceive women's (and men's) problems in science, math and engineering. *Sex Roles, 58,* 251-265.

Henry, P., Bardo, H. R., Mouw, J. T., & Bryson, S. (1987). Medicine as a career choice and Holland's theory: Do race and sex make a difference? *Journal of Multicultural Counseling and Development, 15*, 161-170.

Holland, J. L. (1966). A psychological classification scheme for vocations and major fields. *Journal of Counseling and Psychology, 13*, 278-288.

Holland, J. L. (1978). *Manual for the Vocational Preference Inventory.* Palo Alto, CA: Consulting Psychologists Press.

Hu, L., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling, 6,* 1-55.

Kazdin, A. E. (1979). Imageray elaboration and self-efficacy in the covert modeling treatment of unassertive behavior. *Journal of Consulting and Clinical Psychology, 47*, 725-733.

Kilminster, S., Downes, J., Gough, B., Murdoch-Eaton, D., & Roberts, T. (2007). Women in medicine – is there a problem? A literature review of the changing gender composition, structures, and occupational cultures in medicine. *Medical Education, 41*, 39-49.

Klassen, R. M. (2004). A cross-cultural investigation of the efficacy beliefs of South Asian immigrant and Anglo Canadian nonimmigrant early adolescents. *Journal of Educational Psychology, 96*, 731-742.

Lapan, R. T., Shaughnessy, P., & Boggs, K. (1996). Efficacy expectations and vocational interests as mediators between sex and choice of math/science college majors: A longitudinal study. *Journal of Vocational Behavior, 49*, 277-291.

Lenox, R. A., & Subich, L. M. (1994). The relationship between self-efficacy beliefs and inventoried vocational interests. *Career Development Quarterly, 42*, 302-313.

Lent, R. W., & Brown, S. D. (2006). On conceptualizing and assessing social cognitive constructs in career research: A measurement guide. *Journal of Career Assessment, 14*, 12-35.

Lent, R. W., Brown, S. D., Gover, M. R., & Nijjer, S. K. (1996). Cognitive assessment of the sources of math self-efficacy: A thought listing analysis. *Journal of Career Assessment, 4*, 33-46.

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior, 45*, 79-122.

Lent, R. W., Brown, S. D., & Hackett, G. (2000). Contextual supports and barriers to career choie: A social cognitive analysis. *Journal of Counseling Psychology, 47*, 36-49.

Lent, R. W., Brown, S. D., & Larkin, K. C. (1987). Comparison of three theoretically derived variables in predicting career and academic behavior: Self-efficacy, interest congruence, and consequence thinking. *Journal of Counseling Psychology, 34*, 293-298.

Lent, R. W., Brown, S. D., Nota, L., & Soresi, S. (2003). Testing social cognitive interest and choice hypotheses across Holland types in Italian high school students. *Journal of Vocational Behavior, 62*, 101-118.

Lent, R. W., Brown, S. D., Sheu, H. B., Schmidt, J., Brenner, B. R., Gloster, C. S., Wilkins, G., Schmidt, L. C., Lyons, H., & Treistman. (2005). Social cognitive predictors of academic interests and goals in engineering: Utility for women and students at historically Black universities. *Journal of Counseling Psychology*, *52*, 84-92.

Lent, R. W., & Lopez, F. G. (1992). Sources of math self-efficacy in high school students. *The Career Development Quarterly*, *41*, 3-12.

Lent, R. W., Lopez, F. G., & Bieschke, K. J. (1991). Math self-efficacy: Sources and relation to science-based career choice. *Journal of Counseling Psychology, 38*, 424-430.h

Lent, R. W., Lopez, F. G., & Bieschke, K. J. (1993). Predicting math-related choice and success behaviors: Tests of an expanded social cognitive model. *Journal of Vocational Behavior, 42*, 223-236.

Lent, R. W., Lopez, F. G., Brown, S. D., & Gore, P. A., Jr. (1996). Latent structure of math self-efficacy. *Journal of Vocational Behavior, 49*, 292-308.

Lent, R. W., Singley, D., Sheu, H. B., Schmidt, J. A., & Schmidt, L. C. (2007). Relation of social-cognitive factors to academic satisfaction in engineering students. *Journal of Career Assessment, 15*, 87-97.

Leuwerke, W. C., Robbins, S., Sawyer, R., & Hovland, M. (2004). Predicting engineering major status from math achievement and interest congruence. *Journal of Career Assessment*, *12*, 135-149.

Lindley, L. D. (2006). The paradox of self-efficacy: Research with diverse populations. *Journal of Career Assessment, 14*, 143-160.

Lippa, R. (1998). Gender-related individual differences and the structure of vocational interests: The importance of the people-things dimension. *Journal of Personality and Social Psychology, 74*, 996-1009.

Lopez, F. G., & Lent, R. W. (1992). Sources of math self-efficacy in high school students. *Career Development Quarterly, 41*, 3-12.

MacKinnon, D. P., Lockwood, C. M., Hoffman, J. M., West, S. G., & Sheets, V. (2002). A comparison of methods to test mediation and other intervening variable effects. *Psychological Methods, 7,* 83–104.

Mayorova, T., Stevens, F., Scherpbier, A., van der Velden, L., & van der Zee, J. (2005). Gender-related differences in general practice preferences: Longitudinal evidence from the Netherlands 1982-2001. *Health Policy, 72,* 73-80.

Matsui, T., Matsui, K., & Ohnishi, R. (1990). Mechanisms underlying math self-efficacy learning of college students. *Journal of Vocational Behavior, 37*, 225-238.

McHarg, J., Mattick, K., & Knight, L. V. (2007). Why people apply to medical school: Implications for widening participation activities. *Medical Education, 41*, 815-821.

Miller, P. H., Blessing, J. S., & Schwartz, S. (2006). Gender differences in high school students' views about science. *International Journal of Science Education, 28,* 363-381.

Multon, K. D., Brown, S. D., & Lent, R. W. (1991). Relation of self-efficacy beliefs to academic outcomes: A meta-analytic investigation. *Journal of Counseling Psychology, 38*, 30-38.

Nauta, M. M., Kahn, J. H., Angell, J. W., & Cantarelli, E. A. (2002). Identifying the antecedent in the relation between career interests and self-efficacy: Is it one, the other, or both? *Journal of Counseling Psychology, 49*, 290-301.

Nota, L. Ferrari, L., Solberg, V. S., & Soresi, S. (2007). Career search self-efficacy, family support, and career indecision with Italian youth. *Journal of Career Assessment, 15,* 181-194.

Ozyurek, R. (2001). Global career self-efficacy measurement and its practicing in career counseling. *Kuram ve Uygulamada Egitim Yonetimi, 28*, 557-571.

Ozyurek, R. (2002). Issues of gloval and specific self-efficacy measurements similarity and differences and their practice in career counseling. *Kuram ve Uygulamada Egitim Yonetimi, 30*, 253-270.

Ozyurek, R. (2005). Informative sources of math-related self-efficacy expectations and their relationship with math-related self-efficacy, interest, and preference. *International Journal of Psychology, 40,* 145-156.

Rottinghaus, P. J., Larson, L. M., & Borgen, F. H. (2003). The relation of self-efficacy and interests: A meta-analysis of 60 samples. *Journal of Vocational Behavior, 62*, 221-236.

Russell, D., & Cutrona, C. (1984, August). *The provisions of social relationships and adaptation to stress.* Paper presented at the American Psychological Association Convention, Toronto, Canada.

Satorra, A. & Bentler, P. M. (2001). A scaled difference chi-squire test statistic for moment structure analysis. *Psychometrika, 66*, 507-514.

Schaub, M., & Tokar, M. (2005). The role of personality and learning experiences in social cognitive career theory. *Journal of Vocational Behavior, 66,* 304-325.

Scott, A. B., Mallinckrodt, B. (2005). Parent emotional support, science self-efficacy, and choice of science major in undergraduate women. *The Career Development Quarterly*, 53, 263-273.

Shrout, P. E., & Bolger, N. (2002). Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods, 7*, 422-445.

Smith, P. L., & Fouad, N. A. (1999). Subject-matter specificity of self-efficacy, outcome expectations, interests, and goals: Implications for the social-cognitive model. *Journal of Counseling Psychology, 46*, 461-471.

Stake, J. E. (2006). The critical mediating role of social encouragement for science motivation and confidence among high school girls and boys. *Journal of Applied Social Psychology, 36,* 1017-1045.

Steele, C. M. (1997). A threat in the air: How stereotypes shape intellectual identity and performance. *American Psychologist, 52*, 613-629.

Straus, S. E., Straus, C. S., & Tzanetos, K. (2006). Career choice in academic medicine. *Journal of General Internal Medicine, 21,* 1222-1229.

Tracey, T. J. (2002). Development of interests and competency beliefs: A 1-year longitudinal study of fifth- to eighth-grade students using the ICA-R and structural equation modeling. *Journal of Counseling Psychology, 49*, 148-163.

Tracey, T. J., & Darcy, M. (2002). An idiothetic examination of vocational interests and their relation to career decidedness. *Journal of Counseling Psychology, 49*, 420-427.

Usher, E. L., & Pajares, F. (2005). Sources of academic and self-regulatory efficacy beliefs of entering middle school students. *Contemporary Educational Psychology, 31,* 125-141.

Waller, B. (2005). Math interest and choice intentions of non-traditional African-American college students. *Journal of Vocational Behavior, 68,* 538-547.

Williams, C. M., & Subich, L. M. (2006). The gendered nature of career related learning experiences: A social cognitive career theory perspective. *Journal of Vocational Behavior, 69,* 262-275.

Wintre, M. G., & Bowers, C. D. (2007). Predictors of persistence to graduation: Extending a model and data on the transition to university model. *Canadian Journal of Behavioural Science, 39,* 220-234.

Wong, C., Law, K. S. (2002). The effects of leader and follower emotional intelligence on performance and attitude: An exploratory study. *Leadership Quarterly, 13,* 243-273.

Young, K., Bailey, D., Boysen, G., Quinn, A., Robinson, R. Ruxton, B., Seeman, J., Spencer, K., & Larson, L. M. (2004, August). *Outcome Expectancy in the Career and Academic Domain: A Review*. Poster presented at the American Psychological Association National Convention, Honolulu, Hawaii.

Table 1
Frequencies, Percentages, Means and Standard Deviations on Demographic Variables (n=245)

Variable	Frequency	Percent %	Mean	S.D.
Gender				
Male	88	35.9		
Female	149	60.8		
Missing	7	2.9		
Post-Graduate Plans				
Pre-Medicine	113	46.0		
Not Pre-Medicine	131	54.0		
Age			18.49	.60
Marital Status				
Single	242	98.8		
Married	2	.8		
Divorced/Separated	1	.4		
Racial/Ethnic Background				
African American	9	3.7		
Asian American	10	4.1		
Caucasian/White	206	84.1		
Hispanic American	9	3.7		
International Student	3	1.2		
Other (ex: biracial)	7	2.9		
Prior Performance				
Semesters of HS math taken				
Men			8.73	1.47
Women			8.41	1.61
Semesters of HS science taken				
Men			9.22	1.78
Women			8.82	1.81
HS math GPA				
Men			3.19	.69
Women			3.38	.55
HS science GPA				
Men			3.42	.50
Women			3.47	.50

Table 1 (continued)

Variable	Frequency	Percent %	Mean	S.D.
HS GPA				
Men			3.54	.42
Women			3.65	.35
Number of College math classes taken				
Men			.19	.48
Women			.15	.48
Number of College science classes taken				
Men			.33	.91
Women			.31	.91
ACT Composite scores				
Men			24.48	3.82
Women			23.57	4.13

Note: HS = high school, GPA = grade point average.

Table 2

Internal Consistency Reliability of Sources of Academic Self-Efficacy Subscales

Source	Example of items	No. of items	Internal Consistency Reliability *Current Study (only math/sci)*	*Anderson & Betz (2001)*
Mastery	"I have always done well in school."	10	.82	.80
Modeling	"Many adults that I know have good academic abilities."	9	.71	.77
Social Persuasion	"People have told me that I'm a good student."	10	.83	.87
Anxiety	"I was uncomfortable taking tests in school."	9	.79	.91

Note: sci = science

Table 3

Means, Standard Deviations, and Intercorrelations for Measured Variables

	M	SD	Range	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. PERF	4.32	.82	1-6	**.55**	**.73**	**-.32**	**.26**	**.25**	**.33**	**.50**	**.40**	**.32**	**.25**	.13	.16	**.38**	**.41**
2. MODEL	4.51	.76	1-6	--	**.61**	**-.24**	.13	.01	.14	**.25**	**.39**	**.38**	**.18**	**.17**	.08	**.23**	**.21**
3. SOCPER	4.79	.78	1-6		--	-.11	**.19**	**.21**	**.22**	**.42**	**.49**	**.40**	.11	.09	.07	**.29**	**.29**
4. ANX	3.78	.88	1-6			--	**-.20**	-.01	**-.25**	**-.23**	-.06	-.09	**-.27**	**-.19**	-.02	-.07	-.11
5. MaSci SE	4.49	1.04	1-6				--	**.28**	**.42**	**.34**	.10	.15	**.33**	**.36**	.14	**.23**	.17
6. MaSciOE	4.20	.83	1-6					--	**.44**	**.40**	.05	.080	.11	.13	.13	.12	.06
7. Sci INT	4.05	.86	1-6						--	**.70**	.06	.16	**.27**	**.26**	**.28**	.06	.10
8. Sci GO	4.94	1.00	1-6							--	**.23**	**.22**	.15	.16	**.21**	.13	.15
9. MomSup	4.80	1.19	1-6								--	.52	.03	.05	.01	.15	.09
10.DadSup	4.82	1.26	1-6									--	.04	.09	-.07	.08	.13
11. ACT	23.9	3.99	13-34										--	**.52**	.13	**.44**	**.45**
12. HS Ma ct	8.53	1.57	4-16											--	**.18**	**.39**	**.34**
13. HS Sci ct	8.99	1.84	5-14												--	**.20**	**.21**
14. Ma GPA	3.31	.60	1.34-4.00													--	**.76**
15. Sci GPA	3.46	.50	1.73-4.00														--

Note: PERF = SASE Past Performance, MODEL = SASE Modeling SOCPER = SASE Social Persuasion, ANX = SASE Anxiety (high score indicates high negative emotion), MaSci SE = FSS math/science Self-Efficacy, MaSci OE = FSS math/science outcome expectations, Sci INT = FSS science interests, Sci GO = FSS science goals, MomSup = SPS-P mother support, DadSup = SPS-P father support, ACT = ACT composite score, HS Ma ct = number of semesters of high school math taken, HS Sci ct = number of semesters of high school science taken, Ma GPA = average grades earned in high school math classes on a 4.0 scale, Sci GPA = average grades earned in high school science classes on a 4.0 scale. Higher numbers indicate higher reporting on each variable. Correlations in bold indicate significance at the $p < .01$ level.

Table 4

Intercorrelations of Measured Variables for Males and Females

M/F	Men Mean	Men SD	Women Mean	Women SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. MODEL	4.30	.73	4.65	.75	--	**.59**	**-.28**	.14	-.03	**.25**	**.31**	**.33**	**.34**	.12	.14	.04	.12	.15
2. SOCPER	4.56	.77	4.92	.76	**.60**	--	-.11	.21	.16	**.29**	**.42**	**.50**	**.40**	.07	.09	.06	.17	.20
3. ANX	3.53	.89	3.92	.86	**-.37**	-.27	--	-.15	.03	**-.27**	**-.23**	-.05	-.04	**-.23**	-.16	-.11	-.08	-.15
4. MaSci SE	4.53	1.22	4.46	.93	.17	.21	-.26	--	**.26**	**.44**	**.39**	.14	**.22**	**.36**	**.40**	.11	.13	.15
5. MaSci OE	4.16	.94	4.22	.77	.04	.26	-.04	**.29**	--	**.43**	**.33**	.02	.01	.09	.13	.13	.04	-.02
6. Sci INT	4.34	.80	3.87	.86	.11	**.29**	-.11	**.39**	**.53**	--	**.70**	.03	.19	**.22**	**.23**	**.25**	.01	.07
7. Sci GO	4.93	1.00	4.93	1.02	.19	**.45**	-.27	**.29**	**.52**	**.70**	--	.16	.15	.12	.11	**.25**	-.01	.07
8.MomSup	4.73	1.04	4.86	1.26	**.48**	**.49**	-.17	.11	.11	.18	**.38**	--	**.45**	.04	.01	.01	.15	.11
9.DadSup	4.75	1.05	4.85	1.39	**.45**	**.40**	-.26	.08	.19	.15	**.37**	**.72**	--	.06	.12	-.12	.04	.10
10. ACT	24.48	3.82	23.57	4.13	**.39**	.27	**-.32**	**.29**	.17	**.32**	.21	.02	.04	--	**.50**	.15	**.48**	**.47**
11.HS Ma ct	8.73	1.47	8.41	1.61	**.30**	.22	-.22	**.29**	.16	**.28**	**.32**	.17	.10	**.53**	--	.18	**.38**	**.33**
12.HS Sci ct	9.21	1.78	8.82	1.82	.14	.17	.13	.14	.17	.27	.18	.05	.01	.07	.14	--	**.26**	.11
13. Ma GPA	3.19	.69	3.38	.55	**.32**	**.40**	-.16	**.33**	.20	.22	**.31**	.14	.15	**.46**	**.53**	.13	--	**.77**
14. Sci GPA	3.42	.50	3.47	.50	**.29**	**.42**	-.09	.19	.18	.18	**.28**	.09	.16	**.44**	**.42**	**.33**	**.75**	--

Note: Correlations for females (n=149) are indicated above the diagonal; correlations for males (n=88) are indicated below the diagonal. MODEL = SASE Modeling SOCPER = SASE Social Persuasion, ANX = SASE Anxiety (high score indicates high negative emotion), SciMa SE = FSS math/science Self-Efficacy, SciMa OE = FSS math/science outcome expectations, Sci INT = FSS science interests, Sci GO = FSS science goals, MomSup = SPS-P mother support, DadSup = SPS-P father support, ACT = ACT composite score, HS Ma ct = number of semesters of high school math taken, HS Sci ct = number of semesters of high school science taken, Ma GPA = average grades earned in high school math classes on a 4.0 scale, Sci GPA = average grades earned in high school science classes on a 4.0 scale. Higher numbers indicate higher reporting on each variable. Correlations in bold indicate significance at the $p < .01$ level. Underlined means indicate a significant mean difference between men and women at $p < .05$

Table 5

Fit Indices for All Models

Fit Indices	Hypothesis 1 Men/Women Combined	Hypothesis 2 Men Only	Hypothesis 2 Women Only	Abbrev. model Men/women Combined	Abbrev. model Men Only	Abbrev. model Women Only	Self-report Men/women Combined
Standard χ^2	142.84	93.03	105.88	12.49	9.57	17.29	157.50
Scaled χ^2	124.98	91.63	101.25	11.00	9.89	14.30	148.41
df	53	53	53	10	10	10	59
N	245	88	149	245	88	149	245
CFI	.95	.92	.93	.99	1.00	1.00	.96
RMSEA	.075	.092	.078	.02	.00	.00	.079
Standardized RMR	.078	.11	.084	.019	.027	.029	.084

Note: CFI = comparative fit index; RMSEA = root-mean-square error of approximation. Standardized RMR = standardized root mean square residual.

Table 6
Bootstrap Analysis of Magnitude and Statistical Significance of Indirect Effects

Indirect Effect IV → Mediator → DV	β Standardized Indirect Effect	95% CI Lower	95% CI Upper	*N*
Sci/Ma SE → Sci Int → Sci Goals	(.34)x(.74) = .25	.1558	.3838*	245
Sci/Ma OE → Sci Int → Sci Goals	(.46)x(.71) = .33	.2214	.4654*	245
SocPer → Sci/Ma SE → Sci Int	(.25)x(.32) = .08	.0185	.1699*	245
MaExp → Sci/Ma SE → Sci Int	(.24)x(.31) = .07	.0338	.1264*	245
SciExp → Sci/Ma OE → Sci Int	(.06)x(.42) = .02	.0032	.0512*	245
Model → Sci/Ma OE → Sci Int	(.01)x(.45) = .01	-.0658	.0728	245
SocPer → Sci/Ma OE → Sci Int	(.22)x(.43) = .09	.0261	.2078*	245
ACT → SciExp → Sci/Ma OE	(.06)x(.05) = .0031	.0002	.0091*	245

Note: CI = Confidence interval; SE = FSS math/science self-efficacy; OE = FSS math/science outcome expectations; IN = FSS math/science interests; SocPer = SASE Social Persuasion; Model = SASE modeling; SciExp = number of semesters of high school science taken; MaExp = number of semesters of high school math taken; ACT = ACT composite score; Ma = Math; Sci = Science.
* = $p < .05$ (excluding zero)

Table 7

Bootstrap Analysis of Magnitude and Statistical Significance of Direct Effects

Direct Effect IV → DV	β Standardized Direct Effect	95% CI Lower	95% CI Upper	*N*
Parent Support → Mastery	.224	-.319	.873	245
Parent Support → Model	.318	.130	.559*	245
Parent Support → SocPer	.518	.327	.731*	245
Parent Support → Anx	-.350	-.621	-.105*	245
ACT → Mastery	.591	.214	.856*	245
ACT → Model	.202	.162	.247*	245
ACT → SocPer	.580	.105	.967*	245
ACT → Anx	-.593	-.848	-.317*	245
ACT → MaExp	.528	.411	.646*	245
ACT → SciExp	.426	.243	.646*	245
Mastery → SE	.118	-.225	.485	245
Model → SE	-.097	-.302	.137	245
SocPer → SE	.218	-.257	.444	245
Anx → SE	-.166	-.305	-.033*	245
SciExp → SE	.036	-.034	.104	245
MaExp → SE	.203	.095	.288*	245
Mastery → OE	-.055	-.343	.265	245

Note: CI = Confidence interval; SE = FSS math/science self-efficacy; OE = FSS math/science outcome expectations; INT = FSS math/science interests; Goals = FSS math/science goals; Mastery = SASE Mastery, SocPer = SASE Social Persuasion; Model = SASE modeling, Anx = SASE anxiety; SciExp = number of semesters of high school science taken; MaExp = number of semesters of high school math taken; ACT = ACT composite score; Ma = Math; Sci = Science.

* = p < .05 (excluding zero)

Table 7 (continued)
Bootstrap Analysis of Magnitude and Statistical Significance of Direct Effects

Direct Effect IV → DV	β Standardized Direct Effect	95% CI Lower	95% CI Upper	*N*
Anx → OE	.032	-.090	.150	245
Model → OE	-.208	-.392	-.014*	245
SocPer → OE	.295	.086	.491*	245
SciExp → OE	.038	-.319	.090	245
MaExp → OE	.029	-.043	.102	245
SE → OE	.182	.053	.308*	245
SE → INT	.262	.153	.391*	245
OE → INT	.360	.234	.483*	245
SE → Goals	.060	-.561	.166	245
OE → Goals	.146	-.107	.269	245
INT → Goals	.684	.543	.819*	245

Note: CI = Confidence interval; SE = FSS math/science self-efficacy; OE = FSS math/science outcome expectations; INT = FSS math/science interests; Goals = FSS math/science goals;; Mastery = SASE Mastery, SocPer = SASE Social Persuasion; Model = SASE modeling, Anx = SASE anxiety; SciExp = number of semesters of high school science taken; MaExp = number of semesters of high school math taken; ACT = ACT composite score; Ma = Math; Sci = Science.
* = $p < .05$ (excluding zero)

APPENDIX A

INFORMED CONSENT DOCUMENT

Title of Study: Predictors of Academic Success
Investigators:

1. Lisa M. Larson	Professor, Psychology	IRB training 11/01/2000
2. Jim Werbel	Professor, Management	IRB training 8/5/2003
3. Donna Bailey	Research Coordinator	IRB training 8/27/2003

This is a research study. Please take your time in deciding if you would like to participate. Please feel free to ask questions at any time.

INTRODUCTION

The purpose of this study is to learn more about how your confidence, interests, and commitment across a variety of academic subjects relate to your academic success as a pre-med student. This is a longitudinal study in that we will want to collect follow up information about your success as a pre-med student. You are being invited to participate in this study because you are at least 18 years old and have expressed interest as pre-med student at Iowa State University.

DESCRIPTION OF PROCEDURES

If you agree to participate in this study, your participation will involve participating in this session that will last for no less than 20 minutes and no more than 30 minutes. Second, you would give us permission to access your high school transcript, your ACT score, and your grades here at ISU while you are attending ISU. This will allow us to track academic achievement and see how it relates to other important career variables. Finally, we will ask your permission to contact you at several points during your stay here at ISU. Today, we will ask you to complete some demographic information about yourself, including some questions about your career and educational major. In addition, you will complete five brief questionnaires about your confidence across many different domains (e.g., your confidence in math), your goals, interests, potential career outcomes, and parent support. We are only interested in how the group as a whole responds and not how you, as an individual responds. We are asking you to provide your name, social security number, and email address so that we can contact you during your time at ISU and also so that we can match your responses with the information we obtain from the registrar (e.g., ACT score). Your identifying information will not be stored with your responses and will be accessed only by the senior authors, Drs. Larson and Werbel, or by someone they explicitly supervisee in order to complete the matching. After our follow up is completed, we will destroy identifying information.

Finally, You may skip any question that you do not wish to answer or that makes you feel uncomfortable. Also, you are free to withdraw from the testing session at any time and be awarded credit for your participation.

RISKS

If you decide to participate in this study, there are no foreseeable risks at this time from participating in this study other than increased self-awareness that may cause minimal distress for a small subset of students. If you are one of those students, there is free vocational exploration available at the Student Counseling Services (294-5056).

BENEFITS

If you decide to participate in this study there will be one direct benefit, namely you may become more self-aware about your confidence, interests, goals, and career outcomes to pursue a variety of occupations and be more thoughtful about your career plans. The other benefit is to society in general. It is hoped that the information gained in this study will benefit society by helping researchers and practitioners better understand how confidence to pursue certain occupations affects the career decisions we make.

COSTS AND COMPENSATION

There are no costs or compensation for participation in this study.

PARTICIPANT RIGHTS

Your participation in this study is completely voluntary and you may refuse to participate or leave the study at any time. If you decide to not participate in the study or leave the study early, it will not result in any penalty or loss of benefits to which you are otherwise entitled.

CONFIDENTIALITY

Records identifying participants will be kept confidential to the extent permitted by applicable laws and regulations and will not be made publicly available. However, the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy your records for quality assurance and data analysis. These records may contain private information.

To ensure confidentiality to the extent permitted by law, the following measures will be taken. Participants will be assigned a unique code and letter and will be used on forms instead of their name. Your identifying information will not be stored with your responses and will be accessed only by the senior authors, Drs. Larson and Werbel, or by someone they explicitly supervisee in order to complete the matching. After our follow up is completed, we will destroy identifying information within 5 years. If the results are published, your identity will remain confidential.

QUESTIONS OR PROBLEMS

You are encouraged to ask questions at any time during this study. For further information about the study contact Dr. Lisa M. Larson (294-1487 or lmlarson@iastate.edu), Jim Werbel (294-2717 or jwerbel@iastate.edu). If you have any questions about the rights of research subjects, please contact the Human Subjects Research Office, 2810 Beardshear Hall, (515) 294-4566; austingr@iastate.edu or the Research Compliance Officer, Office of Research Compliance, 2810 Beardshear Hall, (515) 294-3115; dament@iastate.edu

****

PARTICIPANT SIGNATURE

Your signature indicates that you voluntarily agree to participate in this study, that the study has been explained to you, that you have been given the time to read the document and that your questions have been satisfactorily answered. You also understand that your signature below indicates you have given the researchers permission to access your high school and/or community college transcript, your ACT score, and subsequent grades and enrollment status while enrolled at Iowa State University from the registrar's office. You will receive a copy of the signed and dated written informed consent prior to your participation in the study.

Participant's Name (printed) ____

_____________________________________ ____________________

(Participant's Signature) (Date)

INVESTIGATOR STATEMENT

I certify that the participant has been given adequate time to read and learn about the study and all of their questions have been answered. It is my opinion that the participant understands the purpose, risks, benefits and the procedures that will be followed in this study and has voluntarily agreed to participate.

_____________________________________ ____________________

(Signature of Person Obtaining Informed Consent) (Date)

APPENDIX B:

Item numbers	Scale
1-7	Demographics
8-15	Medical experience
16-24	Science and Math Self-efficacy (FSS, Fouad & Smith, 1999)
25-71	Interests in four academic domains (FSS, Fouad & Smith, 1999)
72-80	Science and Math Outcome expectations (FSS, Fouad & Smith, 1999)
81-89	Science and Math Goals (FSS, Fouad & Smith, 1999)
90	Pre-med
91-92	Parent support of pre-med major
93-94	Future parenting plans
95-114	Emotional Intelligence
115-138	Career Commitment
139-150	Parent Support (SPSM, SPSF; Russell & Cutrona, 1984)
151-156	Career decidedness
157-194	Sources of Academic Self-Efficacy (Anderson & Betz, 2001)

Please complete the following information in the indicated spaces:

1. NAME: in the space labeled “NAME” on the first answer sheet.

2. MIDDLE 9 NUMBERS OF YOUR ISU CARD: in the space labeled “IDENTIFICATION NUMBER B-J” spaces on both answer sheets.

For example, the student below would fill in “141456789” in Identification Number B-J.

600957 141456789 20
Jane Q. Doe

3. SEX: in the space labeled “SEX”.

4. MONTH, DAY, and YEAR OF BIRTH: in the space labeled “BIRTH DATE”.

Answer the following questions beginning with question #1 on the 1st answer sheet

1. Please indicate your ethnicity on the answer sheet:
    1. Caucasian/White
    2. African-American
    3. Hispanic-American
    4. Asian-American
    5. Native American
    6. International Student
    7. Other (example: bi-racial)

2. Your Marital Status
   1. Single
   2. Married
   3. Divorced/Separated

3. Major Choice Status (choose only one)
   1. I am undecided about a major
   2. I am tentatively decided about a major
   3. I have decided on a major.

4. Have you declared a major?
   1. Yes
   2. No

5. What is your career choice status (choose only one):
   1. I am undecided about a career
   2. I am tentatively decided about a career
   3. I have decided on a career.

6. What is your current standing in school?
   1. Freshman
   2. Sophomore
   3. Junior
   4. Senior
   5. Graduate Student

7. What are your current educational aspirations: (Bubble in the appropriate number on your answer sheet)
   1. Some college/no degree
   2. Associate Degree
   3. Bachelor's Degree
   4. Master's Degree
   5. Medical Degree (e.g., MD, OD)
   6. Doctorate (Ph.D)
   7. Law Degree (JD)

Please indicate the extent to which you agree or disagree with the statements below by filling in the appropriate bubble (choose a "1", "2", or "3") on your answer sheet.

1= I have and do plan to do these activities
2= I have not done these activities but I plan to do them in the next year
3= I have not done these activities and do not plan to do them in the near future.

8. Shadowed a health care professional.
9. Completed an externship with a health care professional.
10. Interviewed a health care professional about their work.
11. Volunteered in a health care facility (hospital, nursing home, hospice, etc.).
12. Had a family member who is a health care professional.
13. Joined an organization associated with health care.
14. Attended organizational meetings of an organizational associated with health.
15. Taken certification courses (such as CPR, etc.).

Please indicate the extent to which you agree or disagree that you could do each statement below by filling-in the appropriate bubble (“1”, “2”, “3”, “4”, “5”, or “6”) on the answer sheet.

1=Very Strongly Disagree	2= Mostly Disagree	3= Slightly Disagree
4= Slightly Agree	5= Mostly Agree	6= Very Strongly Agree

I feel confident that <u>with the proper training I could</u>:

16. Classify animals that I observe.
17. Earn an A in a calculus course.
18. Earn an A in a college physics course.
19. Figure out the amount of wall paper needed to cover a room.
20. Earn an A in Chemistry.
21. Keep financial records and determine how much to spend for an ISU student organization.
22. Figure out how long it will take to travel from Des Moines to St. Louis, driving 55 mph.
23. Design and describe a chemistry experiment that I want to do.
24. Earn an A in an advanced calculus course.

Please indicate the extent to which you agree or disagree with the statement below by filling-in the appropriate bubble (“1”, “2”, 3”, “4”, “5”, or “6”) on the answer sheet.

1=Very Strongly Dislike	2= Mostly Dislike	3= Slightly Dislike
4= Slightly Like	5= Mostly Like	6= Very Strongly Like

25. Scripting a funny radio commercial.
26. Working as an astronomer.
27. Working with juveniles on probation.
28. Joining a book discussion group.
29. Taking classes in science.
30. Visiting a science museum.
31. Reading a novel.
32. Writing an article for the student newspaper.
33. Listening to a famous scientist talk.

34. Visiting a museum of natural history.
35. Editing short stories.
36. Singing a song in public.
37. Reading poetry.
38. Making a music video.
39. Narrating a play.
40. Solving computer problems.
41. Having a pen-pal.
42. Telling ghost stories to younger children.
43. Solving math problems.
44. Creating new technology.
45. Working word puzzles.
46. Working as a chemist.
47. Reading a biography.
48. Joining a science club.
49. Learning about local history.
50. Reading about science discoveries.
51. Organizing a political rally.
52. Designing art work for a magazine.
53. Working as a physician.
54. Learning about the Federal budget.
55. Working with plants and animals.
56. Working in a science laboratory.
57. Doing research to understand political revolutions.
58. Being a peer mediator.
59. Learning about energy and electricity.
60. Serving in student government.
61. Carving figures of people or animals.
62. Taking math classes.
63. Dancing.
64. Working in a medical lab.
65. Being a member of a community theater group.
66. Working with clay.
67. Inventing.
68. Doing the sound effects for a commercial.
69. Watching a science program on TV.
70. Using a calculator.
71. Writing short stories or articles.

Please indicate the extent to which you agree or disagree with the statement below by filling-in the appropriate bubble (“1”, “2”, 3”, “4”, “5”, or “6”) on the answer sheet.

1=Very Strongly Disagree	2= Mostly Disagree	3= Slightly Disagree
4= Slightly Agree	5= Mostly Agree	6= Very Strongly Agree

72. If I get good grades in chemistry, then my friends will approve of me.
73. If I get good grades in calculus at ISU, then my parents will be pleased.
74. If I take a lot of math classes at ISU, then I will be better able to achieve my future

goals.

75. If I do well in science courses at ISU, then I will be better prepared for the work world.
76. If I learn math well, then I will be able to do lots of different types of careers.
77. If I take a math course at ISU, then I will increase my grade point average.
78. If I do well in science classes at ISU, then I will do better in life.
79. If I get good grades in science at ISU, then my parents will be pleased.
80. If I get good grades in math at ISU, then my friends will approve of me.
81. I am committed to study hard in my calculus courses at ISU.
82. I plan to take more science courses at ISU than will be required of me.
83. In the future I plan to volunteer time to help others.
84. I plan to take more math classes at ISU than will be required of me.
85. I am committed to study hard in my science courses.
86. I intend to enter a career that will use math.
87. I am determined to use my science knowledge in my future career.
88. Learning about different cultures will be beneficial to my career.
89. I intend to enter a career that will use science.
90. I consider myself a premed student.
91. My father wants me to be a premed student.
92. My mother wants me to be a premed student.
93. I plan to be a parent.
94. I plan to stay at home with my children when they are small (under 5 years old).
95. I have a good sense of why I have certain feeling most of the time.
96. I have a good understanding of my own emotions.
97. I really understand what I feel.
98. I always know whether or not I am happy.
99. I always know my friends' emotions from their behavior.
100. I am a good observer of others' emotions.
101. I am sensitive to the feelings and emotions of others.
102. I have a good understanding of the emotions of people around me.
103. I am able to control my temper so that I can handle difficulties rationally.
104. I am quite capable of controlling my own emotions.
105. I can always calm down quickly when I am very angry.
106. I have good control of my emotions.
107. I am strong enough to overcome life's struggles.
108. At root, I am a weak person.
109. I can handle the situations that life brings.
110. I usually feel that I am an unsuccessful person.
111. I often feel that there is nothing that I can do well.
112. I feel competent to deal effectively with the real world.
113. I often feel like a failure.
114. I usually feel I can handle the typical problems that come up in life.

Please indicate the extent to which you agree or disagree with the statement below by filling-in the appropriate bubble ("1", "2", 3", "4", "5", or "6") on the answer sheet.

1=Very Strongly Disagree 2= Mostly Disagree 3= Slightly Disagree
4= Slightly Agree 5= Mostly Agree 6= Very Strongly Agree

115. My career field is an important part of who I am.
116. This career field has a great deal of personal meaning to me.
117. I do not feel "emotionally attached" to this career field.
118. I have created a plan for my development in this career field.
119. I do not have a strategy for achieving my goals in this career field.
120. I strongly identify with my chosen career field.
121. I do not identify specific career goals for my development in this career field.
122. I do not often think about my personal development in this career field.
123. The costs associated with my career field sometimes seem too great.
124. Given the problems I encounter in the career field, I sometimes wonder if I will get enough out of it.
125. Given the problems in this career field, I sometimes wonder if the personal burden is worth it.
126. The discomforts associated with my career field sometimes seem too great.
127. I do not feel a strong sense of belonging to this career field.
128. I frequently tell people how great my career field is.
129. I readily learn new techniques and procedures with my career field.
130. The benefits of this career field outweigh its costs.
131. I am constantly trying to improve the skills I need in my career field.
132. I feel irresponsible if I do not keep up with the developments within my career field.
133. Though my career field has its difficulties, I will continue to try hard.
134. I will continue to work hard in my career field, despite its problem areas.
135. When I initially meet others, I usually don't tell them my career field.
136. In social settings, I rarely discuss my career field.
137. I often discuss my career field with people outside of it.
138. I know I need to reach my goals in this career field.
139. I can depend on my mother to help me if I really need it.
140. I CANNOT turn to my mother for guidance in times of stress.
141. My mother recognizes my competence and skill.
142. I have a close relationship with my mother that provides me with a sense of emotional security and well-being.
143. I feel that my mother shares my attitudes and beliefs.
144. I can talk to my mother about important decisions in my life.
145. I can depend on my father to help me if I really need it
146. I CANNOT turn to my father for guidance in times of stress.
147. My father recognizes my competence and skill.
148. I have a close relationship with my father that provides me with a sense of emotional security and well-being.
149. I feel that my father shares my attitudes and beliefs.
150. I can talk to my father about important decisions in my life.
151. I am exploring a number of different majors.

152. I sense that there are a number of majors that might be good for me.
153. Premed is really the only career option I am considering.
154. Since there are other good majors for me, it's hard for me to decide which one is best.
155. It is important to decide your major early if you are a premed student.

Please indicate the extent to which you agree or disagree with the statement below by filling-in the appropriate bubble ("1", "2", 3", "4", "5", or "6") on the answer sheet.

1=Very Strongly Disagree	2= Mostly Disagree	3= Slightly Disagree
4= Slightly Agree	5= Mostly Agree	6= Very Strongly Agree

156. I sense my best fit with career options is with premed.
157. Thinking about first semester grades make me nervous.
158. I was uncomfortable taking tests in school.
159. I get a sinking feeling when I think of succeeding at school.
160. I get really uptight when I have a lot of homework to do.
161. I almost never get uptight about studying.
162. I usually don't worry about how I'll do in my classes.
163. Studying makes me feel uneasy and confused.
164. Studying makes me feel uncomfortable and nervous.
165. Taking tests makes nervous.
166. People have told me that I am a good student.
167. My peers have told me that I have good study skills.
168. I received strong encouragement to do well in school as a child.
169. Older people have told me that I have good study skills.
170. Other people see my as doing poorly in school.
171. My parent(s) encouraged me to be proud of my academic success.
172. I was encouraged to use my academic skills to assist me with my career choice.
173. High school teachers rarely complimented me on my ability to be a good student.
174. My parents encouraged me to be a good student.
175. My teachers have told me that I have good study skills.
176. My favorite teachers are strong academically.
177. Many of the adults I admire have strong academic skills.
178. My career role model did poorly in school.
179. My friends tend to avoid academic excellence.
180. My parents are not strong academically.
181. Many adults I know have good academic abilities.
182. Many of my friends are pursuing work that does not require academic skills.
183. My parents succeeded in college.
184. I know few people who are talented in getting good grades.
185. I always had difficulty getting good grades.
186. I always do well in my courses.
187. I have always been attracted to books.
188. I always feel like I know what I am doing at school.
189. School has always been difficult for me.

190. I did worse in school than most of my high school acquaintances.
191. When I don’t understand something at school, I work at it until I understand it.
192. I always have had good study skills.
193. I have tried to improve my ability to do well in school whenever I could.
194. I have always done well in school.