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Gender differences in subject-specific academic performance predicted by self-efficacy and interests of 12th grade Indian students

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Gender differences in subject-specific academic performance predicted by self-efficacy and interests of 12th grade Indian students

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ABSTRACT

While in the United States, more and more women are now entering the previously male-dominated science, technology, engineering and mathematics (STEM) professions, not much vocational research on women in STEM careers has been conducted in India, where the traditionally patrifocal culture typically affords limited career choices and educational opportunities to women. This study used structural equation modeling (SEM) to assess potential gender differences in subject-specific self-efficacy, interests and academic performance of 316 high school students from a large city in India. The influence of other contextual factors such as tracking and parental education was also examined. Results indicated definite gender differences in academic performance, self-efficacy and interests in various academic subjects. The female students in this sample show higher confidence and better performance (in all examined academic subjects) than their male counterparts. Significant differences between academic tracks in self-efficacy, interests and academic performance were also observed. The results of this study also emphasize the effects of tracking of the students into specific educational paths on their academic achievement. Implications for counseling with Asian Indian high school students and future research directions are discussed.

CHAPTER ONE: INTRODUCTION

The Social Cognitive Theory, (SCT; Bandura, 1986) postulates that human behavior is a dynamic and reciprocal interaction of personal factors, behavior, and the environment. SCT also states that a person's behavior is influenced by both personal and environmental factors. In addition, SCT posits that individuals observe consequences of engaging in similar behavior both themselves and by others and form expectations of the outcomes of their behavior. The social cognitive career theory (SCCT; Lent, Brown, & Hackett, 1994) postulates that the "person variables" of self-efficacy beliefs, vocational interests, performance goals and outcome-expectancies help to develop an individual's academic and vocational choices. Extant vocational psychology literature has demonstrated that these elements are key to the development of academic and vocational choices (e.g. Betz & Hackett, 1997; Lent, Lopez, & Biescke, 1991, 1993; Sax & Bryant, 2006), and of academic and career performance (e.g. Lent et. al., 1993; Swanson, 1993). This study builds on Bandura's social cognitive theory (Bandura, 1986) and SCCT.

In addition to the above mentioned factors, vocational choices might depend on several other factors. Eccles (1987) suggests that vocational choices might be influences by an individual's experiences, capabilities, and other environmental factors including cultural influences such as stereotypes etc. The individual's interpretation of these experiences might influence vocational choice. In addition, factors such as lack of opportunity, social influences and other contextual supports and barriers affect vocational choice (e.g. Crozier, 1999; Eccles, 1994; Lent et. al, 1994; McCracken & Weitzman, 1997).

Traditionally, some occupations such as medicine and law have been male-dominated, and certain other occupations such as teaching, nursing, dental hygienist etc. have been predominantly female-dominated (Betz, 2004). Vocational researchers are aware of the small numbers of women operating within many areas within the science, technology, engineering and mathematics (STEM) career fields (e.g. Fitzgerald & Harmon, 2001; Scott & Mallinckrodt, 2005). While in the United States, more and more women are now entering the previously male-dominated professions (Fitzgerald & Harmon, 2001), the progress towards occupational desegregation remains painfully slow, and men still dominate the STEM occupations. It is of great significance therefore, to understand these trends better with an aim to increase the proportion of women within these fields.

Betz (2004) considers mathematics as the 'critical filter' that women might tend to ignore, thus shutting out the opportunities to qualify for some of the most lucrative jobs available. The choice of women to enter nontraditional careers depends on several environmental and contextual factors (e.g. Bleeker & Jacobs, 2004; Gottfredson, 1996; VanLeuvan, 2004). The self-efficacy and interests of women might have significant influences on their performance and persistence in science, technology, engineering, and mathematics (STEM) related career fields.

Understanding women's vocational choices, and their career development, especially within the STEM fields has intrigued vocational researchers for long. Extensive vocational psychology research has been conducted over the past few decades that examine the career development of women in the fields that have hitherto been male dominated. Researchers have examined self-efficacy beliefs (e.g. Farmer, Wardrop, Anderson, & Risinher, 1995; Lent et. al., 1993), interests (e.g. Lopez, Lent, Brown, & Gore, 1997; Rottinghaus, Larson, &

Borgen, 2003; Schaub & Tokar, 2005), cultural influences (e.g. Gottfredson, 1996; Phillips & Imhoff, 1997), and several other such factors that impact women's career choices and persistence within STEM fields.

However, most of the existing research is based on the U.S. population. Very little such research has been conducted in other countries and research along these lines for the population of the Indian subcontinent is virtually non-existent. India's traditionally patrifocal culture typically affords limited career choices and educational opportunities to women (Gupta & Sharma, 2003). While some research exists that examines gender differences in education and career opportunity (Gupta & Sharma, 2003; Indresan, 2002), and some literature exists that speculates about possible reasons (e.g. Bannerjee, 2002; Handy & Kassam, 2004) for the stark difference between male and female representation within higher education, there is almost no empirical research that investigates the career development of Indian women. This only highlights the need for additional vocational psychology research with this population, especially with a focus on the career development of Indian women within the STEM fields.

This study will build on existing literature by examining the applicability of the SCCT within the Asian Indian population. This is a longitudinal, passive deign study that assesses the effects of interests and academic self-efficacy of Indian 12th grade students on their academic performance. Self-efficacy, interests and academic performance of 12th grade Indian high school students are measured in this study over the three major subject groups of mathematics, science, and English.

One of the core purposes of this study is to examine support for the SCCT within an Asian Indian population. More specifically, this study assesses whether subject-specific self-efficacy and interests at the beginning of the academic year significantly predict half-yearly academic performance in 12th grade high school students in India. Furthermore, this study examines the effect that the sources of self-efficacy put forth by SCCT has on the math, science, and English self-efficacy of Asian Indian 12th grade students. Finally, this study also attempts to gauge whether significant differences exist in the self-efficacy and interests of male and female students in subjects that are nontraditional for women (mathematics, science) and those that are more typically more 'traditional' for women (English). It will also gather information that will be used to provide information regarding women's career development within the math and science fields for the Asian Indian population. Results of this study will likely stimulate avenues for further research focusing on the career development of women in India.

CHAPTER TWO: LITERATURE REVIEW

Though the enrollment of women within some of the science, technology, engineering and mathematics vocational fields has shown a considerable increase, several STEM fields continue to be male-dominated. This has been of great interest to vocational psychology researchers, and extensive research has been conducted to examine and understand this trend. This chapter outlines the major theories and discusses the empirical research findings within this area of vocational psychology. Firstly, I will describe the current trends of women within STEM career fields and discuss the importance of continued vocational research in this area. Next, I will discuss the SCCT (Lent et. al., 1994), with emphasis on the constructs of self-efficacy, its sources, interests, and gender differences that have been observed. In additionally, I will discuss additional contextual factors that might influence women's career choices. Finally, I will discuss the body of literature that addresses these issues within India. Throughout this paper, I shall use the term "performance attainment" to denote past performance, and "achievement" to denote subsequent performance. The contribution of performance attainment towards building self-efficacy will be termed "mastery".

Women in the STEM Fields

Slightly more than half (51.1%) of the U.S. population is female (NSF/DSRS). However, the number of women working within the STEM fields has always been disproportionately low. As per the NSF/DSRS 2005 statistics, enrollment of students in undergraduate STEM degrees over the past 40 years has risen from 24.8% in 1966 to 50.4% in 2004. Although the past few decades have seen substantial increases in the enrollment of American women in science, technology, engineering, and mathematics (STEM) related fields, they are still an underrepresented group within these fields. However, though the numbers of women obtaining graduate degrees in STEM careers continues to lag behind those of men (37.4% in 2004), there has been a considerable increase (compared to the 8.0% in 1966). This being so, it is important to note that most of these trends are primarily reflected in the "science" areas such as biology, genetics and so on. For technology, engineering, and mathematics, the statistics are less encouraging. For example, in the year 2004, 85.43% of the degrees in healthcare fields were awarded to women, and only 14.57% of these were earned by men. On the other hand, for engineering technology, an overwhelming majority of 86% of the graduating students in 2004 were men, and only 14% were women (NSF/DSRS).

Betz (2004) considers mathematics as the 'critical filter' influencing the choice of women within the STEM fields. For the U.S. population, across ethnic backgrounds, only approximately 5% of female freshmen reported intentions of pursuing an engineering degree, as opposed to approximately 20% of male freshmen reporting similar intentions. The reasons for this persistent trend despite the availability of the opportunities to pursue satisfying STEM careers continue to intrigue vocational psychology researchers.

Furthermore, although in terms of education, women are now much better represented within STEM majors, significant differences continue to exist between men and women employed within the STEM fields. For example, the number of people that men within science and engineering fields supervise is higher than the number of subordinates under the supervision of women within similar fields. Women in science and engineering careers also earn less than men in this occupation. NSF/DSRS reported that in 2003, the median annual salary of women in these careers was $58,000, as opposed to $70,000 for men. These and other similar findings underline the importance of continued research to investigate reasons that such trends occur. One of the areas that has been most researched with a view to explain this phenomenon is the domain of self-efficacy beliefs.

Self-Efficacy

Self-efficacy is a construct central to both SCT and SCCT. Bandura (1986) defined self-efficacy as a person's judgment of his/her own capabilities of performing a specific task in the near future. Self-efficacy for a specific task is defined as the belief of a person in his or her competence at accomplishing the specific task (Lent et al., 1994). Self-efficacy is one's subjective perception of successfully completing a specific task. A person's self-efficacy "is postulated to influence persistence of behavior when disconfirming or dissuading experiences are confronted" (Betz & Hackett, 1981, p. 400). Self-efficacy of a person could therefore be used to predict the outcome or in this case, the academic performance of a student. In the present study, self-efficacy was defined and measured as the beliefs of a student about his or her ability to perform well in tasks related to specific subjects in the near future.

The social learning theory (Bandura, 1986) proposes that learning occurs observationally through modeling of behaviors, attitudes, and emotional reactions of others. By observing others, a person forms an idea of how new behaviors are performed, and performs subsequent behavior based on this information. Bandura’s self-efficacy theory (Bandura, 1977, 1982) proposes that situation-specific self-efficacy beliefs influence behaviors that lead to specific performance accomplishments. According to self-efficacy theory, a person's self-efficacy perceptions are formed by four sources: from the interpreted results of past performance (or mastery), modeling or vicarious learning, social persuasion a person receives and their physical and emotional states (i.e., anxiety) (Bandura, 1986; Lent, 2004; Zedlin & Pajares, 2000; Zimmerman, 2000). Performance attainment has been found to be a factor that influences self-efficacy expectations (e.g. Lent et al., 1993; Zeldin & Pajares, 2000). Similarly, verbal or social persuasion was also found to influence self-efficacy (e.g. Lent et. al., 1991, 1996). Lent et al. (1991) found that vicarious learning might be influential in determining performance indirectly through self-efficacy. Matsui, Matsui, & Ohnishi (1990) found that all four factors: performance attainment, vicarious learning, social persuasion and anxiety are significant predictors of mathematics self-efficacy.

Bandura (1986) theorized that of these four sources, mastery was the strongest predictor of self-efficacy. Muretta (2005) supported Bandura's theory. It was found that for aircraft personnel of the U.S. Navy, positive mastery correlated to high self-efficacy. Also, for the same sample, negative experiences with anxiety tended to lower self-efficacy beliefs. Several studies which examined the sources of the self-efficacy, yielded results inconsistent with Bandura's theory. For example, Schaub & Tokar (2005) report that all four sources of self-efficacy similarly predicted self-efficacy and outcome expectations for both males and females. Lapin (2001) found that for men, mastery was the strongest predictor of self-efficacy, while for females it was found that social persuasion and vicarious learning were the strongest predictors of self-efficacy. While these results make it difficult to draw conclusive inferences about the effect of the self-efficacy sources on an individual's self efficacy, In general, mastery appears to be the strongest predictor of academic self-efficacy (e.g. Britner & Pajares, 2007; Klassen, 2004; Lent et. al., 1996; Usher & Pajares, 2006).

The SCCT (Lent et al., 1994) posits that self-efficacy influences interests and career choice (Lent et al., 1994). This theory is widely supported in extant literature (e.g. Betz, Harmon, & Borgen, 1996; Fouad & Smith, 1996; Fouad, Smith, & Zao, 2002; Lapan, Shaughnessy, & Boggs, 1996; Smith & Fouad, 1999). Self-efficacy has been shown to have a significant direct effect on a person's interests (e.g. Brown & Lent, 1996; Rottinghaus, Larson, & Borgen, 2003; Schaub & Tokar, 2005). Lopez, Lent, Brown, and Gore (1997) found that for U.S. high school students, self-efficacy predicts subject-specific interests. Ozyurek (2005) reported similar findings for a sample of Turkish high school students. Nauta (2005) reported that career self-efficacy mediated four out of five personality-interest relationships.

The SCCT also suggests that self-efficacy predicts academic achievements. Once again, there has been a considerable amount of research that has shown that self-efficacy is also influential in predicting performance (e.g. Lent, Brown, & Larkin, 1986; Pajares & Kranzler, 1995; Pajares & Miller, 1995; Nauta, Kahn, Angell, & Cantrelli, 2002). Multon, Brown, & Lent (1991) reported that the relation between self-efficacy and performance varies with the students' age and achievement status. "… self-efficacy beliefs with respect to specific domains of career-related behavior influence educational and occupational choice, and performance and persistence in the implementation of these choices" (Betz & Hackett, 1997, p. 383). Lopez et. al., (1997) found evidence that for high school students, self-efficacy partially mediated the effect of capability on performance. From a counseling perspective, it is important to know the relationships between these constructs in order to assist individuals who underestimate their efficacy in certain fields (Lent et al., 1986). The self-efficacy beliefs of a person also influence their choices they make. A person's self-efficacy was also found to significantly predict academic persistence, and range of perceived career options (e.g. Gwilliam & Betz, 2001; Lent, Brown, & Larkin, 1987) Multon, Brown, & Lent (1991) found supporting evidence for this theory in a meta-analytic study.

Research has indicated some interesting differences between the self-efficacy beliefs of men and women. Gender differences for math self-efficacy beliefs were not observed for sixth graders (Middleton & Midgley, 1997), for middle-school students (Fouad & Smith, 1996), or for high-school students (Lopez & Lent, 1992). However, Gainor and Lent (1998) found that male African-American undergraduate college students reported higher math self-efficacy beliefs than did their female peers. Gender differences for learning experiences were observed by Williams and Subich (2006) reported that women in their study reported higher learning experiences and higher self-efficacy beliefs within the traditional social domain; whereas the men in the same study reported that they had better learning experiences and higher self-efficacy within the traditionally male domains of science and math. Scott & Mallinckrodt (2005) reported that women majoring in science reported higher science self-efficacy than the women who chose non-science majors. Hackett (1995) suggested that the stronger the perceived connection between an activity and gender is, the more likely it is to encounter self-efficacy differences between males and females for that particular activity.

Gender differences are conjectured to exist in the vocational aspirations, expectations, and achievement (Rojewski, 2004). Lent et. al., (1993), found that differences in self-efficacy explain gender differences in enrollment and interest in mathematics-related courses. There are several possible barriers to the development of positive self-efficacy beliefs for women within STEM fields. Negative encounters with teachers, advisors, and peers are a strong reason why female students opt out of STEM majors sooner than male students who are performing at comparable or lower levels than them (Seymour & Hewitt, 1997). Women, more than men, are likely to consider the needs of others while making their vocational decisions (Betz, 1992; O'Brien et. al., 2000). Seymour and Hewitt (1997) also found that women are more likely to consult with others on matters of career indecision. Therefore, the quality and direction of the feedback they receive from the individuals in their environment could prove to be a barrier to their self-efficacy beliefs and consequently, their career choice. There are important implications of these findings because counselors, teachers and advisors who work with women in STEM careers are in a position to strongly influence not only career choice and direction, but also persistence within a STEM major or career.

Interests

One of the core constructs of SCCT, interests are defined as “patterns of likes, dislikes and indifferences regarding relevant activities and occupations” (Lent et. al., 1994, p. 88). The SCCT (Lent et. al., 1994) theorize that self-efficacy and outcome expectancies influence interests directly. Thus, SCCT posits that for a particular task, high self-efficacy, and positive expectations of the outcome of engaging in the task result in heightened interests for that specific task. The effect of self-efficacy beliefs on an individual’s interests has been widely researched. Results indicate strong support for the theorized relation between these constructs (e.g. Betz et. al, 1996; Brown & Lent, 1996; Fouad & Smith, 1996; Fouad et. al, 2002; Lapan et. al, 1996; Rottinghaus, et. al., 2003; Schaub & Tokar, 2005; Smith & Fouad, 1999). The effect of career self-efficacy on interests was even found to mediate four out of five personality-interest relationships (Nauta, 2005).

Tracey (1997, 2002) suggested that the relationship between self-efficacy and interests was reciprocal. Thus, in addition to the effect that self-efficacy has on interests proposed by SCCT, Tracey (2002), found that for middle-school students, interest in a specific area might motivate the development of positive self-efficacy. Nauta et. al. (2002)

observed a similar reciprocal relationship between self-efficacy and career interests. A bi-directional relationship was observed between interests and self-efficacy of college students.

The SCCT (Lent et. al., 1994) also posited a relation between outcome expectancies and interests. This is supported by the literature (e.g. Hackett, Betz, Casas, & Rocha-Singh, 1992; Lent et. al., 1993; Fouad & Smith, 1996). Fouad & Smith (1996) found that for middle school students, there was a strong association between outcome expectations and interests and career exploration intentions. Dielgelman and Subich (2001) found that the outcome expectation of a college student in completing his/her degree related strongly to interest in pursuing the degree. They suggested the possibility that changes in outcome expectancies might also impact interests. Ferry, Fouad, & Smith (2000), reported that in addition to self-efficacy, learning experiences also influenced interests.

Within the vocational psychology literature, interest has long been recognized as an important contributing factor to vocational behavior. Most notably, along with self-efficacy, interests of an individual have been found to predict his/her future academic achievement (e.g. Lent et al., 1994; Long, Monoi, Harper, Knoblauch, & Murphy, 2007; Schiefele, Krapp, & Winteler, 1992). Interest has also been shown to be a strong predictor of career choice (e.g. Betz & Hackett, 1981). The impact of vocational interests on occupational choices was demonstrated by Lapan et. al. (1996) who found that math interests of high school students significantly predicted their choice of major in college. Furthermore, the interpretation of reported vocational interests, such as the Strong Interest Inventory (SII: Harmon, Hansen, Borgen, & Hammer, 1994) has been extensively used in career counseling as a tool to help clients make career-related decisions and choices. Nauta et. al. (2002) found that interests over a seven-month period are more stable than their self-efficacy beliefs.

In the area of vocational interests, gender differences have been reported in the literature (e.g. Betz & Hackett, 1983; Hansen, Collins, Swanson, & Fouad, 1993; Lippa, 1998; Lubinski & Benbow, 1992). Lippa (1998) reported that men showed greater strength in their interests in mechanics and objects, whereas females showed greater strength in their interests related to their feelings and other people. Jones, Howe, and Rua (2000) report that 6th grade boys showed more interested in the physical sciences, whereas girls demonstrated more interests in the biological sciences. More recently, within the general representative sample Inventory (N = 2250) of the 2005 Strong Interest, which is highly representative of the general U.S. population, men from the reported significantly higher Realistic interests, especially within the “mechanics and construction”, and the “military” interest scales (Donnay, Morris, Schaubhut, & Thompson, 2005).

Parental Influences

Burlin (1976) examined the relationship between parental education, occupation, and occupational status and the occupational aspirations of adolescent women. There was a significant relation between occupational aspiration of the adolescent daughter and father's education. Another significant association was found between the daughter’s occupational aspiration and mother's occupational status. A longitudinal study following East German adolescents for six years found that during the time of socio-political change, with the emerging of new career options, adolescents whose parents had graduated from a university were more likely to form and follow through with aspirations of pursuing a college degree (Pinquart, Juang, & Silbereisen, 2004). Lauer (2003) reported that in France and Germany, higher parental educational attainment is associated with higher levels of achievement in school for the children. The father’s occupational status was positively linked with academic performance in both countries. While such research implies that educational attainment of both parents matters with respect to the educational and career paths of individuals, it has been argued that the mother's educational attainment (compared to father's educational attainment) has a greater impact on the vocational behavior of the individual for Hispanic individuals (Chiswick, 1984; Heckman & Hotz, 1986).

Gender Differences within the U.S.

In the United States, a large amount of research has been done over the last couple of decades on the self-efficacy and interests of women in the STEM fields. Most women need the intellectual fulfillment obtained by vocational achievement without which they might become susceptible to psychological distress (Betz, 2004). For women who are interested in fields of study that have traditionally trained men for 'male' occupations, inability to attain the desired educational achievement can lead to distress and unhealthy feelings and emotions. However, several women might tend not to enroll in such areas of education that have long been predominantly male such as engineering-related fields because of a variety of factors. Such factors might include perceptions of role conflict, amount of encouragement/ support received (Eccles, 1994). On the other hand, a commitment to high science achievement significantly influences a woman's decision to pursue a career that was not traditional (Sax & Bryant, 2006).

In the United States, gender differences still exist in the mathematics and science-related career choice process even though both men and women now get comparable mathematics and science-related education (e.g. Morgan, Isaac, & Sansone, 2001). Lent & Hackett (1987) reported that self-efficacy for nontraditional fields were better predictors of choice of nontraditional college majors than interests, ability, and various background variables. The sex-role stereotyping of activities and occupations influences the low self-efficacy expectations of women in masculine stereotyped occupations (Whiston, 1993). Whiston also found that as measured by the People Task Self-Efficacy Scale (PTSE) and the Thing Task Self-Efficacy Scale (TTSE), women who enter nontraditional occupations have lower self-efficacy on the more traditional tasks such as serving and helping than women who enter traditional occupations. This leads to speculation that the low self-efficacy of a person might not be entirely due to sex-role stereotyping, but also partly to what vocational choice the person makes (Whiston, 1993).

Morgan et. al., (2001) studied differences between the goals and interests of male and female college students in the United States and reported that both men and women were similar in the kinds of work goals. However, they reported that women perceived their competence for the physical/mathematical science careers as significantly lower than their perceived competence for education/social services and in medicine. There was no significant difference found in the perceived competence across careers for men. Whiston (1993) found that women reported lower self-efficacy for working with things that were sex-role stereotyped as masculine activities. Gender has been suggested to be a powerful and persistent influence on career choice and development (Rojewski, 2004). A person's choice of vocation is very often chosen at a young age by him/her based on its social evaluations and gender-specific social appropriateness (Turner & Lapan, 2004). Lapan, Hinkelman, Adams, & Turner (1999) found in a study that women placed greater value compared to men on Artistic and Social themes.

Research outside the U.S.

Most of the research cited here is based on samples from the United States population. Within the field of psychology there is enormous interest in extending psychological research to applying psychological models across other countries, and learning about their applicability across cultures (e.g. Ben-Porath, 1990; Hesketh & Rounds, 1995; Van de Vijver & Poortinga, 1991). SCCT interest and choice models have received support in the Hispanic, African-American and Asian American populations within the United States. (e.g. Fouad & Smith, 1996; Gainor & Lent, 1998; Tang, Fouad, & Smith, 1999). Day and Rounds (1998), found that within the U.S., there was no difference in how men and women of diverse ethnic backgrounds reported that they interpreted vocational interest patterns. There is a need for comparable research to be conducted across other countries. However, very few such studies exist in the current literature. Lopez et. al. (1997) found that for U.S. high school students, self-efficacy predicts subject-specific interests. Ozyurek (2005) reported similar findings for a sample of Turkish high school students.

Rounds and Tracey (1996) conducted a structural meta-analysis to analyze the structural equivalence of three interest measurement models between the United States and benchmarks from 18 other countries. The fit of Holland's circular order model (1985a), Gati's three-group partition (1982), and an alternative three-class partition model was assessed with benchmarks from 18 other countries. The results revealed that none of the non-U.S. countries demonstrated a good fit for the U.S. benchmark across the three interest models. One of the countries compared to the United States in this study was Pakistan, a country which is extremely similar to India in its cultural-norms, education system, language, values and other such cultural factors. However, it was found that the Pakistani benchmarks showed poor model fit with the three interest measurement models. It is possible by extension to assume that measured interests of an Indian sample would also differ substantially from measured interests from within the U.S. population.

Careers of Women in India

Very little psychological research has been conducted in India. The research within the area of vocational psychology is even more deficient. Women in India have traditionally been relegated to occupations less related to mathematics and science, and especially toward the social sciences. Careers such as engineering and other mathematics and science related careers have traditionally been considered 'male' professions (Gupta & Sharma, 2003). The Indian University Grants Commission (1993-94) reported that the proportion of women is significantly lower in the nontraditional academic fields of science (22.87%) and engineering (8.16%) than in the more traditional fields of education (56.52%) and the arts and languages (44.68%) (Indiresan, 2002).

In recent years, more women have been choosing nontraditional careers. Over the past decade, there had been an increase in the enrollment of women in these nontraditional fields. Gupta & Sharma (2002) reported that the proportion of women enrolled in science-related subjects was approximately 33% and the proportion of women enrolled in engineering-related subjects was approximately 14%. The traditional belief that mathematics and science are “male” domains has been often inculcated into the Indian psyche. Gupta & Sharma (2003), surveyed female academics and reported that: (a) 74.1% of them agreed that they had encountered people who thought that "women cannot be successful in science and engineering", (b) 62.4% of the respondents reported the presence of the stereotype that women are incapable of solving problems, and (c) 72.8% had encountered people who thought that "a woman has less analytical ability than a man." (Gupta & Sharma, 2003, pp.

286). As a result of this, many Indian women are led to believe that they 'might not be suited' for mathematics and science-related education and vocations.

Several factors contribute to the under-representation of Indian women in STEM fields. India has traditionally been a patriarchic or patrifocal society. Handy & Kassam (2004), speculate that women in India have low self-efficacy beliefs that stem from the disadvantaged positions of women in society. This might lead them to experiment less and be less innovative in their careers (Bannerjee, 2002). Scientific training has long been thought to cultivate values and behaviors such as critical thinking, innovativeness, and willingness to abandon outmoded traditions in women that are considered antithetical to the idealized woman of a patrifocal family structure and ideology (Mukhopadhyay, 1994). This has been a significant factor that hinders the enrolment of women in science and engineering-related colleges and schools (Mukhopadhyay & Seymour, 1994). This is also a major reason that women occupy a disproportionately small number of science and engineering-related professions. Gupta & Sharma (2002) studied academic women scientists in India and found that among four of the nation’s leading institutes of higher education and research in technology and science, only 6.92% of the faculty were female. They also found that 88% of the women in their sample expressed that women had to work much harder to prove themselves equally capable of the same tasks as men. Also, 66% of the female academics agreed that their performance was underestimated by their male peers (Gupta & Sharma, 2002).

Mathematics, science, and engineering-related careers in India are generally considered extremely prestigious and are highly coveted. A woman in such a career or with such academic training, though highly respected, might suffer marital consequences such as experiencing severe difficulties in finding a similar or higher 'ranked' spouse (Mukhopadhyay & Seymour, 1994). Gender-differentiated family obligations lead to gender-differentiated educational expectations. There is very often a preemptive priority placed on marriage that often requires a woman to pursue education that will make her a more desirable daughter-in-law. Similarly, the academic success needed to enter a science or engineering-related field implies a woman's commitment to education and learning and is often thought to show a lack of emphasis on family-oriented pursuits (Mukhopadhyay & Seymour, 1994). Singhal & Misra, (1994) found in a study with Indian students that the preferences for achievement goals for Indian students were significantly influenced by the expectations of their parents, teachers, and peers.

A lack of mathematics-related education is one of the major barriers to women's career development (Betz, 2004). Stage & Maple (1996), studied U.S. women who did not follow through on their initial goal of a career in a mathematics-related area, and found that these women perceived a conflict between mathematics as a profession and other roles such as parent, significant other, etc. They also reported that women who enrolled in collegiate mathematics did so because of interest in mathematics, but when faced with negative experiences associated with gender-based stereotypes and being a mathematics student, they left the mathematics field for other areas of education and careers (Stage & Maple, 1996). It is important that the self-efficacy of a person be studied because it affects academic choice, academic persistence, and academic performance (Betz, 1992). Hackett (1995) reported that women are less likely to persist in traditionally male occupations if their self-efficacy in these domains is low. Thus, low self-efficacy in Indian women could influence their choice (or avoidance) of nontraditional academic fields, premature dropouts, and low academic achievement. It is therefore crucial to study these factors for careers that have traditionally been underrepresented by women in India.

CHAPTER THREE: METHODS

This section will be structured in the following manner. I will first describe the participants of this study, including information about their demographics, followed by a description of the curricular tracking system used in Indian post-secondary education, and it's relevance to the current study. Next, I will discuss the instruments used to measure the various constructs of interest in this study. Please see Appendix A for a table outlining the various contructs of interest and their measurement. Following this, a description of the procedures followed in the conduction of this study will be presented. Finally, the hypotheses proposed in this study, and their rationale based on existing theoretical and empirical research will be discussed.

Participants

The demographic questionnaire, Fouad-Smith Scales for Subject-Matter Specific Social Cognitive Constructs (Smith & Fouad, 1999) self-efficacy and interest subscales and the modified version of the Sources of Social Self-Efficacy Expectations Scale (Anderson & Betz, 2001) that was customized to specifically measure the mathematics/science self-efficacy (J. Woerbel, personal communication, April 1, 2005), were administered to a total of 527 students from two Asian Indian schools. Of these, 36 records were excluded from the dataset because no 11th grade (Time1) performance attainment scores were available, either because the student had transferred to the school after the 11th grade, or because he/she had not taken one or more of the 11th grade tests. Another 83 records were eliminated from the dataset because no 12th grade half-yearly (Time2) scores were available because the students had either transferred to another school, had not taken one or more of the 12^{th} grade half-yearly tests, or had dropped out of school. Of the remaining records, 72 were incomplete and were excluded from the data analysis. At this point the dataset included 336 complete records, which was 82% of the participants who had their grades reported. Twenty of these students were in the CEC (Civics, Economic, Commerce, English and a 2nd language) track. These were all female students belonging to only one school. They had also not taken any math or science classes. The records of these students were subsequently eliminated from the final data analysis. The final dataset contained a total of 316 usable responses.

Male students accounted for 48.4% of the sample (n = 153). Female students comprised 51.6% of the sample (n = 163). The average age of the respondents was 16.15 (SD = .41), with a range from 16 to 18 years. Data describing the demographic variables is presented in Table 1. The participants were drawn from two schools. Of these two schools, one was patronized by students from families of higher affluence (n = 156, 49.4%) than the other (n = 160, 50.6%).

Tracking

According to the Indian National Center on Education and the Economy (NCEE), the post-secondary educational system in India (after 10th grade), follows a system of curricular tracking. Thus, for education past the 10th grade, the curriculum becomes differentiated. Academic tracks in post secondary schools (or "junior colleges", as they are called in India) are based on scholastic aptitude (NCEE, 2006). The two junior colleges sampled in this study used the 10^{th} grade board examination scores, which is the standard method for tracking in India (NCEE, 2006), to separate students into different curricular tracks.

The two most prestigious curricular tracks are the science track, and the math and science track. Students opting for these tracks are required to demonstrate very high 10th grade performance. Admission to these tracks is merit-based (10th grade scores). Students in these tracks are required to study physics and chemistry, and/or mathematics. Additional subjects offered to those not taking mathematics included botany and zoology. On the second tier of tracking is the commerce track. Subjects offered within this stream are accounting, math, economics, and commerce. The last set of tracks fall under the “humanities/arts” category, and were not used in this study. Students in all three tracks were required to take two language classes.

Students in this sample belonged to one of three subject tracks: MPC (mathematics, physics, chemistry, English, and a 2nd language), BPC (biology, physics, chemistry, English, and a 2nd language) and MEC (mathematics, economics, commerce, English, and a 2nd language). However, all three tracks were not offered by both schools to their students. While the more affluent school offered its students all three tracks, the les affluent school only offered its students the MPC and BPC tracks.

Measures

In addition to a demographic questionnaire, this study uses the self-efficacy and interests subscales from the Fouad-Smith Scales for Subject-Matter Specific Social Cognitive Constructs (Smith & Fouad, 1999) and a the Sources of Social Self-Efficacy Expectations Scale (Anderson & Betz, 2001). In addition, the students’ 11th grade final examination, and their 12th grade half-yearly examination scores were also used. Detailed information about these measures is presented below.

Demographic Questionnaire: All participants in this study completed a demographic questionnaire. Participants were asked to indicate their sex, age, educational aspirations, religion, caste, household income, parental educational attainment level (for both father and mother), parents’ occupation (for both father and mother), and the number of hours they spent studying. They were also asked about their career aspirations, and what educational and career aspirations their parents had for them. For a complete list of questions, please see Appendix B.

Sources of Math/Science Self-efficacy: Bandura (1977, 1997) proposed that self-efficacy is determined by four factors: performance attainments (or mastery), vicarious learning, social persuasion, and anxiety. The Social Sources Scale (Anderson & Betz, 2001), measures experiences related to the development of self-efficacy in a person's social skills. This is a 40-item measure that is divided into four scales of 10 items each. These four subscales are Emotional Arousal (anxiety), Social Persuasion, Vicarious Learning and Past Performance (performance attainment). Each item is reported on a five-point Likert-type scale ranging from (strongly disagree) to 5 (strongly agree). I was interested in studying the effects of all four factors on mathematics/science self-efficacy of 12th grade Indian students. For the purposes of this study, I used the Emotional Arousal (EA), Social Persuasion (SP), and Vicarious Learning (VL) subscales of the Social Sources Scale. Performance attainment (or mastery), was measured and operationalized by the 11th grade annual examination scores of the students. Also, since I was particularly interested in mathematics/science self-efficacy, I used the Sources of Academic Self-Efficacy Scale (SASS), a modified version (see Appendix C for sample items) of the Social Sources Scale (see Appendix D for sample items), that is customized to specifically measure the mathematics/science self-efficacy (J. Woerbel, personal communication, April 1, 2005). For example, the EA item "Parties make me feel uncomfortable and nervous." was changed to, "Studying mathematics/science makes me feel uncomfortable and nervous." Similarly, the VL item, "Many of my friends are pursuing studies that do not require social skills." was changed to, "Many of my friends are pursuing studies that do not require mathematics/science skills." An example of an SP item that was changed is "I received strong encouragement to socialize as a child." This item was changed to "I received strong encouragement as a child to do well in mathematics/science classes." Other EA, VL, and SP items have been similarly changed (see Appendices C, D).

The items used in this study were adapted to measure sources of mathematics/science self-efficacy rather than sources of social self-efficacy. The reliability and validity evidence provided here is reported by Anderson & Betz (2001) for the Social Sources of Self-Efficacy Scale. For a U.S. sample, internal consistency reliability of the Social Sources Scale is demonstrated by the following coefficient alphas: Vicarious Learning, (.77), Emotional Arousal (.91), and Social Persuasion (.87). For this study, the internal consistency reliability coefficient alphas for the three subscales were: Vicarious Learning, (.39), Emotional Arousal (.93), and Social Persuasion (.60). Table 2 describes the internal consistency reliability for this scale. Anderson & Betz (2001) also reported that for the Social Sources of Self-Efficacy Scale, convergent validity is demonstrated by significant correlations between the sources of self-efficacy: emotional arousal, vicarious learning, and social persuasion with criterion measures of self-efficacy (social confidence and social self-efficacy) and related constructs (depression, social anxiety, shyness). Correlations among the sources were significant, ranging from .27 to .58 in males (significant at the .05 level) and from .49 to .72 in females (significant at the .001 level). The sources of self-efficacy were also significantly correlated with the criterion measures of self-efficacy. Correlations for VL, EA, and SP with social confidence were .36, .55, and .50 respectively, and were .46, .69, and .65 for correlations with social self-efficacy.

Further evidence for construct validity is demonstrated by the significant correlations of the predictors with self-efficacy related constructs of depression and shyness. EA and SP were also found to correlate significantly with social anxiety (-.51 and -.35 respectively for males and -.62, -.50 respectively for females). However, though VL was found to correlate significantly with social anxiety for women (-.36) if was not significantly correlated for men (-.19) (Anderson & Betz, 2001).

Subject-Specific Self-efficacy: Self-efficacy of the Asian Indian students in this study is operationalized and measured by the self-efficacy subscale of the Fouad-Smith Scales for Subject-Matter Specific Social Cognitive Constructs (Smith & Fouad, 1999). While this instrument measures self-efficacy related to school subjects grouped into the five major categories of English/language arts, social studies, mathematics, science, and art, for the purposes of this study, only the mathematics, science and English Self-Efficacy and Interests subscales were used (see Appendix F for sample items). These are a total of 19 self-report items. Several items were edited to reflect an Indian sample. For example, "I feel confident that with the proper training, I could figure out how long it would take to travel from Green Bay to Detroit, driving at 55 mph.", has been changed to, "I feel confident that with the proper training, I could figure out how long it would take to travel from Bombay to Hyderabad, driving at 55 kmph." Other such changes have been made to reflect Indian usage (see Appendix E.) Each item of this subscale was reported on a six-point Likert scale ranging from 1 (very strongly disagree) to 6 (very strongly agree). There were a total of 19 items in the Self-Efficacy subscale (5 – mathematics, 5 – science, and 9 – English).

The internal consistency reliability of the Fouad-Smith self-efficacy subscale was validated for a U.S. sample (Smith & Fouad, 1999), and is described by subject in Table 3.

The coefficients for internal consistency reliability of the math and science self-efficacy subscales were reported combined in Smith & Fouad (1999). By subject, these were: math/science (.85), and English (.88). Table 3 also presents the Chronbach alphas representing the internal consistency reliability of the self-efficacy subscales for this sample. For this sample, internal consistency reliability is demonstrated by the following coefficient alphas: math (.74), science (.69), and English (.75).

The construct factors and the subject matter factors showed discriminant validity (Smith & Fouad, 1999). The scale was also tested for factorial validity (including convergent and discriminant validity) using CFA procedures (Smith & Fouad, 1999). Comparative Fit Index (CFI) was assessed for several different models. CFI = .927 for a model that included the construct factors (including self-efficacy, interests) as well as the subject-matter factors (mathematics/science, English, art, and social studies). It was found that through the addition of subject-mater factors, the constructs show much greater discriminant validity. The subject-specific self-efficacies were highly correlated with their respective interests ranging from .533 (mathematics/science) to .643 (art). Self-efficacies of the individual subjects were also highly correlated with each other, the highest being the correlation between English self-efficacy and social studies self-efficacy (.747), and the lowest being the correlation between English self-efficacy and mathematics/science self-efficacy (.465).

Subject-Specific Interests: Career interests are defined as "patterns of likes, dislikes and indifferences regarding career-relevant activities and occupations" (Lent et al., 1994, p. 88). SCCT posits that performance attainment of a particular task depends on a person's interest in the task (Lent et al. 1994). Subject-specific academic interests were defined in this study as a person's interest in performing tasks that are related to specific subjects.

Mathematics, science and English interests were measured by the Fouad-Smith Interests subscales (Smith & Fouad, 1999). Each item was reported on a six-point Likert scale ranging from 1 (very strongly dislike) to 6 (very strongly like). There were a total of 29 questions in the Interests subscale (4 – mathematics, 15 – science, and 10 – English). As with the self-efficacy scale, some items in this scale were altered to reflect Indian usage (see Appendix E). A sample of an interest item is "Visiting a museum of natural history." The Fouad-Smith Scales are scored by averaging the individual item scores within each scale for each participant.

The internal consistency reliabilities of the Fouad-Smith interest subscales validated for a U.S. sample are shown in Table 4 (Smith & Fouad, 1999). The highest reliability is for the mathematics/science interest scale (.94). The lowest reliability is for the English interest scale (.86). The scales with fewer items tended to have lower reliability than the scales with more items. Smith & Fouad (1999) reported the internal consistency of the math and science interest subscales combined. Table 4 also presents the Chronbach alphas representing the internal consistency reliability of the interest scales for this sample. For this sample, internal consistency reliabilities are demonstrated by the following coefficient alphas: math (.63), science (.91), and English (.82). Also, the construct factors and the subject matter factors for the Fouad-Smith interest scales showed discriminant validity (Smith & Fouad, 1999). It was found that interests in individual subjects were highly correlated with each other with the highest being the correlation between English interest and art interest (.57), and the lowest being the correlation between English interest and mathematics/science interest (.19).

Subject-Specific Past Performance Attainment: Performance attainment (or mastery) is operationalized and measured by the students' grades on their 11th grade final examination scores for all of the subjects that the participants were taking. However, of note to this study are only the scores of their math, physics, chemistry, and English scores. The 11th grade annual examinations are comprehensive end of the year examinations, usually held in May, that cover material taught over the span of one whole academic year. These examinations typically consist of short and long essay-type questions and are used in high schools throughout India.

Subject-Specific Subsequent Academic Achievement: Subsequent academic achievement was operationalized and measured by the subsequent subject-specific achievement and their 12th grade half-yearly examination scores for the following subjects: mathematics, physics, chemistry, and English. Half-yearly examinations are comprehensive mid-year examinations, typically held in December every year that cover material taught over the span of one half of an academic year. These examinations typically consist of short and long essay-type questions and are used in high schools throughout India. Having received the consent of the participants' parents, and obtained the students' assent, the two schools were contacted in January 2006, and these scores were acquired from them.

Procedures

In the Asian Indian educational system, 11th and 12th grades are usually taught in an institution referred to as a "junior college". I was given permission by the principals of two Indian junior colleges (equivalent to 11th and 12th grade U.S. high schools) to enter all the 12th grade classrooms in each school and address the students collectively about the study. Being an Indian citizen, and having been born and raised in the same city that these colleges are located in, I was conversant with the local customs and culture. After obtaining the approval from the Institutional Review Board, I sampled five classes of the less affluent school, and three classes of the more affluent school. Entering each of the participating classes on a Monday, I read to the students in these classes a letter of information describing the reason for the study and the nature of the measures (see Appendix G). Since almost all the subjects were minors, they were informed about parental consent and were each given a parental consent form (see Appendix H) to take home and have reviewed and signed by a parent. They were informed that the questionnaires would be handed out on Friday by which time the parental consent forms would also be collected from them. The teachers of each of these classes reminded the students at the beginning of class each day for one week about the parental consent forms and that students might bring signed copies of these parental consent forms and give them to the teacher who would collect them and give them to me when I returned to the classroom on Friday. On Friday, I returned to each of these classes and handed out to all students willing to participate in the study, a packet containing an informed assent form (see Appendix I), and the questionnaire consisting of the Fouad-Smith Scales, the Social Sources Scales, and the demographic questions.

The first language taught in the two junior colleges sampled was English. Also, English is the medium of instruction in these colleges. Therefore, there was no need to translate the questions or measures into an Indian language. The survey questionnaire was administered in a classroom setting, and it took on an average around 30 minutes to complete. Upon completion, the students handed the completed measures to me along with the informed assent and parental consent forms if they had not already turned them in to their teachers. Each participating student then received a letter of debriefing (see Appendix J). Students not wishing to participate simply indicated this by not signing the assent form or completing the questionnaire.

Previous academic performance was measured by the students' 11th grade cumulative annual examination scores (finals of the previous year). The predicted performance achievement was measured by the students' 12th grade half-yearly examination scores (a cumulative mid-year examination conducted usually in December). Both the sampled schools were contacted by in January 2006 in order to obtain these examination scores. The parental consent and informed assent forms contained permission to access the participant's academic records for the purpose of obtaining these scores.

Hypotheses.

One of the main purposes of this study was to test the applicability of the SCCT for an Asian Indian high school population. To this end several hypotheses were proposed in order to test within an Asian Indian population, several relations between constructs that have been theorized within the SCCT framework.

Math Self-Efficacy: The first hypothesis proposed that the sources of academic self-efficacy for mathematics/science as measured by the Sources of Mathematics/Science Self-Efficacy Scale, and the past performance attainment for mathematics as measured by the 11th grade final mathematics examination will directly contribute to the math self-efficacy of the individuals as measured by the Fouad-Smith mathematics self-efficacy subscale (see Figure 1).

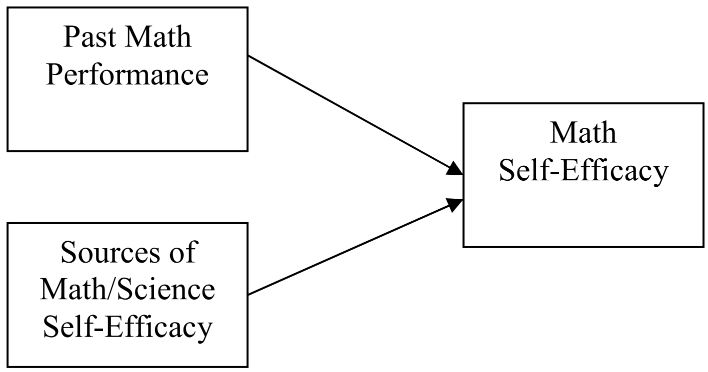

Figure 1. Hypothesis for Predicting Mathematics Self-Efficacy.

Math Achievement: The second hypothesis was that math self-efficacy as measured by the Fouad-Smith mathematics self-efficacy subscale and math interests as measured by the Fouad-Smith mathematics interests subscale, would directly influence the subsequent math achievement that was operationalized by the 12th grade half-yearly mathematics examination scores after the variance due to the 11th grade final mathematics examination was removed. Also, math self-efficacy would indirectly contribute to subsequent math achievement through math interest (see Figure 2).

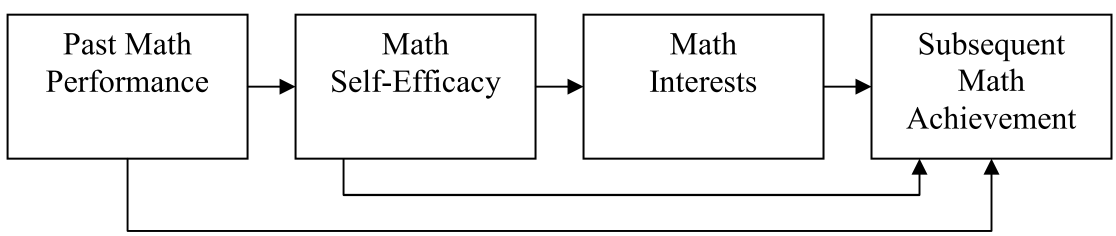

Figure 2. Model for Predicting Mathematics Achievement.

Science Self-efficacy: The third hypothesis posits that the sources of academic self-efficacy for mathematics/science as measured by the Sources of Mathematics/Science Self-

Efficacy Scale, and the past performance attainment for physics and chemistry as measured by the 11th grade final physics and chemistry examination scores, will directly contribute to the science self-efficacy of the students as operationalized by the Fouad-Smith science self-efficacy subscale (see Figure 3).

Science Achievement: The fourth hypothesis proposed that science self-efficacy efficacy as measured by the Fouad-Smith science self-efficacy subscale and science interests as measured by the Fouad-Smith science interests subscale would directly predict the subsequent science achievement that was operationalized by the 12th grade half-yearly physics and chemistry examination scores after the variance due to the 11th grade final physics and chemistry examination was removed. Additionally, I proposed that science self-efficacy would affect subsequent physics and chemistry achievement through science interests (see Figure 4).

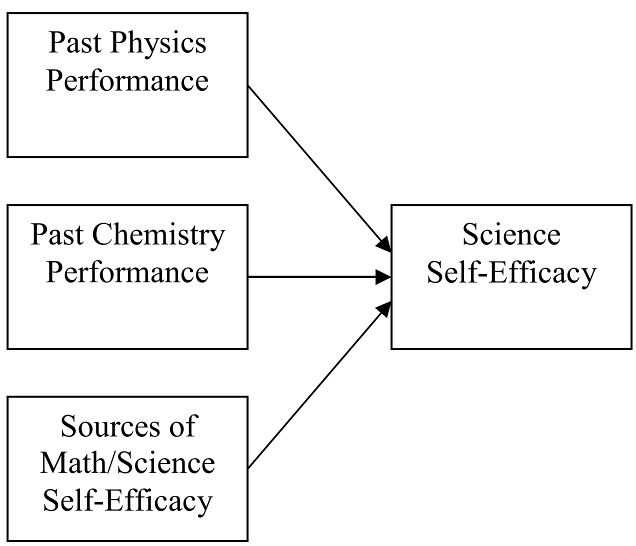

Figure 3. Hypothesis for Predicting Science Self-Efficacy.

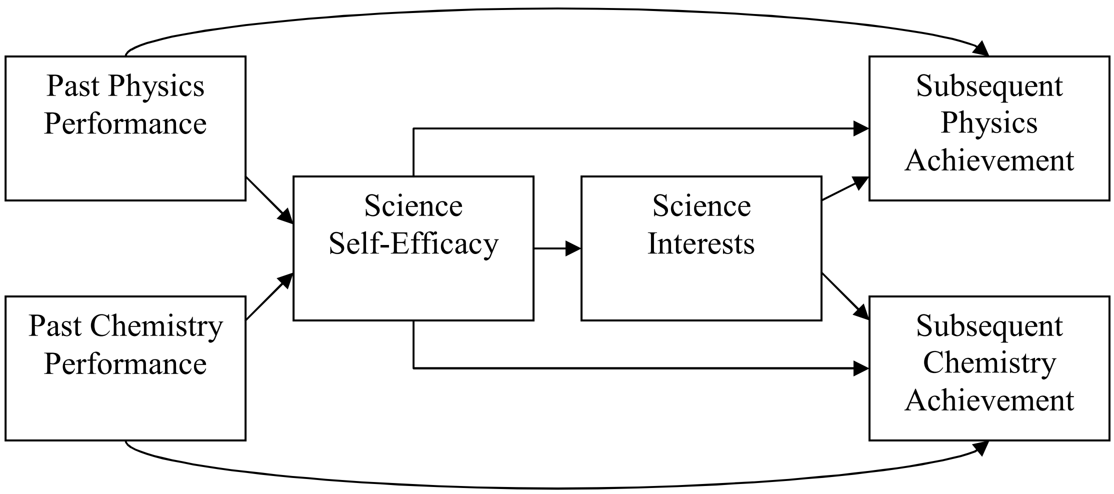

Figure 4. Model for Predicting Science Achievement.

English Self-Efficacy: The fifth hypothesis proposed that the English performance attainment as measured by the 11th grade annual examination for English will directly contribute to English self-efficacy as measured by the Fouad-Smith English self-efficacy subscale (see Figure 5).

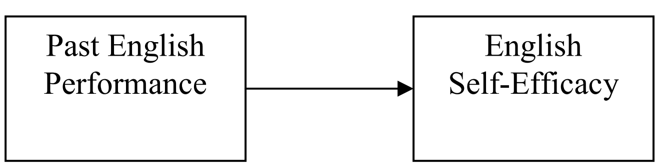

Figure 5. Hypothesis for Predicting English Self-Efficacy.

English Achievement: The sixth hypothesis was that English self-efficacy as measured by the Fouad-Smith English self-efficacy subscale and English interests as measured by the Fouad-Smith English interest subscale would directly predict subsequent English achievement as operationalized by the 12^{th} grade half-yearly English examination scores after the variance due to the 11^{th} grade final English examination was accounted for. Also, it was proposed that English self-efficacy would indirectly influence subsequent English achievement through English interests (see Figure 6).

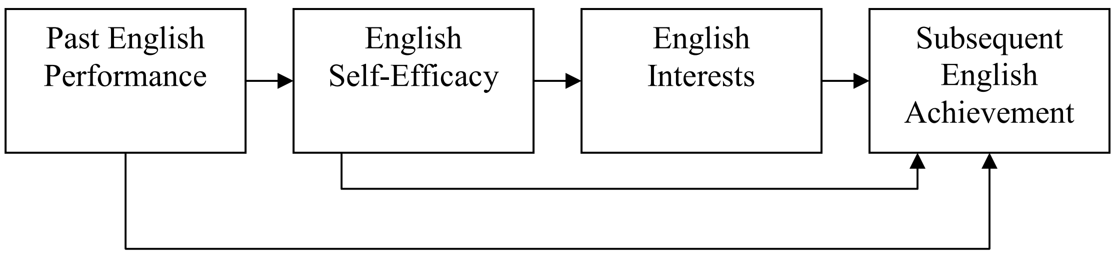

Figure 6. Model for Predicting English Achievement.

Gender Differences: Another purpose of this study was to examine the differences between genders in self-efficacy and interests for nontraditional fields. The seventh hypothesis contained three parts: (a) male students, compared to female students, would have significantly higher mathematics self-efficacy and science self-efficacy means; (b) male, compared to female students, would have significantly higher math interest and science interests means; and (c) female students will show significantly higher self-efficacy and higher interest means for English, compared to the math, physics, and chemistry subjects.

Rationale for the Hypotheses.

All the hypotheses proposed above were based on the construct relations theorized by SCCT (Lent et. al., 1994) and extant empirical research into the tenets proposed by the authors of SCCT. The rationale for each individual hypothesis is described below.

Self-Efficacy: Bandura's (1977, 1997) self-efficacy theory posited that performance attainments, vicarious learning, social persuasion and anxiety are factors that determine a person's self-efficacy (Zimmerman, 2000). Empirical evidence supporting the hypothesis has been found in studies that found that past performance influences self-efficacy expectations (e.g. Lent et al., 1993; Matsui et al., 1990; Zeldin & Pajares, 2000). Similarly, social persuasion (e.g. Lent, et. al, 1996, Lent et. al., 1991, Matsui et al., 1990) and vicarious learning (e.g. Lent et al., 1991, Matsui et al., 1990) were found to significantly influence self-efficacy.

The volume of empirical evidence that suggests that sources of self-efficacy beliefs and past performance influence self-efficacy led to the first hypothesis that math self-efficacy is influenced by the sources of math/science self-efficacy, and previous mathematics performance. Similar reasoning led to the third hypothesis that science self-efficacy is influenced by the sources of math/science self-efficacy, and previous science (physics and chemistry) performance. While no studies were found that were related specifically to sources of English self-efficacy, fifth hypothesis that stated that past English performance would be related to English self-efficacy.

Achievement: Self-efficacy has also been shown to have a significant direct effect on a person's interests (e.g. Brown & Lent, 1996; Ferry et al., 2000; Lent & Hackett, 1987; Lent, Larkin, & Brown, 1989; Lent et al., 1993; Rottinghaus et al., 2003; Schaub & Tokar, 2005). Self efficacy also has an effect on academic performance, both directly (e.g. Ferry et al., 2000, Hackett et al., 1992, Lent et al., 1984, Lent et al., 1986, Lent & Hackett, 1987), and indirectly (e.g. Ferry et al., 2000, Lent et al., 1993). Similarly, interest has also been found to influence academic performance (e.g. Ferry et al., 2000, Lent et al., 1993). The rationale for the second and fourth hypotheses was drawn from the results of the above research. Thus, it was proposed that for the Asian Indian sample too, math self-efficacy and math interests would directly predict math achievement; science self-efficacy and science interests will directly predict physics and chemistry achievement; math self-efficacy would indirectly (though math interests) influence subsequent math achievement; and that science self-efficacy would indirectly (through science interests) predict physics and chemistry achievement. The rationale for the sixth hypothesis about the relation between English self-efficacy, interests, and achievement also follow from the SCCT, and the existing research literature.

Gender Differences: Even within U.S. samples, gender differences have been observed for math self-efficacy and science self-efficacy which indicate that men report higher math and science self-efficacy and interests than women (Gainor & Lent, 1998; Pajares & Graham, 1999; Post, Stewart, & Smith, 1991). In India, mathematics and science related fields have traditionally been male-dominated academic areas (Gupta & Sharma, 2003). Women are often hindered from entering mathematics/science related professions and training (Gupta & Sharma, 2003; Mukhopadhyay & Seymour, 1994). Low enrollment of women in nontraditional areas of study (Gupta & Sharma, 2002, Indiresan, 2002) also might reinforce the sex-role stereotype to women that mathematics, science, and engineering-related fields are masculine. Thus women receive less vicarious learning as well as social persuasion to study nontraditional subjects, thus lowering their self-efficacy and in turn their interest in nontraditional areas. This leads us to speculate that male students may display higher self-efficacy and interests than female students in mathematics and science-related subjects.

Asian Indian women have been traditionally relegated to English, social science, and art related subjects (Gupta & Sharma, 2003), and very often hindered from entering mathematics/science related professions and training (Gupta & Sharma, 2003; Mukhopadhyay & Seymour, 1994). Thus, they receive limited vicarious learning or social persuasion for entering a nontraditional vocational area, and it is possible that their self-efficacy related to the math and science related areas would be less than their self-efficacy related to traditional areas of study for which they receive many more positive modeling and social persuasion experiences.

CHAPTER FOUR: RESULTS

Descriptive Statistics and Preliminary Analyses

Hatcher (1994) recommended that at least 200 participants, and at least five subjects for each parameter to be estimated, are needed when using path analysis. For the proposed models, the sample size of 316 participants was utilized. The data was checked for multivariate normality, and the were found not to multivariate normal, $\chi^2(2, N = 316) = 350.67$, $p < .001$. Therefore, the scaled chi-square statistic developed by Satorra & Bentler (1988) was used for adjusting the impact of non-normality on the results. Means, standard deviations, and zero-order correlations for the seventeen measured variables (i.e., three sources of math/science self-efficacy, four past performance attainment, four academic performance, three self-efficacy, and three interest variables) are shown in Table 5. Not surprisingly, performance attainment scores for mathematics, physics, chemistry, and English are strongly correlated ($r > .50$) with each other. Similarly, achievement scores for mathematics, physics, chemistry, and English are also strongly correlated ($r > .50$) with each other. This indicates that students who perform well in one subject are apt to perform well in other subjects as well. Also, I anticipated that performance attainment would be strongly correlated with academic achievement, both within and across subjects. These correlations were found as expected. Performance attainment scores for physics, chemistry, and English were found to be highly correlated ($r > .50$) with achievement scores for physics, chemistry, and English. For mathematics, performance attainment was highly correlated ($r > .50$) with English achievement and moderately ($r > .30$) with math, physics, and chemistry achievement scores. And achievement scores were moderately correlated ($r > .30$) with all performance attainment scores.

As shown in Table 5, the sources of self-efficacy were also found to be moderately correlated with each other ($r > .30$). One exception was emotional arousal, which displayed strong negative correlation ($r = -.61$) with social persuasion, indicating as expected that the more positive reinforcement an individual received regarding his/her math/science skills, the less anxious he/she was about them. These three sources of self efficacy were found to be significantly correlated ($r > .20$) with math interests. Math self-efficacy was significantly correlated ($r > .20$) with two of the sources – emotional arousal and social persuasion. Additionally, science interests appeared to be correlated positively with social persuasion ($r > .20$).

Interestingly, math self-efficacy was significantly correlated ($r > .20$) with both the prior and the subsequent English, physics, and chemistry performances, but not with math performance at either time. Also, math interests were significantly correlated ($r > .20$) with both the prior and the subsequent physics and chemistry performances, but with neither math performance. The within-subject self-efficacy – interest correlation ranged from moderate ($r > .30$ for math and science) to high ($r = .62$ for English). Between subject self-efficacy – interest correlation was significant ($r > .20$) for science and English, but not for mathematics.

The zero-order correlations for same seventeen variables by sex are shown in Table 6. Striking amongst the differences between males and females was the correlation between science self-efficacy and math achievement. While high science self-efficacy in females appeared to be positively correlated with math achievement ($r = .22$), for males curiously there appears to be a weakly negative correlation ($r = -.14$) between these variables indicating that higher science self-efficacy was related to lower math scores for males. Also, for females, the English self-efficacy shows significant correlation ($r = .29$) with English performance attainment. For males, this correlation is non-significant (r = .002). However, math achievement scores displayed stronger correlation with chemistry and English achievement for males (r > .60) than for females (r > .30).

In order to further examine the major variables of this study, I conducted thirteen 2 (sex) by 2 (school) analyses of variance (ANOVAs), with the dependent variables being the three sources of math/science self-efficacy (SASS subscales for emotional arousal, social persuasion, and vicarious learning), four past performance attainment (11th grade final exam scores for math, physics, chemistry, and English), three self-efficacy (Fouad-Smith subscales for math SE, science SE, and English SE), and three interest subscales (Fouad-Smith subscales for math IN, science IN, and English IN). A Bonferroni adjustment was applied to control for multiple comparisons ($p < .05/13 = .004$). As shown in Table 7, this revealed that math performance attainment, [$F_{Math}(1, 249) = 17.55$, $p < .0001$], and math self-efficacy [$F(1, 312) = 17.11$, $p < .0001$] yielded main effects for sex. Female students compared to male students performed better on math tests and demonstrated greater math self-efficacy. There was also a main effect of the school for emotional arousal, [$F(1, 312) = 85.08$, $p < .0001$]; social persuasion, [$F(1, 312) = 62.50$, $p < .0001$]; math performance attainment, [$F_{Math}(1, 249) = 80.25$, $p < .0001$]; English performance attainment, [$F(1, 312) = 68.98$, $p < .0001$]; science self-efficacy, [$F(1, 312) = 11.91$, $p < .001$], and science interests [$F(1, 312) = 9.42$, $p < .003$]. These effects indicate that students of the less affluent school were less anxious about their math/science efficacy and received more positive social persuasion about their math/science skills than did the students of the more affluent school. They also reported higher science interests than the students of the more affluent school. However, students of the more affluent school had higher math and English performance attainment, and higher science self-efficacy than those from the less affluent school. No significant sex X school interactions were observed.

Next, I conducted thirteen 2 (sex) X 3 (track) ANOVAs for the same variables as the 2 X 2 ANOVAs above. Once again, a Bonferroni correction was made to control for multiple comparisons ($p < .05/13 = .004$). The results are shown in Table 8. Main effects for sex were found only for math self-efficacy [$F(1, 310) = 11.06$, $p < .001$]. Female students reported more math self-efficacy than male students. Main effects for track were observed for emotional arousal, [$F(2, 310) = 21.41$, $p < .0001$]; social persuasion, [$F(2, 310) = 9.52$, $p < .0001$]; math performance attainment, [$F_{Math}(1, 249) = 48.72$, $p < .0001$]; physics performance attainment, [$F(1, 256) = 59.10$, $p < .0001$]; chemistry performance attainment, [$F(1, 256) = 47.26$, $p < .0001$]; English performance attainment, [$F(2, 310) = 377.96$, $p < .0001$]; math self-efficacy, [$F(2, 310) = 12.68$, $p < .0001$]; math interests, [$F(2, 310) = 8.29$, $p < .001$], and science interests [$F(2, 310) = 25.32$, $p < .00$]. Students in the MPC track displayed less anxiety about their combined math/science skills than those in the BPC or MEC tracks. They also reported higher social persuasion for their combined math/science self-efficacy than the students in the BPC and MEC tracks. Students in the MEC track performed better on their math tests than students in the MPC track. However MPC students, who took math in addition to science classes, scored significantly higher in their physics and chemistry tests than did BPC students who took only science classes. MEC students scored the highest in English, followed by MPC students, and students in the BPC track scored the lowest in English compared to MEC and MPC track students. Students in the MPC and MEC tracks (taking math classes) showed higher math self-efficacy and math interests than students in the BPC track (not taking math classes). Regarding science interests, the BPC only science) students reported the highest interest followed by MPC (science and math) students. MEC students, who took no science classes, endorsed the lowest science interests. No sex X track interactions were observed.

Path Analyses

Preliminary regression analyses indicated that the students' sex, school, and track accounted for significant variation in the students' performance attainment. Also, for the nontraditional (math/science) subjects, there were significant differences across differential parental education. Consequently, these variables were included in the hypothesized models. The less affluent school offered only the MPC and BPC tracks to its students, while the more affluent school offered the MPC, BPC, and the MEC tracks. Since all three tracks were not offered by both schools, it was not possible to include both school and track in the same model. The results of the path analysis will be ordered according to the three subjects: mathematics, science, and English. Within each of these subjects, I will first present the models for the prediction of self-efficacy followed by the models for prediction of achievement.

For the prediction of both self-efficacy and achievement, two models will be tested that are identical with one exception. In the first model, the school attended (less affluent vs. more affluent) is one of the exogenous variables. In the second model, track replaces school as one of the exogenous variables. For the math models, track was defined as taking math and science classes versus only taking math classes (MPC vs. MEC). For the science models, track was defined as taking math and science classes versus only taking science classes (MPC vs. BPC). For the English models, track was defined as taking math and science classes versus only taking science classes versus only taking math classes (MPC vs. BPC vs.

MEC). The notation $\text{Model1}_{\text{subscript}}$ will be used to represent a model that includes school as the exogenous variable. The notation $\text{Model2}_{\text{subscript}}$ will be used to represent models that include track as the exogenous variable. The subscript in these notations will indicate the endogenous variable being predicted (subject-specific self-efficacy or academic achievement).

In order to conduct the path analysis, the maximum-likelihood method in LISREL 8.80 was used. To assess the goodness-of-fit of the model, Hu & Bentler (1999) suggest the comparative fit index (CFI; values greater than or equal to .95 indicate a sufficient goodness-of-fit), and the standardized root-mean-square residual (SRMR; values less than or equal to .08 or less signify adequate fit to the data). The fit indices of all ten models are shown in Table 9.

Mathematics Self-efficacy. The first hypothesis is that the sources of mathematics/science self-efficacy as operationalized by the EA, VL, and SP subscales of SASS and math performance attainment will directly contribute to math SE. The proposed models for mathematics are shown in Figure 7 ($\text{Model1}_{\text{MathSE}}$) and Figure 8 ($\text{Model2}_{\text{MathSE}}$). The initial test of the $\text{Model1}_{\text{MathSE}}$ resulted in a good fit to the data: standard $\chi^2(6, N = 253) = 32.24$, $p < .001$, scaled $\chi^2(6, N = 253) = 26.08$, $p < .001$, CFI = .97, SRMR = .04. All hypothesized paths except the direct paths from social persuasion and vicarious learning to math SE, and the direct path from father's educational attainment to math performance attainment were found to be significant. This is indicated in Figure 7. $\text{Model2}_{\text{MathSE}}$ also resulted in a good fit to the data: standard $\chi^2(6, N = 253) = 12.03$, $p = .06$, scaled $\chi^2(6, N = 253) = 11.27$, $p = .08$, CFI = .99, SRMR = .03. Once again, all paths except the direct paths from social persuasion and vicarious learning to math SE, and the direct path from father's educational attainment to math performance attainment were found to be significant. This is illustrated in Figure 8. Thus, path analysis indicates that sex of the student influences both self-efficacy and past performance. Female students perform better than male students in math classes, as well as report higher math self-efficacy.

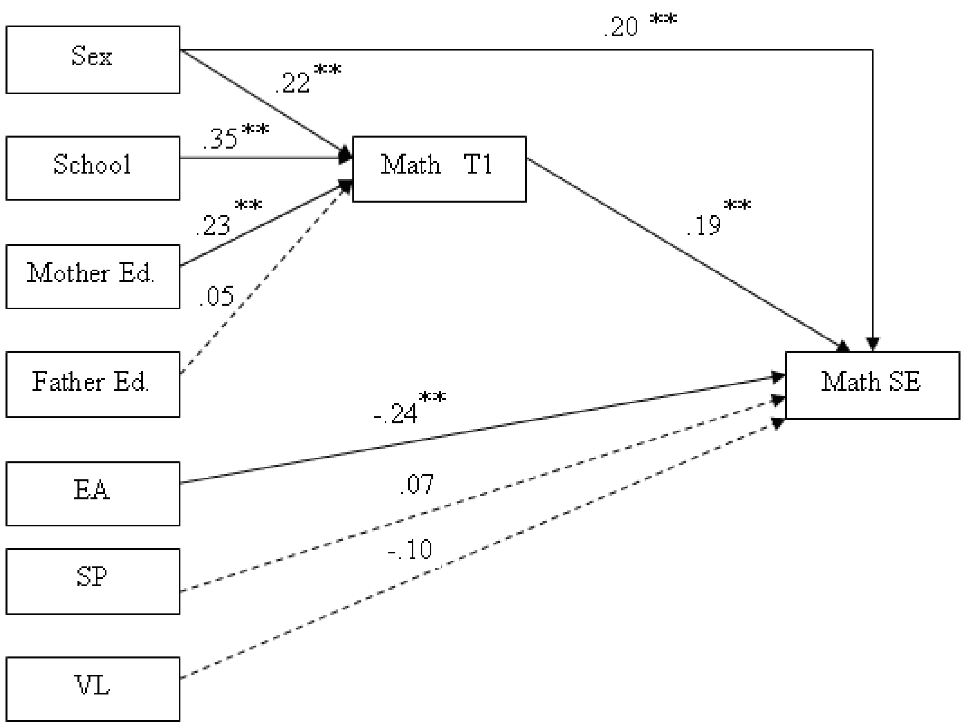

Figure 7. Model1$_{MathSE}$. *Note*: n = 253. * $p < .05$, ** $p < .01$.

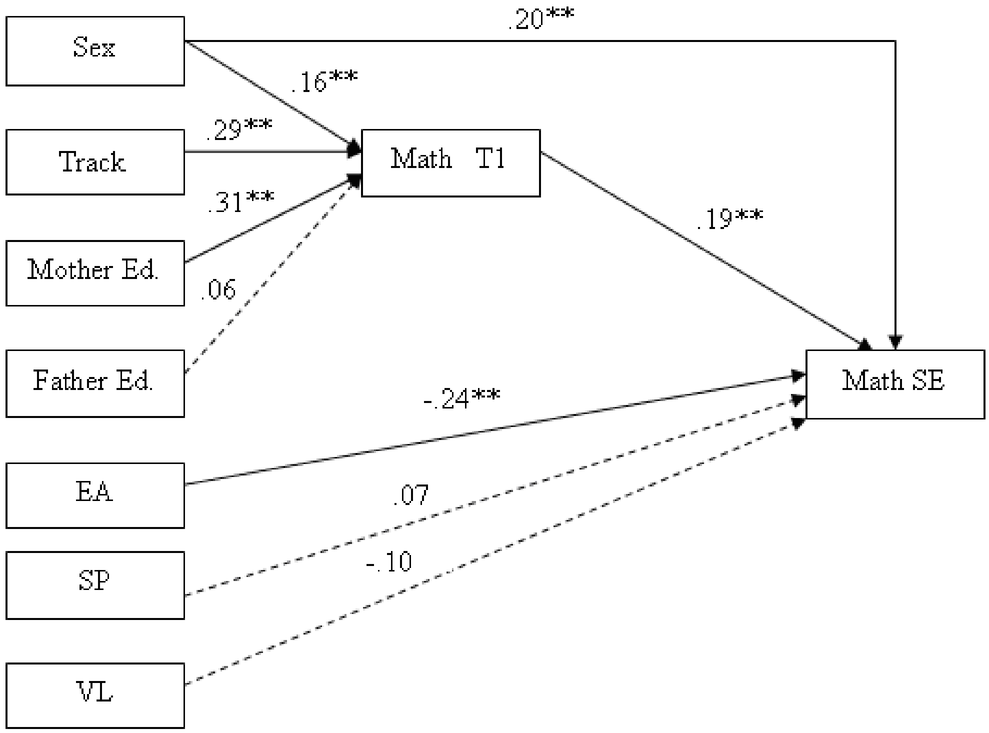

Figure 8. Model2$_{MathSE}$. *Note*: n = 253. * $p < .05$, ** $p < .01$.

Mathematics Achievement. The second hypothesis posits that math SE and math IN operationalized as the mathematics SE and Interests subscales on the Fouad-Smith Scales, will significantly predict the math achievement once the variation due to math performance attainment is removed. It was also hypothesized that math SE will directly contribute to the math achievement and indirectly contribute to math achievement through math IN. Also, it was hypothesized that math IN will directly contribute to math achievement. Results of path analyses for these hypotheses are represented in Figure 9 (Model1$_{MathAch}$), and Figure 10 (Model2$_{MathAch}$). Model1$_{MathAch}$ did not adequately fit the data: standard $\chi^2(5, N = 253) = 164.17$, $p < .001$, scaled $\chi^2(5, N = 253) = 135.90$, $p < .001$, CFI = .40, SRMR = .15. Furthermore, Model2$_{MathAch}$ while displaying a better fit than Model1$_{MathAch}$, still did not demonstrate adequate fit to the data: standard $\chi^2(5, N = 253) = 38.07, p < .001$, scaled $\chi^2(5, N = 253) = 43.43, p < .001$, CFI = .78, SRMR = .07.

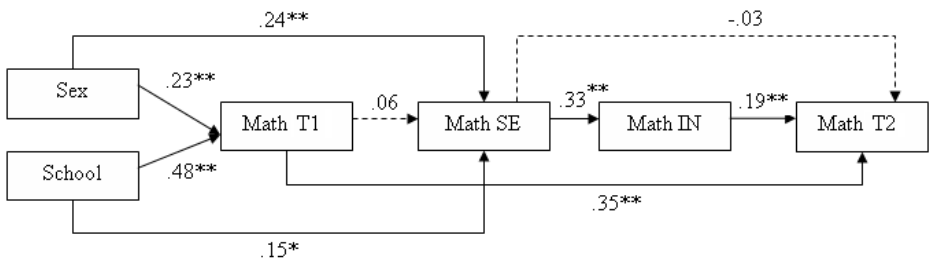

Figure 9. Model1$_{MathAch}$. *Note*: n = 253. * $p < .05$, ** $p < .01$.

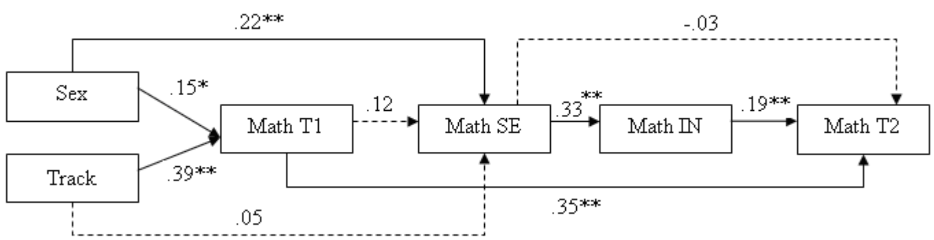

Figure 10. Model2$_{MathAch}$. *Note*: n = 253. * $p < .05$, ** $p < .01$.

In Model1$_{MathAch}$, all paths except past math academic performance → math self-efficacy, and math self-efficacy → future math achievement were significant. The path from math interest → math achievement, indicating that the math SE → math achievement predictive relationship is fully mediated by math interest. Path analysis of Model2$_{MathAch}$ yielded similar results. However, in this model track → math self-efficacy path was non-significant indicating that when taking similar math classes, the student's math self-efficacy is independent of their track.

Science Self-efficacy. The third hypothesis is that the sources of mathematics/science self-efficacy as operationalized by the EA, VL, and SP subscales of SASS and performance attainment for physics and chemistry will directly contribute to science SE. The proposed models for science are shown in Figure 11 ($Model1_{SciSE}$) and Figure 12 ($Model2_{SciSE}$).

Path analysis of $Model1_{SciSE}$ yielded some support for the hypothesis: standard $\chi^2(9, N = 260) = 77.34$, $p < .001$, scaled $\chi^2(9, N = 260) = 74.48$, $p < .001$, CFI = .90, SRMR = .08. All paths in this model with the exception of sex → science SE were non-significant indicating that the science self-efficacy of the sampled students was independent of past science performance or any of the three measured sources of academic self-efficacy. Also, science performance attainment appears to be independent of sex, school or parents' educational attainment.

Running the $Model2_{SciSE}$ resulted in a good fit to the data: standard $\chi^2(9, N = 260) = 48.58$, $p < .001$, scaled $\chi^2(9, N = 260) = 42.26$, $p < .001$, CFI = .96, SRMR = .06. Results of this path analysis are shown in Figure 12. Path analysis indicated that track was a significant predictor of the science achievement of the students. Students who took both math and science classes showed better physics performance while students who took science but no math classes performed better on chemistry compared to students who took both math and science classes. Additionally a significant path from chemistry → science self-efficacy indicates that higher chemistry performance attainment related to higher science self-efficacy. Sex of the student was not an indicator of either self-efficacy or academic performance in physics or chemistry.

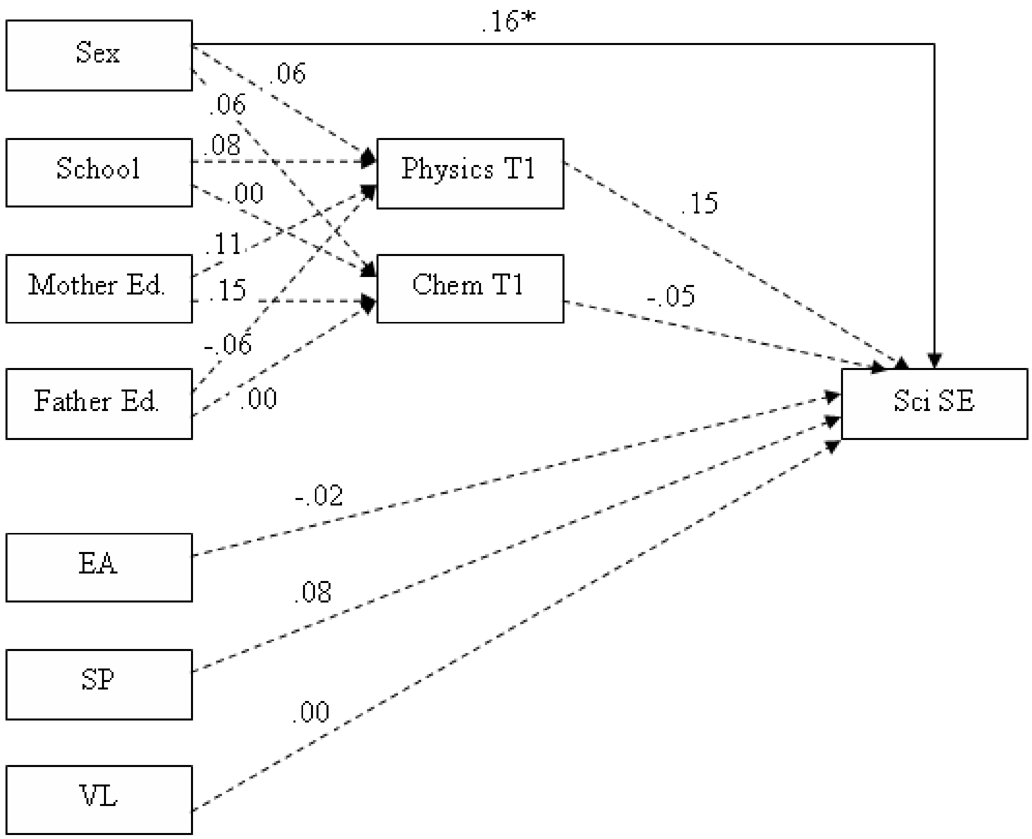

Figure 11. Model1$_{SciSE}$. *Note*: n = 260. * $p < .05$, ** $p < .01$.

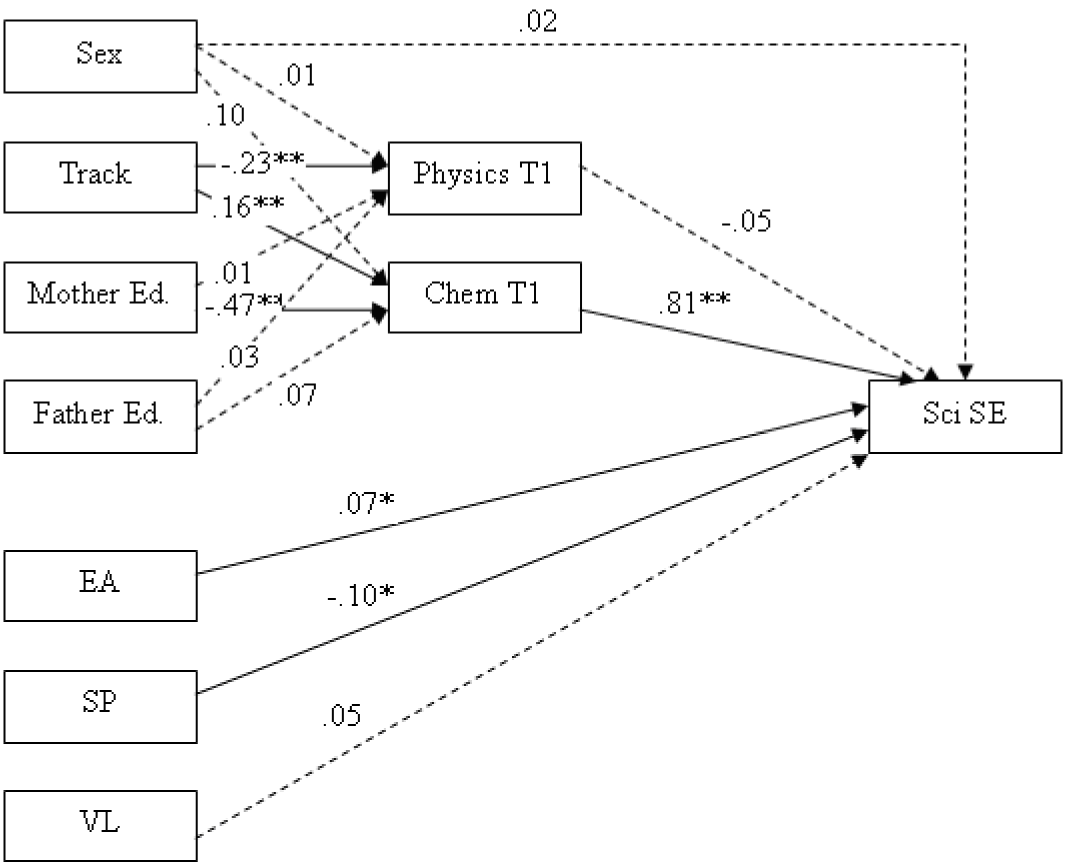

Figure 12. Model2$_{SciSE}$. *Note*: n = 260. * $p < .05$, ** $p < .01$.

Science Achievement. The fourth hypothesis postulates that science SE and science IN operationalized as the science SE and Interests subscales on the Fouad-Smith Scales, will significantly predict the science (physics and chemistry) achievement once the variation due to physics and chemistry performance attainment is removed. It was also hypothesized that science SE will directly contribute to the science achievement and indirectly contribute to science achievement through science IN. Also, it was hypothesized that science IN will directly contribute to science achievement.

Path analysis for Model1$_{SciAch}$ did not result in a good fit to the data: standard $\chi^2(8, N = 260) = 194.13$, $p < .001$, scaled $\chi^2(8, N = 260) = 158.94$, $p < .001$, CFI = .83, SRMR = .13. None of the suggested modification indices were theoretically feasible. Further exploration might be needed to identify alternate models that might result in a better fit the data. Figure 13 illustrates this model. As expected, past academic performance significantly predicts the future academic achievement. Science self-efficacy is a moderate predictor of science interest. Also, the path from science self-efficacy → performance on physics tests was fully mediated by science interests.

Model2$_{SciAch}$ resulted in a better fit to the data than Model1$_{SciAch}$, though not an adequate one. Standard $\chi^2(8, N = 260) = 142.97$, $p < .001$, scaled $\chi^2(8, N = 260) = 126.21$, $p < .001$, CFI = .88, SRMR = .09. This model indicated significant paths from track → physics performance and from track → chemistry performance. We can infer that students who took both math and science classes performed better on science tests than students who took science classes alone. Figure 14 illustrates this.

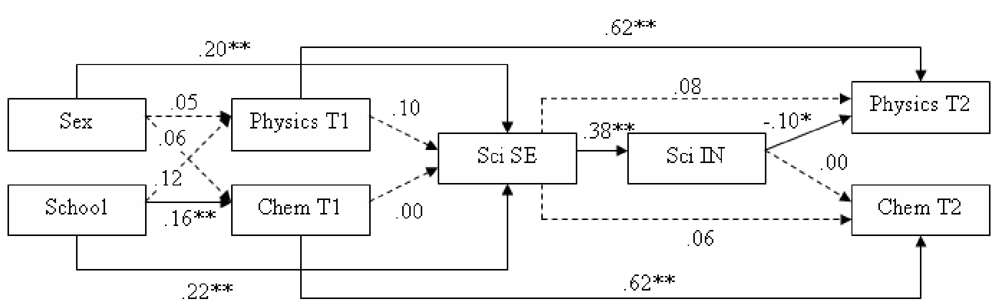

Figure 13. Model1$_{SciAch}$. *Note*: n = 260. * $p < .05$, ** $p < .01$.

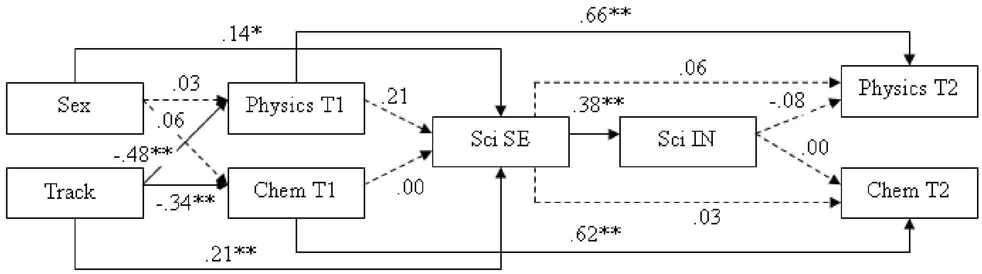

Figure 14. Model2$_{SciAch}$. *Note*: n = 260. * $p < .05$, ** $p < .01$.

English. The fifth hypothesis was that past performance attainment for English will directly contribute to English SE. And the sixth hypothesis proposed that English SE and English IN will significantly predict the subsequent English achievement. It was also anticipated that English SE will directly contribute to the English IN and indirectly contribute to English achievement through English IN. In addition, it was hypothesized that English IN will directly contribute to subsequent English achievement. The models illustrating these hypothesis and the results of the path analysis used to test these models are presented in Figure 15 and Figure 16.

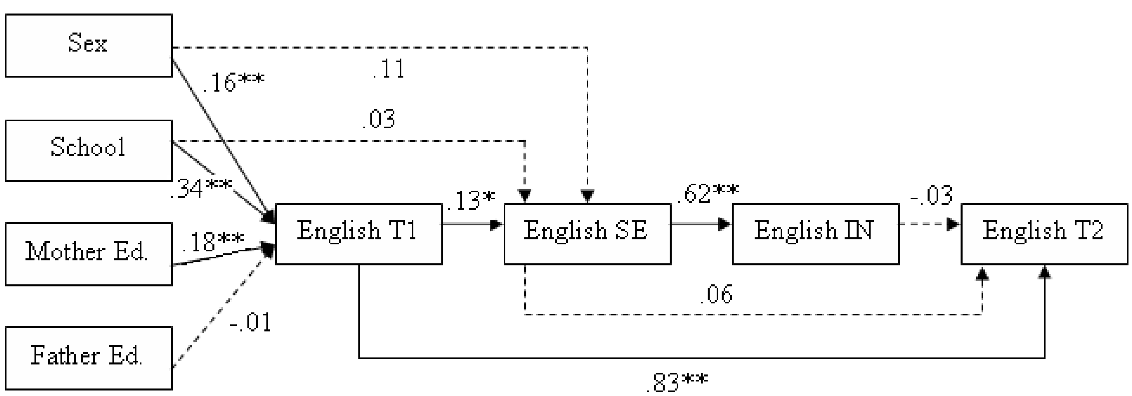

Figure 15. Model1$_{English}$. *Note*: n = 316. * $p < .05$, ** $p < .01$.

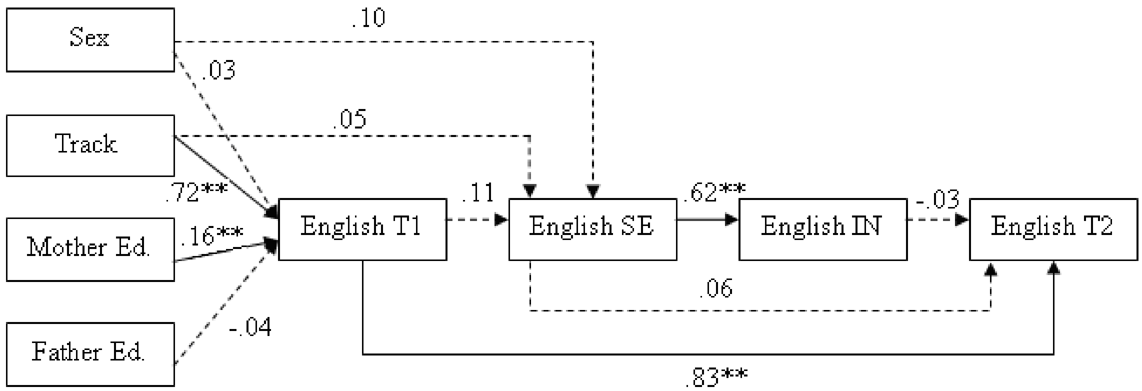

Figure 16. Model2$_{\text{English}}$. *Note*: n = 316. * $p < .05$, ** $p < .01$.

Model1$_{\text{English}}$ resulted in an excellent fit to the data: standard $\chi^2(11, N = 316) = 38.07$, $p = .004$, scaled $\chi^2(11, N = 316) = 27.12$, $p = .004$, CFI = .98, SRMR = .03. All of the proposed hypotheses except two were supported by the path analysis. The path analysis failed to support significant predictive relationship between English SE → English achievement, and between English interests → English achievement. Additionally, path analysis showed that the higher the mother's educational attainment, the higher academic performance attainment was likely to be. No significant causal link between sex and academic performance, or sex and English self-efficacy was ascertained.

Similarly, Model2$_{\text{English}}$ also resulted in an excellent fit to the data: standard $\chi^2(11, N = 316) = 23.02$, $p = .02$, scaled $\chi^2(11, N = 316) = 22.98$, $p = .02$, CFI = .99, SRMR = .03. The hypothesized paths that were found to be non-significant were English performance attainment → English SE; English SE → English achievement; and English interests → English achievement.

Additional Hypothesis: In addition to proposing the above subject specific models, the seventh hypothesis concerned sex differences, and contained three parts. Firstly, I hypothesized that male students would have significantly higher mathematics self-efficacy and science self-efficacy than the female students. Independent samples t-tests indicated that there was a significant difference between the male and female students for math self-efficacy: $t(314) = -3.91$, $p < .01$, and for science self-efficacy: $t(314) = -2.85$, $p < .01$; with female students reporting higher math and higher science self-efficacy than the male students. Secondly, I hypothesized that male students will have significantly higher nontraditional (mathematics/science) interests than the female students. Independent samples t-tests indicated that there was no significant difference between the male and female students for math interest: $t(314) = .97$, $p > .05$; or for science interest: $t(314) = 1.29$, $p > .05$. Thirdly, I hypothesized that female students will show higher self-efficacy and higher interests in the traditional (English) subjects than in the nontraditional (math and science) subjects. A paired samples t-test showed that the female students sampled show no statistically significant difference between science self-efficacy and English self-efficacy: $t(162) = .38$, $p > .05$. Similarly, no significant difference was observed between the science interests and English interests: $t(162) = .61$, $p > .05$. However, female students reported higher math self-efficacy than English self-efficacy: $t(162) = 5.85$, $p < .001$; and higher math interests than English interests: $t(162) = 1.98$, $p < .05$.

Testing the Significant Levels of Indirect Effects

Finally, the bootstrap procedure was used to test levels of indirect effects (e.g. MacKinnon et. al., 2002; Shrout & Bolger, 2002). Bootstrapping is an empirical method used to test the significance level of the indirect effects. In the bootstrap procedure (Shrout & Bolger, 2002), for each model, by randomly sampling the original sample, with replacement, the bootstrap method created 1000 samples of participants. The bootstrap sample size varied according to the original data sets of the respective models. For example, the models for mathematics were sampled 1000 times with replacement to create 1000 samples with n = 253. Similarly, for the science models, n = 260, and for the English models, n = 316. Following this, each of the models is tested with their 1000 respective bootstrap samples, yielding for each model 1000 different estimates of each path coefficient. Then, estimates of the indirect effects were computed from the resulting output by multiplying the path coefficients of (a) the exogenous variables to the mediator variables, and (b) the mediator variables to the endogenous variables. Next, the 95% confidence intervals (CI) were computed for the 1000 indirect effect estimates. If the CI's did not include zero, they were considered significant at the .05 level (Shrout & Bolger, 2002). A statistically significant CI provides evidence that the indirect effects tested by the model are significant.

The results in Table 10 show the results of the bootstrap procedure for these models. It was anticipated that self-efficacy would influence achievement indirectly through interests for math, science and English. As shown, the only hypothesized indirect effect that proved to be significant was for math SE → math IN → math achievement. The indirect effects of science self-efficacy on physics and achievement and chemistry achievement, and that of English self-efficacy on English achievement were insignificant.

CHAPTER FIVE: DISCUSSION

In order to facilitate ease of comprehension, this section will be structured in the following manner. I will first discuss, interpret and evaluate the results of the present study according to the three subjects: mathematics, science, and English. Within each of these subjects, I will first talk about the subject-specific self-efficacy followed by a discussion of the subject-specific academic achievement. This will be followed with an account of the contextual factors that influence the variables of note in this study. These contextual factors include sex, track, and parental educational attainment. Finally, I will examine the limitations of this study, offer recommendations for future research and review the implications that the results of this study have on vocational counseling, and their possible applications.

Hypotheses

The intent of the present study was to determine if sources of self-efficacy predict self-efficacy and subsequently do social cognitive variables predict achievement in an Asian Indian high school population. The hypotheses were based on SCCT (Lent et al., 1994). The hypothesized models extended the SCCT model to the Indian high-school population and attempt to assess the effects of interests and academic self-efficacy of Indian 12th grade students on their academic performance. Specifically, to assess whether subject-specific self-efficacy and interests at the beginning of the 12th grade academic year significantly predict 12th grade half-yearly academic performance in 12th grade high school students in India. This study also attempts to gauge whether significant differences exist in the self-efficacy and interests of male and female students in the math, science and English subjects.

Mathematics Self-efficacy. The first hypothesis proposed that the sources of academic self-efficacy for mathematics/science and the past performance attainment for mathematics will directly contribute to the math self-efficacy of the individuals. The hypothesized model for the prediction of math self-efficacy was based on SCCT (Lent et al., 1994). Path analysis resulted in a good fit of the model to the data, and the results supported the first hypothesis. Past math performance attainment (i.e., mastery) was found to be significantly related to math self-efficacy, supporting the hypothesized relation. This finding is also in accordance with previous empirical evidence that shows that mastery is the strongest predictor of self-efficacy among the four sources (e.g. Bandura, 1986; Britner & Pajares, 2006; Klassen, 2004; Lent et. al., 1996; Muretta, 2005; Usher & Pajares, 2006). Muretta (2005) found that emotional arousal is a better predictor of self-efficacy than social persuasion and vicarious learning. This finding was reinforced by the results of this study that found that of the remaining sources of self-efficacy, math/science emotional arousal was the only one that demonstrated a significant relation with math self-efficacy. Specifically, the results indicate that there is a significant negative correlation between emotional arousal and self-efficacy indicating that the more anxious a student is about his/her math/science skills, the lower his/her math self-efficacy is.

Although I expected sex to be a significant predictor of math self-efficacy, the results were opposite to my expectations and those stated in the U.S. samples (e.g. Lent et. al., 1991; Betz & Hackett, 1983; Lapan et. al., 1999) with females and males in the mathematics domain. In this Asian Indian sample, girls had significantly higher rather than lower math self-efficacy after other factors had been removed. This finding is intriguing given the writings that suggest that women lose confidence in science and math related areas due to sex-role defined messages within the society (Seymour & Hewitt, 1997). Given Indian society as being patrifocal, these girls likely heard those messages but somehow their confidence in math was not impacted.

Mathematics Achievement. The second hypothesis was that math self-efficacy and math interests would directly influence the subsequent math achievement after the variance due to the 11th grade final math examination was removed. Also, that math self-efficacy would indirectly contribute to subsequent math achievement through math interest. A multitude of research findings within the realm of vocational psychology literature support the theorized conceptualization (SCCT: Lent et al., 1994) that, self-efficacy beliefs directly predict interests (e.g., Betz, Harmon, & Borgen, 1996; Betz & Hackett, 1997; Brown & Lent, 1996; Fouad & Smith, 1996; Fouad et. al., 2002; Lapan et. al., 1996; Lent et. al., 1991, 1993; Lopez et. al., 1997; Ozyurek, 2005; Rottinghaus et. al., 2003; Sax & Bryant, 2006; Schaub & Tokar, 2005; Smith & Fouad, 1999; Swanson, 1993; Zedlin & Pajares, 2000). Some research also reports that interests influence academic achievement (e.g. Lent et al., 1994; Long et. al., 2007; Schiefele et. al., 1992). Furthermore, it is theorized that self-efficacy predicts academic achievement directly and indirectly through interests (Lent et al., 1994; Lent et. al., 1997). The present results also provide empirical evidence to generally support the theoretical conceptualization that for mathematics, self-efficacy directly predicts interests. The higher the students perceived their math self-efficacy to be, the higher were their reported math interests. Given that self-efficacy and interests were measured concurrently, we cannot ascertain the causal nature of the relationship. Some studies have provided evidence that the influence is bi-directional (e.g., Nauta et. al., 2002; Tracey, 2002).

The present results provide empirical evidence indicating that for mathematics, interests directly predict math achievement. This study also found that the relation between math self-efficacy and math achievement is completely mediated by math interest. The SCCT model expects self-efficacy to have a direct effect on math achievement (Lent et al., 1994) and research supports that contention (e.g., Pajares, 1996b; Pajares & Miller, 1994, 1995). In fact, self-efficacy has been found to predict math performance even better than math anxiety (Pajares & Miller, 1994). As expected, math performance attainment was a significant predictor of subsequent math achievement. However, interests remained a significant predictor of math achievement after performance attainment was accounted for. This suggests that doing well in prior math courses and enjoying math both predict subsequent achievement.

It must be noted that the results of the path analysis indicate that the hypothesized models for math achievement did not fit well with the data from the current sample in that the paths from math performance attainment → math self-efficacy, and from math self-efficacy → math achievement were not found to be statistically significant. However, bootstrap analysis for the hypothesized indirect effects indicated that the indirect effect of math self-efficacy → math interest → math achievement was significant. Since the direct path math self-efficacy → math achievement was not found to be significant, this finding indicates that the effect of math self-efficacy on math achievement is entirely mediated by math interests. Among the hypothesized indirect effects, this was the only one that proved to be significant.

The non-significance of the paths from math performance attainment → math self-efficacy, and from math self-efficacy → math achievement is inconsistent with the theoretical model (SCCT; Lent et al., 1994). This non-adequate fit of the data and the non-significance of the paths involving self-efficacy, indicated that for the present sample, math self-efficacy might not be one of the factors that influenced math achievement. To test this, I ran both $Model1_{MathAch}$ and $Model2_{MathAch}$ again, this time eliminating self-efficacy from the model. The results indicated that the model $Model1_{MathAch}$ (which included school), was now a good fit the data: standard χ^2 (5, n = 253) = 31.22, $p < .001$, scaled χ^2 (5, n = 253) = 34.73, $p < .001$, CFI = .90, SRMR = .06. However, the fit of $Model2_{MathAch}$ (which included track) did not improve despite the elimination of the endogenous variable, self-efficacy. This suggests that factors that are not included in the original hypothesis might be more indicative of the self-efficacy, interests and academic achievement. Further research is needed to identify alternate models.

Science Self-efficacy. The third hypothesis posits that the sources of academic self-efficacy for math/science and the past performance attainment for physics and chemistry, will directly contribute to the science self-efficacy of the students. Based on the conceptual model (SCCT), and preliminary analyses, I expected that the three sources of self-efficacy, physics, and chemistry performance attainment (i.e., mastery), sex, school, track, and parental educational attainment, would predict science self-efficacy. Two models were run to test the hypothesized relationships, both identical except for one exogenous variable – the first model included school, and the second included track. For the first model, none of these hypothesized factors except sex displayed a significant predictive influence. It was found that female students display greater science self-efficacy than male students. This model was not a very good fit with the data, and did not support the first hypothesis for science. The results indicated that the science self-efficacy of the sampled students was independent of past science performance or any of the three measured sources of academic self-efficacy. Since current literature suggests that self-efficacy beliefs are determined to a large extent by mastery, anxiety, social persuasion, and modeling (e.g. Bandura, 1986; Britner & Pajares, 2007; Klassen, 2004; Lapin, 2001; Lent et. al., 1996; Muretta, 2005; Schaub & Tokar, 2005; Usher & Pajares, 2006), the obtained result highlights the need for additional research to identify other possible causal relations.

The second model, with track as the exogenous variable, yielded different results. For this sample, the hypothesized causal relation physics performance attainment to science self-efficacy proved to be non-significant ($\beta = -.05$). However, as hypothesized, chemistry performance attainment (mastery) displayed a strong ($\beta = .81$) positive causal relation to science self-efficacy. Similar trends were found by Britner & Pajares (2006) who reported that for science only mastery experiences predicted self-efficacy. Interestingly, they also found for their sample of U.S. middle school students that female students reported stronger science self-efficacy than male students. For the current study, in addition to mastery, emotional arousal, and social persuasion emerged as significant predictors of science self-efficacy. Both beta weights were quite modest in strength; however their loadings were opposite of expectations. High anxiety about math and science tasks related positively to higher science self-efficacy; and the presence of social persuasion for their math and science skills appeared to negatively influence science self-efficacy, namely more math/science anxiety and less math/science social persuasion related to higher self efficacy. Once again, these results are intriguing and seemingly inexplicable since current literature suggests that self-efficacy beliefs are determined to a large extent the sources of self-efficacy (Bandura, 1986; Britner & Pajares, 2007; Lent et. al., 1996; Schaub & Tokar, 2005; Usher & Pajares, 2006).

Amongst the various paths representing variable relations hypothesized by the science self-efficacy models, the only path of moderate or high significance supported by the literature is the relation between chemistry performance attainment and science self-efficacy ($\beta = .81$). This indicates that there is a need for further inquiry into the sources of science self-efficacy for Asian Indian students. One possibility for the non-significance of the hypothesized relations between the variables is that the Fouad-Smith subscales for science self-efficacy (see Appendix F for sample items) might not have captured the subject domain adequately as has already been discussed. Of the five items within the science self-efficacy subscale, only two items are directly and unambiguously related to physics and chemistry. Of the other three, one item ("Classify animals that I observe") relates to the biological sciences and did not relate to the other variables measured in this study. Another item, ("Construct and interpret a graph of rainfall amounts by state.") is ambiguous in that it might be interpreted to be related to statistics rather than science. A third item ("Predict the weather from weather maps") is directly indicative of neither physics nor chemistry.

With respect to sex, the science self-efficacy models yielded mixed results. When school was an exogenous variable in the model, the sex of the student was significant ($\beta = .16$). However, in the model with track, sex ceased to be significant with relation to science self-efficacy ($\beta_{Chem} = .02$). For $Model1_{SciSE}$, the result showing sex to be a predictor of science self-efficacy was anticipated. However, contrary to the hypothesis, this proved to be a positive rather than a negative loading. For this study, like math self-efficacy, girls reported higher science self-efficacy than boys after other factors were accounted for. These findings are also counter to studies in the U.S. that show men reporting stronger science self-efficacy than women (Cohen's *d* = .33; Rottinghaus, Betz, & Borgen; 2003).

Science Achievement. The fourth hypothesis proposed that science self-efficacy efficacy and science interests would directly predict the subsequent physics and chemistry examination scores after the variance due to the 11th grade final physics and chemistry examination was removed. Additionally, it was hypothesized that science self-efficacy would affect subsequent physics and chemistry achievement through science interests. Similar to self-efficacy, for examining causal relations for achievement, two models, varying school and track were tested. Neither model resulted in a good fit with the data. However, the results of these models partially support the second hypothesis for science. As anticipated, performance attainment was a strong predictor of subsequent achievement. Also, in congruence with standing research, science self-efficacy was a significant predictor of science interests (see Rottinghaus et al., 2003). Counter to the results of the current study, Kupermintz (2002) found that science self-efficacy predicts science achievement for middle school students.

The exclusion of parental educational attainment (which was part of the self-efficacy model) from the achievement model resulted in strengthening the effect of track on physics and science performance attainment (β_{Phy} = -.48; β_{Chem} = -.34). The path analysis shows that in this model, for both physics and chemistry, students who took both math and science classes (i.e., the MPC track) performed better than students who only took science classes (i.e., the BPC track). A very likely explanation for this might be that since physics and chemistry tests often necessitate mathematical computations, students who take math classes in addition to science classes perform better on these tests.

For the model including school, an atypical negative relationship between science interest and physics achievement was identified. Although the beta weight was not substantial (β = -.10), more science interests resulted in lower physics and achievement. The reason for such a finding is not immediately apparent. However, for both physics and chemistry, achievement was largely hypothesized to be accounted for by prior achievement in these subjects, and the track and school. Also, contradictory to the proposed hypothesis, no direct relation was found between science self-efficacy and science achievement. This finding is similar to the non-significant relation between self-efficacy and achievement for mathematics, also found for this sample. In addition, bootstrap analyses indicated that the science self-efficacy → science interests → physics achievement and the science self-efficacy → science interests → chemistry achievement paths were non-significant, indicating that science self-efficacy did not exert any indirect influence on either physics or chemistry achievement through science interests. These findings signify that for the students in this study, other unmeasured variable(s) influence achievement more than self-efficacy.

English Self-efficacy. The fifth hypothesis proposed that the English performance will directly contribute to English self-efficacy. Based on the theoretical model (SCCT) and preliminary analyses, in addition to the 11^{th} grade performance, it was anticipated that English self-efficacy would be related with sex, school (or track), mother's education, and father's education. Path analyses yielded excellent fits to the data for both models. In the first model (Figure 15), English performance attainment (mastery) was significantly related to English self-efficacy, but the magnitude was modest (β = .13). Also, all the exogenous variables except father's education level were indirectly related to English self-efficacy through prior English performance. No other sources of self-efficacy for English were measured in this study. The second model, entering track rather than school, shown in Figure 16, was similar to the earlier model with the exception of the role of sex, track, and prior

English performance attainment. When track was introduced into this model, sex ceased to be significant (β = .03) with relation to English performance attainment. However, track showed a much stronger relation (β = .72) than school with English performance attainment. Students who only took math [the MEC (math/economics/commerce) track] had the highest English performance attainment scores, followed by those students who took both math and science [the MPC (math/physics/chemistry) track]. Students who only took science courses [the BPC (biology/physics/chemistry) track] scored the lowest on their English performance attainment.

The students who attended the more affluent school generally performed better on English tests than those in the less affluent school. Also, income was significantly positively correlated with English performance attainment (r = .38) and with achievement (r = .30). By extension, it is possible to assume that affluence and/or other such unmeasured factors influenced the students' English self-efficacy. Additional research analyses could be conducted to look into this possibility.

English achievement. The sixth hypothesis was that English self-efficacy and English interests would directly predict subsequent English achievement after the variance due to the past English performance was accounted for. Also, it was proposed that English self-efficacy would indirectly influence subsequent English achievement through English interests. Both models, illustrated in Figures 11 and 12, yielded an excellent fit to the data regardless of whether school or track was one of the exogenous variables. English achievement was directly influenced by prior English performance attainment and indirectly influenced by all of the exogenous variables with the exception of father's education level. Thus here, self-efficacy and interests did not directly or indirectly influence achievement as witnessed elsewhere in the literature (e.g. Lent, Brown, & Larkin, 1987; Pajares & Kranzler, 1995; Pajares & Miller, 1995; Schiefele et. al., 1992).

As anticipated, a strong causal association was found between English self-efficacy and English interest (β = .62). This is consistent with other research findings that indicate a similar pattern (see Rottinghaus et al., 2003). In addition, the present results revealed insignificant indirect effects of sex (β = .01), school (β = .03) and mother's educational attainment (β = .01), on English self-efficacy. Finally, in accordance with expectation, a strong association was found between past and subsequent English achievement (β = .83). However neither English self-efficacy nor English interests were found to directly predict English achievement.

Once again, the lack of significant causal relations between self-efficacy and achievement is markedly noticeable for this sample. Current literature (e.g. Lent, Brown, & Larkin, 1987), has reported for non-English fields that self-efficacy and interests are significantly predictive of achievement, though self-efficacy is a stronger predictor of achievement than interest alone is. However, the hypothesis that for English, self-efficacy would directly predict achievement, and indirectly predict achievement through interests, did not find adequate support in the current study. Path analysis revealed that for both the models (with school, or track), English SE did not significantly predict English achievement. Furthermore, bootstrap analyses for both models (with school or track), did not reveal any significant indirect effect for English self-efficacy → English achievement.

I also hypothesized that for English, an individual's interests would directly predict their English achievement. This hypothesis too, was disconfirmed in this study. For both the English models (with school, or track), interests demonstrated no significant causal relation to achievement. While no research that was specific to English was found, this result is contrary to findings in the literature regarding the relation between academic interests and achievement (e.g. Long et. al., 2007; Schiefele et. al., 1992). Similar findings were also manifested for this sample for both math and science achievement, except for math interests which did predict math achievement. Bootstrap analysis of the hypothesized indirect effect of English self-efficacy on English achievement through English interests, once again indicated no significant results. Thus, English self-efficacy demonstrated no direct or indirect effect on English achievement. This atypical finding strongly emphasizes the need for further investigation into other probable influences on the English achievement of students in this sample.

Gender Differences. The seventh hypothesis pertained to the differences between the sexes in self-efficacy and interests. This hypothesis was tripartite. Given the disparity between the sexes, and the emphasis placed on a traditional education for women (Gupta & Sharma, 2002, 2003), it was expected that the Asian Indian female students (when compared with Asian Indian male students), would (a) demonstrate lower math self-efficacy and science self-efficacy, (b) report lower math interests and science interests, and (c) report higher self-efficacy and interests in English than in math or science.

The results obtained disconfirmed all of the above hypotheses. Female students demonstrated higher self-efficacy in both math and science areas than the male students. In the U.S., several studies have indicated that males tend to have higher self-efficacy beliefs related to mathematics compared with women (e.g. Gainor & Lent, 1998; Pajares & Graham, 1999; Post et. al. 1999). Although no comparable studies conducted in India could be found, based on the emphasis on a traditional education for women within the Indian culture (Gupta

& Sharma, 2002, 2003; Indresan, 2002), the assumption was made than men would demonstrate higher self-efficacy for the math-related areas. No U.S. studies with similar results were found in the literature, but a few studies (Fouad & Smith, 1996; Lopez & Lent, 1992; Middleton & Midgley, 1997) indicated that males and females did not differ in their math self-efficacy. Interestingly, female students also reported having higher interest in mathematics than the male students. Once again, this is a result that has very little (if any) support in the literature. Given that for this sample, girls outperformed the boys in mathematics, and that such mastery has the strongest influence on self-efficacy, it is not surprising that the girls report higher self-efficacy in this area. Also, since for this sample it was found that math self-efficacy and math interests were strongly related, it is reasonable to assume that good past performance attainment experiences have influenced both math self-efficacy and math interests for these girls. For science, female students when compared with male students demonstrated no significant differences in either self-efficacy or interests. Once again, this finding does not find a lot support in the literature. However, Britner & Pajares (2001), observed that female middle-school students in their study (n = 262), reported higher science self-efficacy than the male students. Similar to the current study, the girls in Britner & Pajares (2001) also obtained higher science grades than the boys.

No U.S. literature was found that specifically compared English self-efficacy and interest to science self-efficacy and interests, or to math self-efficacy and interests. However, Scott & Mallinckrodt (2005), found in their study that female high school students who were majoring in science reported higher self-efficacy than those who were not majoring in science. For the current study, since English is one of the traditional subjects for women, it was hypothesized that female students would show higher self-efficacy and interests in

English than they would in mathematics. This hypothesis was disconfirmed for the students in this study. For the comparison between English and science, girls did not demonstrate any differences between their English SE and Science SE, or between their English IN and science IN. However, they did show significantly higher math self-efficacy than English self-efficacy and higher math interests than English interests. Once again, this was an interesting difference, but could be explain by the fact that on the whole, girls performed better on their math examinations than on their English examinations, both during the 11th grade final examinations (M_{Math} = 77.97%, SD_{Math} = 10.92%; M_{Eng} = 52.01%, SD_{Eng} = 18.40%), and on the 12th grade half-yearly examinations (M_{Math} = 79.33%, SD_{Math} = 9.11%; M_{Eng} = 43.08%, SD_{Eng} = 17.57%).

Contextual Factors

Sex. For the students sampled for the present study, sex of the participants exhibited significant associations with several of the variables that I was interested in. For mathematics, sex was moderately associated with both performance attainment, and math self-efficacy. Surprisingly, female students performed better than male students in math classes. They also reported higher math self-efficacy. Even more surprising was the finding that this relation was also true for science, and to a smaller extent, for English.

One possible explanation for these findings might be that in a comparatively conservative and patrifocal culture where women are traditionally discouraged from pursuing nontraditional subjects (e.g. Mukhopadhyay, 1994; Mukhopadhyay & Seymour, 1994), the female students who have been tracked to math and science-related fields must perform better on tests and be more confident in their math and science skills than their male peers.

Jussim and Eccles (1992) found that some women held the belief that in order to succeed in traditionally male fields, they need to work harder than men within these fields. It was possible that the sampled Asian Indian female students held similar beliefs. In holding such an opinion, in order to perform as well as their male counterparts, they would have to strive to put in greater effort into their math and science classes, thus leading to higher self-efficacy, and subsequently to higher achievement. However when this possibility was tested by comparing the mean hours that the male and female students in math/science and science track reported having spent studying per week. This revealed that there was no significant difference between the sexes (M = 72.03 hrs/wk, SD = 12.90 for males, as compared with M = 71.67 hrs/wk, SD = 15.02 for females) in the amount of time they spent on preparation for classes.

The finding that female students consistently report higher math and science self-efficacy than male students is particularly interesting since math and science are nontraditional fields for women, and existing literature in the United States indicates that for in these areas, males report higher math and science self-efficacy (Rottinghaus et al., 2003). However, men and women within the same science, technology, engineering, or math (STEM) major have not shown differences in their confidence (e.g. Larson, Wei, Borgen, & Wu, 2007). Boys and girls in U.S. high schools however show no achievement differences (National Center for Education Statistics, 2005). Hackett and Lent (1992), reported that in samples of women and men who have comparable efficacy-building experiences, fewer self-efficacy differences are found even for traditionally gender-typed tasks. Finally, high school students from other countries reveal meaningfully higher (as high as one standard deviation) achievement scores in math than U.S. students and these countries' means also show girls either outperforming boys (e.g., Singapore) or no significant differences (e.g., Japan) (Mullis, Martin, & Foy, 2005).

School. The participants in this study were drawn from two schools. One of these schools was patronized by more affluent families than the other. In this study, school of the participant emerged as a variable that manifested significant associations with several of the key variables under investigation. For both math and English, an association of moderate magnitude (β_{Math} = .35; $\beta_{English}$ = .34) was found between school and performance attainment. In both cases, students of the more affluent school showed higher math and English performance attainment scores. Smaller associations (β_{Math} = .15; $\beta_{Science}$ = .22) were also observed between school and self-efficacy for math and science. Here too, students of the more affluent school reported higher self-efficacy in their math and science skills than the students from the other school. Interestingly, students of the less affluent school reported more interest in science, less math and science anxiety, and higher social persuasion. This indicates that some marked differences existed between the two schools.

Track. The participants in this study were drawn from three tracks: MPC (math and science classes), BPC (science classes, but no math), and MEC (math classes, but no science). Track was one of the contextual variables that demonstrated significant associations with the other variables under investigation. An association of moderate magnitude was found between track and math performance attainment (β = .29) indicating that students who took only math classes demonstrated higher performance attainment than did students who took both math and science classes. For science, students who took both math and science (i.e., the MPC track) performed better in chemistry, while students who only took science classes (i.e., the BPC track) performed better in physics. Track also demonstrated a moderate association with science self-efficacy (β = .21). Students who took only science classes reported higher science self-efficacy than students who took both math and science classes. For English, a strong association was found between track and English performance attainment (β = .72). Students who only took math [the MEC (math/economics/commerce) track] had the highest English performance attainment scores, followed by those students who took both math and science [the MPC (math/physics/chemistry) track]. Students who only took science courses [the BPC (biology/physics/chemistry) track] scored the lowest on their English performance attainment scores.

Since we were unable to enter both track and school into the same model, it was not possible to study the association between school and track. This would be an interesting direction of inquiry. It is possible that the effects of track and school might not be entirely independent of each other. For both math and English, students who only took math showed higher academic achievement. This track was offered only by the more affluent school. Thus, one conceivable reason for the high performance attainment of the MEC students might be their affiliation with the more affluent school. However, further investigation will be needed to confirm this hypothesis. While no conclusive evidence was found to indicate that affluence influences achievement, it has been found in the literature to influence other vocational behavior. When studying vocational education in Thailand, Moenjak & Worswick (2000), found that individuals from more affluent families were more likely to pursue vocational education (as compared with students who chose not to continue any education after secondary school).

Ozyurek (2005) found that for high school students in Turkey, while the sources of self-efficacy influenced self-efficacy, and self-efficacy predicted interests, neither math self-efficacy, nor math interests influenced math-weighted major preferences. Like the Asian Indian students sampled in the current study, the Turkish students in Ozyurek (2005) were tracked onto "desirable" tracks based on university entrance examinations. Thus, their individual interests and self-efficacy were outweighed by the chance to be part of an "elite" or popular track of study. It is possible that the Asian Indian students sampled in this research also follow similar thought processes.

Parental Educational Attainment. The associations between the educational attainment of the participants' mother and father, and the primary variables under investigation, were examined. Controlling for other variables, mothers' educational attainment was found to positively relate with performance attainment for math, science (especially chemistry), and English. The educational of the father was observed to be inconsequential across the board.

Other Potential Contextual Factors. The Eccles expectancy value model of achievement-related choices (Eccles et. al., 1983) describes some possible factors that could influence achievement. Eccles' model correlates achievement-related choices with general expectancy value beliefs (e.g. expectations of success, interpretation of past experiences, cultural beliefs etc.), and subjective task value of the available options (including the attainment value, costs, utility, and enjoyment) and other stable individual characteristics such as aptitudes, temperament, and personality. According to Eccles' model, cultural milieu such as gender roles, stereotypes, etc impact the individual's perception of past achievement-related experiences. As a result, the individual attaches affective reactions and memories to these experiences which in turn impact the individual's interpretation of the experiences. The model posits that the subjective interpretation of the experience can subsequently influence the individual's self-concept, outcome expectations and achievement related choices, thus impacting overall achievement. Thus, within the Eccles' model, vocational behavior is described using factors that have not been included in this study. Perhaps some of the unexpected results obtained in this study can be explained by the exclusion of other variables such as those that Eccles suggests.

Limitations and Recommendations

Limitations: This study has several limitations. A major limitation of this study is its limited sample size for structural equation modeling involving a large number of parameters. Despite getting a total of 527 responses, only 316 of these were usable. This sample size ruled out the possibility of merging the self-efficacy and the achievement models for math and science. Secondly, all three tracks (MPC, BPC, and MEC) were not offered by both the schools sampled. Unfortunately, this resulted in the fragmentation of each hypothesized model into two separate models each identical except for the school (or track) exogenous variable. This separation of analyses involving school and track made it difficult to examine track differences without confounding these with school effects. Better examination of the track differences could have been facilitated by choosing to sample schools that offered similar tracks. Furthermore, there were some marked differences between the two schools. Specifically, one school was patronized by more affluent families than the other. Any future research in this direction would benefit greatly by the exclusion of any evident differences between the schools sampled.

Another drawback of the current study lies in the measures used. Specifically, the Sources of Academic Self-efficacy Scale measured the effect of these sources for both math and science simultaneously. For example, items of this scale such as, "Studying math/science makes me uneasy and confused.", or "My parents succeeded in college in math/science", could be construed to refer to math, or science or both. This fact makes it impossible to accurately study the effects of these sources separately on math self-efficacy and science self-efficacy. Similarly, the items for science self-efficacy and science interests included items that referred to biology – a science subject not included in this research. For instance, items such as "I feel confident that with proper training I could classify animals that I observe", and "I am interested in working in a medical lab", are items that gauge biology self-efficacy and biology interests. Similarly, the science self-efficacy subscale did not seem to adequately capture efficacy related to science. For instance, an item like "I feel confident that with proper training I could construct and interpret a graph of rainfall amounts by state", might be construed to be more reflective of statistics self-efficacy than of science self-efficacy.

Future Research. The results of the present study suggest several interesting future directions for research. Firstly, this study found numerous non-significant relations in the hypothesized model, especially between prior academic performance and self-efficacy, and between self-efficacy and subsequent academic achievement. These hypotheses were theoretically based (SCCT; Lent et. al., 1994) and have empirical support within the U.S. population (e.g. Lent et. al., 1987; Pajares & Kranzler, 1995; Pajares & Miller, 1995; Schiefele et. al., 1992). Additional research needs to be done to identify other possible factors that might influence self-efficacy and academic achievement for the Asian Indian population, and alternate models investigated. Second, the effect of tracking on students' self-efficacy and achievement need to be further investigated. Within the Indian educational system, students are irrevocably tracked before they begin their 11^{th} grade. What immediate effects does this have on the students' academic functioning and career-related beliefs? What are the longer-term effects of tracking on the careers of these students? Sampling schools offering similar tracks can facilitate better exploration of these track effects.

While this study only examined students who were taking math and/or science classes, avenues for further research are manifold. There is a necessity of similar research in the non math/science fields which are traditionally "female" subjects. This would facilitate a wider exploration of the effects of tracking. Also, this study was conducted in one of India's largest metropolitan areas, with a population of approximately 8.3 million. The striking differences between the cultural norms, beliefs, values, and educational opportunities between the Indian urban vs. rural regions poses an important question: will similar research in the rural regions of India yield comparable findings to this study? In addition, future researchers could compare this Asian Indian high school sample with U.S. high school samples. Other exciting areas for future research for the Asian Indian population include an examination of the barriers to academic achievement, and to the development of positive self-efficacy beliefs within various academic fields.

Implications. The results of the present study have several implications for the Asian Indian high school population. Firstly, it is clear that for this sample, tracking effects are dominant, especially for performance. This indicates that the tracking of students into specific educational paths significantly influences their academic achievement among other things. Given that the tracking process within the Indian educational system is irreversible, this has profound implications for career counseling with Asian Indian students. Results of this study also indicate that for these students, subject-specific academic self-efficacy beliefs significantly impact how interested they are in these subjects. Counselors and advisors working with these students could encourage students who show confidence within specific subjects to consider applying for tracks that offer those subjects. For all hypothesized models in this study, it was clearly evident that mastery (prior performance attainment) is a powerful source of academic self-efficacy. Counselors, teachers, and advisors working with students might stress the importance of adequate preparation in relevant coursework for math/science coursework as a way of enhancing mastery experiences, especially with students reporting lower self-efficacy in these subjects. Additionally, the negative correlation between emotional arousal and self-efficacy for mathematics suggests to counselors and teachers working with students experiencing math-anxiety that such students will need more help with their math skills in order to develop positive math self-efficacy.

The finding that the mothers' educational attainment positively influences academic achievement has significant implications for the Asian Indian society. In a society where educational opportunities for women continue to be limited, this is strong encouragement to create additional opportunities for female students. Furthermore, these findings could be the precursors to dispelling the assumption that for the traditionally "male" subjects, female students are less self-efficacious than the male students. The female students in this sample have demonstrated that they are capable of being more confident and more efficacious (in all examined subjects) than their male counterparts.

REFERENCES

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

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84(2)*, 191-215.

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

Bandura, A. (1997). *Self-Efficacy: The Exercise of Control*. New York: Freeman.

Banerjee, N. (1995). Something old, something new, something borrowed… the electronics industry in Calcutta. In S. Mitter & S. Rowbotham (Ed.), *Women encounter technology: Changing patterns of employment in the third world.* New York, NY: UNU Press.

Ben-Porath, Y.S. (1990). Cross-cultural assessment of personality: the case for replicatory factor analysis. In J. N. Butcher & C. D. Spielberger (Eds.), *Recent advances in personality assessment* (pp. 27-48). LEA Press, Hillsdale, NJ.

Betz N. E., & Hackett, G. (1997). Applications of self-efficacy theory to the career assessment of women. *Journal of Career Assessment, 5,* 383-402.

Betz, N. E. (1992). Counseling uses of career self-efficacy theory. *The Career Development Quarterly, 41(1),* 22-26.

Betz, N. E. (2004). Women's Career Development. In S. D. Brown & R. W. Lent (Eds.). *Career development and counseling: Putting theory and research to work* (pp. 253-277). Hoboken, NJ: Wiley.

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 mathematics self-efficacy expectations to the selection of science-based college majors. *Journal of Vocational Behavior, 23,* 329-345.

Betz, N. E., & Hackett, G. (1997). Applications of self-efficacy theory to the career assessment of women. *Journal of Career Assessment, 5,* 383–402.

Betz, N., Harmon, L., & Borgen, F. (1996). The relationships of self-efficacy for the Holland themes to gender, occupational group membership, and vocational interests. *Journal of Counseling Psychology, 43,* 90-98.

Bleeker, M. M., & Jacobs, J. E. (2004). Achievement in math and science: Do mothers' beliefs matter 12years later? *Journal of Educational Psychology, 96*, 97–109.

Britner, S. L., & Pajares, F. (2006). Sources of science self-efficacy beliefs of middle school students. *Journal of Research in Science Teaching, 43(5)*, 485-499.

Britner, S.L., & Pajares, F. (2001). Self-efficacy beliefs, motivation, race, and gender in middle school science. *Journal of Women and Minorities in Science and Engineering, 7*, 271-285.

Brown, S. D., & Lent, R. W. (1996). A social cognitive framework for career choice counseling. *The Career Development Quarterly, 44(4),* 354-366.

Burlin, F. D. (1976). The relationship of parental education and maternal work and occupational status to occupational aspirations in adolescent females. *Journal of Vocational Behavior, 9,* 99-104.

Chiswick, B. R. (1984). Illegal aliens in the United States labor market: Analysis of occupational attainment and earnings. *International Migration Review, 18(3),* 714-732.

Crozier, S. (1999). Women's career development in a "relational context". *International Journal for the Advancement of Counseling, 21,* 231-247.

Day, S. X., Rounds, J., & Swaney, K. (1998). The structure of vocational interests for diverse racial-ethnic groups. *Psychological Science, 9*, 40-44.

Diegelman, N. M., & Subich, L. M. (2001). Academic and vocational interests as a function of outcome expectancies in social cognitive career theory. *Journal of Vocational Behavior, 59,* 394-405.

Donnay, D. A. C., Morris, M. L., Schaubhut, N. A., & Thompson, R. C. (2005). *Strong Interest Inventory manual: Research, development, and strategies for interpretation.* Mountain View, CA: CPP Inc.

Eccles, J. S. (1987). Gender roles and women's achievement-related decisions. *Psychology of Women Quarterly, 11, 135-172.*

Eccles, J. S. (1994). Understanding women's educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. *Psychology of Women Quarterly, 18,* 585–609

Eccles, J. S., Adler, T. F., Futterman, R., Goff, S. B., Kaczala, C. M., Meece, J., & Midgley, C. (1983). Expectancies, values and academic behaviors. In J. T. Spence (Ed.), *Achievement and achievement motives* (pp. 75-146). San Francisco: W. H. Freeman.

Farmer, H., Wardrop, J., Anderson, M., & Risinger, R. (1995). Women's Career Choices: Focus on Science, Math, and Technology Careers. *Journal of Counseling Psychology, 42(2)*, 155-70.

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 and science perspective. *Journal of Vocational Behavior, 57,* 348-364.

Fitzgerald, L. F., & Harmon, L. W. (2001). 's Women's career development: A post-modern update. In F. T. L. Leong & A. Barak (Eds.), *Contemporary models in vocational psychology* (pp. 207-230). Mahwah, NJ: Erlbaum.

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.

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

Gainor, K. A., & Lent, R. W. (1998). Social cognitive expectations and racial identity attitudes in predicting the math choice intentions of Black college students. *Journal of Counseling Psychology, 45,* 403-413.

Gottfredson, L. S. (1996). Gottfredson's theory of circumscription and compromise. In D. Brown & L. Brooks (Eds.), *Career choice and development* (pp. 179-232). San Francisco: Jossey-Bass.

Gupta, N., & Sharma, A. K. (2002). Women academic scientists in India. *Social Studies of Science, 32(5-6)*, 901-915.

Gupta, N., & Sharma, A. K. (2003). Patrifocal concerns in the lives of women in academic science: Continuity of tradition and emerging challenges. *Indian Journal of Gender Studies, 10(2)*, 279-305.

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. (1995). Self-efficacy and career choice and development In A. Bandura (Ed.), *Self-efficacy in changing societies.* New York: Cambridge University Press.

Hackett, G. (1995). Self-efficacy in career choice and development. In A. Bandura (Ed.). *Self-efficacy and changing societies* (pp. 232-258). New York, NY: Cambridge University Press.

Hackett, G., & Lent, R. W.1992. Theoretical advances and current inquiry in career psychology. In S. D. Brown & R. Lent Eds., *Handbook of counseling psychology 2nd ed.*, pp. 419–451. Wiley, New York.

Hackett, G., Betz, N., 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.

Handy, F., & Kassam, M. (2004). *Women's empowerment in rural India*. International Society for Third-Sector Research Sixth International Conference proceedings, July, 2004. Toronto, Canada.

Hansen, J. C., Collins, R. C., Swanson, J. L., & Fouad, N. A. (1993). Gender differences in the structure of interests. *Journal of Vocational Behavior, 40,* 188-193.

Harmon, L. W., Hansen, J. C., Borgen, F. H., & Hammer, A. L. (1994). *Applications and technical guide for the Strong Interest Inventory.* Stanford Univ. Press, Stanford.

Heckman, J. J., & Hotz, V. J. (1986). An Investigation of the Labor Market Earnings of Panamanian Males: Evaluating the Sources of Inequality. *Journal of Human Resources, 21*, 507-42.

Hesketh, B., & Rounds, J. (1995). International cross-cultural approaches to career development. In W. B. Walsh & S. H. Osipow (Eds.), *Handbook of vocational psychology: Theory, research, and practice* (pp. 367-390). Mahwah, NJ: Lawrence Erlbaum.

Holland, J.L. (1985a). *Making Vocational Choices.* Odessa, FL: Psychological Assessment Resources.

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.

Indiresan, J. (2002). *Education for women's empowerment.* Delhi: Konark Publishers.

Jones, M.G., Howe, A., & Rua, M.J. (2000). Gender differences in students' experiences, interests, and attitudes toward science and scientists. *Science Education, 84*, 180-192.

Jussim, L., & Eccles, J. S. (1992). Teacher expectations II: Construction and reflection of student achievement. *Journal of Personality and Social Psychology, 63*, 947–961.

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

Kupermintz, H. (2002). Affective and cognitive factors as aptitude resources in high school science achievement. *Educational Assessment, 8,* 123-137.

Lapan, R. T., Hinkelman, J. M., Adams, A., & Turner, S. (1999). Understanding rural adolescents' interests, values, and efficacy expectations. *Journal of Career development, 26(2),* 107-124.

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.

Larson, L. M., Wei, M., Wu, T. F., Borgen, F. H., & Bailey, D. C. (2007). Discriminating among educational majors and career aspirations in Taiwanese undergraduates: The contribution of personality and self-efficacy. *Journal of Counseling Psychology, 54(4)*, 395-408.

Lauer, C. (2003), Familiy Background, Cohort and Education. A French-German Comparison based on a multivariate ordered probit model of educational attainment, *Labour Economics, 10*, 231-251.

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., Larkin, K. C., & Brown, S. D. (1989). Relation of self-efficacy to inventoried vocational interests. *Journal of Vocational Behavior, 34,* 279-288.

Lent, R. W. (2004). A social cognitive view if career development and counseling. In S. D. Brown & R. W. Lent (Eds.). *Career development and counseling: Putting theory and research to work* (pp. 101-127). Hoboken, NJ: Wiley.

Lent, R. W., & Hackett, G. (1987). Career self-efficacy: Empirical status and future directions. *Journal of Vocational Behavior, 30,* 347-382.

Lent, R. W., Brown, S. D., & Larkin, K. C. (1986). Self-efficacy in the prediction of academic performance and perceived career options. *Journal of Counseling Psychology, 33(3),* 265-269.

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

Lent, R. W., Lopez, F. G., & Bieschke, K. J. (1993). Predicting mathematics-related choice and success behaviors: Test 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. (1996). Latent structure of the sources of mathematics self-efficacy. *Journal of Vocational Behavior, 49(3),* 292-308.

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.

Long, J. F., Monoi, S., Harper, S., Knoblauch, D., & Murphy, P. K. (2007). Racial identity attitudes, school achievement, and academic self-efficacy among African American high school students. *Urban Education, 23(4),* 344-57.

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

Lopez, F. G., Lent, R. W., Brown, S. D., & Gore, P. A., Jr. (1997). Role of social-cognitive expectations in high school students' mathematics related interest and performance. *Journal of Counseling Psychology, 44*, 44-52.

Lubinski, D., & Benbow, C. E (1992). Gender differences in abilities and preferences among the gifted: Implications for the math-science pipeline. *Current Directions in Psychological Science, 1,* 61-66.

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.

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

McCracken, R. S., & Weitzman, L. M. (1997). Relationship of personal agency, problem-solving appraisal, and traditionality of career choice to women's attitude toward multiple role planning. *Journal of Counseling Psychology, 44*, 149-160.

Middleton, M., & Midgley, C. (1997). Avoiding the demonstration of lack of ability: An underexplored aspect of goal theory. *Journal of Educational Psychology, 89*, 710–718.

Moenjak, T. & Worswick, C. (2003) Vocational education in Thailand: a study of choice and returns. *Economics of Education Review, 22*, 99–107.

Morgan, C., Isaac, J. D., & Sansone, C. (2001). The role of interest in understanding the career choices of female and male college students. *Sex Roles, 44(5-6),* 295-320.

Mukhopadhyay, C. C. (1994). Family structure and Indian women's participation in science and engineering. In C.C. Mukhopadhyay & S. Seymour (Eds.), *Women, education & family structure in India,* (pp. 1-33). Boulder, CO: Westview Press.

Mukhopadhyay, C. C., & Seymour, S. (1994). Introduction and theoretical overview. In C.C. Mukhopadhyay & S. Seymour (Eds.), *Women, education & family structure in India* (pp. 103-132). Boulder, CO: Westview Press.

Mullis, I. V. S., Martin, M. O., & Foy, P. (2005). *IEA's TIMSS 2003 International Report on Achievement in the Mathematics Cognitive Domains: Findings from a Developmental Project*. Boston: TIMSS & PIRLS International Study Center.

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

National Science Foundation, Division of Science Resources Statistics. (2007). *Women, minorities, and persons with disabilities in science and engineering: 2007* (NSF 07-315). Arlington, VA: National Science Foundation.

Nauta, M., Kahn, J., Angell, J., & Cantarelli, E. (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.

O'Brien, K. M., Friedman, S. M., Tipton, L. C., & Linn, S. G. (2000). Attachment, separation, and women's vocational development: A longitudinal analysis. *Journal of Counseling Psychology, 47,* 301–315.

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(3),* 145-156.

Pajares, F. (1996b). Self-efficacy beliefs and mathematical problem solving of gifted students. *Contemporary Educational Psychology, 21,* 325-344.

Pajares, F., & Graham, L. (1999). Self-efficacy, motivation constructs, and mathematics performance of entering middle school students. *Contemporary Educational Psychology, 24*, 124–139.

Pajares, F., & Kranzler, J. (1995). Self-efficacy beliefs and general mental ability in mathematical problem-solving. *Contemporary Educational Psychology, 20*, 426-443.

Pajares, F., & Miller, M. D. (1994). The role of self-efficacy and self-concept beliefs in mathematical problem-solving: A path analysis. *Journal of Educational Psychology, 86*, 193-203.

Pajares, F., & Miller, M. D. (1995). Mathematics self-efficacy and mathematics outcomes: The need for specificity of assessment. J*ournal of Counseling Psychology, 42*, 190-198.

Phillips, S., & Imhoff, A. (1997). Women and career development: A decade of research. *Annual Review of Psychology, 48*, 31-59.

Pinquart, M., Juang, L., & Silbereisen, R.K. (2003). Self-efficacy and successful school-to-work transition: A longitudinal study. *Journal of Vocational Behavior, 63*, 329–346.

Post, P., Stewart, M. A., & Smith, P. L. (1991). Self-efficacy, interest, and consideration of math/science and non-math/science occupations among Black freshmen. *Journal of Vocational Behavior, 38*, 179-186.

Rojewski, J. W. (2004). Occupational Aspirations: Constructs, Meanings and Application. In S. D. Brown & R. W. Lent (Eds.). *Career development and counseling: Putting theory and research to work* (pp. 131-153). Hoboken, NJ: Wiley.

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.

Rottinghaus, P., Betz, N., & Borgen, F. (2003). Validity of parallel measures of vocational interests and confidence. *Journal of Career Assessment, 11*, 355-378.

Rounds, J., & Tracey, T. L. (1996). Cross-cultural structural equivalence of RIASES models and measures. Journal of Counseling Psychology, 43, 310-329.

Satorra, A., & Bentler, P. M. (1988). Scaling corrections for chi-square statistics in covariance structure analysis. In *American Statistical Association 1988 proceedings of the business and economic section* (pp. 308–313). Alexandria, VA: American Statistical Association.

Sax, L. J. and A. N. Bryant (2006). The impact of college on sex-atypical career choices of men and women. *Journal of Vocational Behavior, 68*, 52-63.

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

Schiefele, U., Krapp, A., & Winteler, A. (1992). Interest as a predictor of academic achievement: A meta-analysis of research. In K. A. Renninger, S. Hidi, & A. Krapp

(Eds.), *The role of interest in learning and development* (pp. 183-212). Hillsdale, N J: Erlbaum.

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

Seymour, E., & Hewitt, N. M. (1997). *Talking about leaving: Why undergraduates leave the sciences.* Boulder, CO: Westview.

Shrout, P. E., & Bolger, N. 2002. Mediation in experimental and nonexperimental studies: New procedures and recommendations. *Psychological Methods, 7(4),* 422-445.

Singhal, R., & Misra, G. (1994). Achievement Goals: A situational-contextual analysis. *International Journal of Intercultural Relations, 18(2),* 239-258.

Smith, P.L. & Fouad, N.A. (1999). Subject-matter specificity of self-efficacy, outcome-expectancies, interests and goals: Implications for the social cognitive model. *Journal of Counseling Psychology. 46(4),* 461-471.

Stage, F. K., & Maple, S. A. (1996). Incompatible goals: Narratives of graduate women in the mathematics pipeline. *American Educational Research Journal, 33,* 23-51.

Swanson, J. L. (1993). Integrated assessment of vocational interests and self-rated skills and abilities. *Journal of Career Assessment, 1,* 50-65.

Tang, M., Fouad, N. A., & Smith, P. L. (1999). Asian Americans' career choices: A path model to examine factors influencing their career choices. *Journal of Vocational Behavior, 54*, 142-157.

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

Tracey, T.J.G. (1997). The structure of interests and self-efficacy expectations: An expanded examination of the spherical model of interests. *Journal of Counseling Psychology, 44,* 32–43.

Turner, S. L, & Lapan, R T. (2004) Promoting career development and aspirations in school-age youth. In S. D. Brown & R. W. Lent (Eds.). *Career development and counseling: Putting theory and research to work* (pp. 417-439). Hoboken, NJ: Wiley.

Usher, E. L., & Pajares, F. (2006). Sources of academic and self-regulatory efficacy beliefs of entering middle school students. *Contemporary Educational Psychology, 31,* 125-141.

Van de Vijver, F. J. R., & Poortinga, Y. H. (2002) Structural equivalence in multilevel research. *Journal of Cross Cultural Psychology, 33*, 141-156.

Van Leuvan, P. (2004). Young women's science/mathematics career goals from seventh grade to high school graduation. *ProQuest Psychology Journals, 97(5)*, 248-267.

Whiston, S. C. (1993). Self-efficacy of women in traditional and nontraditional occupations: Differences in working with people and things. *Journal of Career Development, 19(3),* 175-186.

Williams, C., & 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.

Zeldin, A. L. & Pajares, F. (2000). Against the odds: Self-efficacy beliefs of women in mathematical, scientific and technological careers. *American Educational Research Journal, 37,* 215-246.

Zimmerman, B. J. (2000). Self-efficacy: An essential motive to learn. *Contemporary Educational Psychology, 25,* 82-91.

Table 1.
Frequencies, Percentages, Means and Standard Deviations on Demographic Variables (n=316)

Variable	Frequency	Percent %	Mean	S.D.
Gender				
Male	153	48.4		
Female	163	51.6		
School				
Less Affluent	160	50.6		
More Affluent	156	49.4		
Age			16.15	.41
Track				
MPC	197	62.3		
BPC	63	19.9		
MEC	56	17.7		
Educational Aspirations				
High School	2	.6		
Associate's Degree	1	.3		
Bachelors	117	37.0		
Bachelor's of Medicine	40	12.7		
Bachelor's of Law	7	2.2		
Masters	126	39.9		
Ph.D.	23	7.3		
Religion				
Hindu	203	64.2		
Muslim	73	23.1		
Christian	29	9.2		
Jain	5	1.6		
Sikh	3	.9		
Buddhist	2	.6		
Parsi	1	.3		
Hours/week spent studying *			68.92	14.87
Mathematics/Physics/Chemistry			71.21	13.76
Biology/Physics/Chemistry			73.89	14.43
Mathematics/Economics/Commerce			55.30	11.00

Table 1. (continued)

Variable	Frequency	Percent %	Mean	S.D.
Household Income				
< 5000	42	13.3		
5000-15000	114	36.1		
15000-25000	90	28.5		
25000-50000	45	14.2		
>50000	25	7.9		
"I have lived most of my life in" **				
Village	17	5.4		
Town	14	4.4		
Small City	9	2.8		
Large City	276	87.3		
Mother's Educational Attainment				
Uneducated	27	8.5		
10th Grade	89	28.2		
High School	69	21.8		
Associate's Degree	14	4.4		
Bachelors	78	24.7		
Bachelor's of Medicine	3	.9		
Bachelor's of Law	1	.3		
Masters	29	9.2		
Ph.D.	6	1.9		
Mother Working				
Deceased	1	.3		
Unemployed	243	76.9		
Full Time	60	19.0		
Part Time	12	3.8		
No. of Hours Mother Works			10.56	20.59
Father's Educational Attainment				
Uneducated	5	1.6		
10th Grade	39	12.3		
High School	43	13.6		
Associate's Degree	16	5.1		
Bachelors	120	38.0		
Bachelor's of Medicine	5	1.6		
Bachelor's of Law	17	5.4		

Table 1. (continued)

Variable	Frequency	Percent %	Mean	S.D.
Masters	63	19.9		
Ph.D.	8	2.5		
Father Working				
Deceased	18	5.7		
Unemployed	0	.0		
Full Time	280	88.6		
Part Time	18	5.7		
No. of Hours Father Works			60.66	21.86
After you get married, who will decide whether you work or not (Females ONLY, n=163)				
Will not work	3	1.8		
I decide	51	31.3		
Husband & I decide	94	57.7		
Husband Decides	4	2.5		
Husband's family decides	5	3.1		
Undecided	6	3.7		

* *Hours/week spent studying* indicates study time for a total of five subjects – three indicated in the table and two language subjects

** *"I have lived most of my life in"*. Population estimates were not indicated in the item. However, "Village" is defined by the Indian State Governments as a settlement whose population is either under 10,000, or whose administration is under the "notified area committee". "Town" is defined as a region administered by a "town area committee". Cities are areas administered by a "municipal corporation". There was no distinction explicitly made in the item between "small city" and "large city". However, an example of a small Indian city would be Mangalore which has a population of 3,98,745 (Indian census, 2001), and an example of a large city would be Bhopal, which has a population of 1,482,718 (Indian census, 2001).

Abbreviations

Track

MPC = Mathematics + Physics + Chemistry
BPC = Biology + Physics + Chemistry
MEC = Mathematics + Economics + Commerce

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)*
Emotional Arousal	"I am uncomfortable taking maths/science classes."	10	.93	.91
Social Persuasion	"People have told me that I am a good student in maths/science."	10	.60	.87
Vicarious Learning	"Many adults that I know have good maths/science abilities."	10	.39	.77

Table 3.

Internal Consistency Reliability of Constructs for the Fouad-Smith Self-Efficacy Subscales

Subject	Example of items	No. of items	Internal Consistency Reliability *Current Study*	*Fouad & Smith (1999)*
Mathematics	"I feel confident that with proper training, I could earn more than 75% in a mathematics class."	5	.74	.85 (math/science)
Science	"I feel confident that with proper training, I could classify the animals I observe."	5	.69	.85 (math/science)
English	"I feel confident that with proper training, I could write a short story."	9	.75	.88

Table 4.

Internal Consistency Reliability of Constructs for the Fouad-Smith Interests Subscales

Subject	Example of items	No. of items	Internal Consistency Reliability	
			Current Study	*Fouad & Smith (1999)*
Mathematics	"Taking mathematics classes."	4	.63	.94 (math/science)
Science	"Visiting a science museum."	15	.91	.94 (math/science)
English	"Reading a novel."	10	.82	.86

Table 5.

Means, Standard Deviations, and Intercorrelations for Measured Variables

	M	SD	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. EA	19.56	9.24	**-0.61**	**-0.34**	**0.20**	**-0.26**	**-0.32**	0.05	**-0.26**	**-0.41**	**-0.40**	-0.01	**-0.30**	-0.09	-0.04	**-0.39**	-0.17	-0.03
2. SP	40.78	4.98	--	**0.35**	-0.14	0.13	0.20	0.00	**0.26**	**0.33**	**0.29**	0.01	**0.28**	0.13	0.12	**0.42**	**0.21**	0.10
3. VL	35.94	4.49		--	-0.08	0.06	0.04	-0.05	0.13	0.11	0.11	0.04	0.03	0.05	0.03	**0.23**	0.10	0.07
4. Math T1	75.45	12.02			--	**0.57**	**0.60**	**0.61**	**0.34**	**0.41**	**0.36**	**0.58**	0.18	0.20	0.14	-0.07	-0.06	0.08
5. Phy T1	45.65	16.60				--	**0.83**	**0.67**	**0.31**	**0.63**	**0.55**	**0.54**	**0.25**	0.13	0.08	**0.25**	0.04	-0.02
6. Chem T1	46.72	16.67					--	**0.71**	**0.38**	**0.66**	**0.62**	**0.61**	**0.27**	0.10	0.03	**0.25**	0.11	-0.03
7. Eng T1	49.57	18.47						--	**0.34**	**0.62**	**0.58**	**0.84**	**0.23**	0.14	0.16	0.16	**-0.20**	0.06
8. Math T2	75.78	11.61							--	**0.63**	**0.65**	**0.54**	0.10	0.04	0.08	0.15	0.06	0.01
9. Phy T2	49.84	16.01								--	**0.75**	**0.67**	**0.22**	0.11	0.06	**0.27**	-0.01	0.02
10. Chem T2	40.70	17.66									--	**0.75**	**0.20**	0.13	0.10	**0.21**	0.09	0.06
11. Eng T2	38.76	19.00										--	**0.20**	0.17	0.17	0.13	-0.16	0.06
12. Math SE	23.16	5.04											--	**0.47**	**0.34**	**0.40**	0.07	0.15
13. Sci SE	21.07	5.08												--	**0.48**	0.16	**0.40**	**0.30**
14. Eng SE	38.05	8.50													--	0.13	**0.26**	**0.62**
15. Math IN	18.16	4.05														--	0.16	0.13
16. Sci IN	66.22	15.57															--	**0.27**
17. Eng IN	42.19	9.83																--

Note: EA = Emotional Arousal, SP = Social Persuasion, VL = Vicarious Learning, MathT1=11th grade Math scores, PhyT1 = 11th grade Physics scores, ChemT1 = 11th grade Chemistry scores, EngT1 = 11th grade English scores, MathT2=12th grade Math scores, PhyT2 = 12th grade Physics scores, ChemT2 = 12th grade Chemistry scores, EngT2 = 12th grade English scores, Math SE = Math Self-Efficacy, Sci SE = Science Self-Efficacy, Eng SE = English Self-Efficacy, Math IN = Math Interests, Sci IN = Science Interests, Eng IN = English Interests. Correlations underlined indicate significance at the $p < .01$ level, correlations in bold indicate significance at the $p < .001$ level.

Table 6.

Intercorrelations of Measured Variables for Males and Females

M\F	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. EA	--	-0.57	-0.43	0.26	**-0.39**	**-0.43**	-0.05	-0.20	**-0.54**	-0.47	-0.02	-0.37	-0.09	0.05	-0.38	-0.13	-0.01
2. SP	-0.65	--	0.35	-0.17	0.20	0.21	0.04	0.24	0.32	0.35	0.02	**0.41**	0.23	0.09	0.45	0.23	0.15
3. VL	-0.23	0.33	--	-0.02	**0.19**	**0.17**	0.14	0.20	0.19	0.19	0.09	0.08	0.04	0.03	0.23	0.16	0.10
4. Math T1	0.19	-0.15	-0.17	--	0.61	0.62	0.57	0.23	0.29	0.31	0.56	0.13	0.18	0.21	-0.10	0.01	0.16
5. Phy T1	**-0.14**	0.06	**-0.10**	0.53	--	0.86	0.70	0.22	0.61	0.63	0.48	0.31	0.07	0.05	0.17	**-0.08**	-0.06
6. Chem T1	**-0.21**	0.18	**-0.09**	0.58	0.80	--	0.72	0.30	0.62	0.65	0.59	0.33	0.12	0.03	0.17	0.02	-0.08
7. Eng T1	0.16	-0.05	-0.07	0.61	0.64	0.70	--	**0.16**	0.57	0.62	0.81	0.28	0.14	**<u>0.29</u>**	0.13	-0.12	0.14
8. Math T2	-0.29	0.26	0.03	0.33	0.33	0.40	**0.41**	--	0.63	**<u>0.46</u>**	**<u>0.37</u>**	0.08	**<u>0.22</u>**	0.03	0.16	0.14	0.02
9. Phy T2	**-0.32**	0.33	0.02	0.44	0.70	0.71	0.66	0.55	--	0.75	0.63	0.26	0.11	**-0.07**	**0.15**	-0.08	-0.09
10. Chem T2	-0.38	0.24	0.02	0.32	0.54	0.64	0.56	**<u>0.67</u>**	0.70	--	0.70	0.23	0.18	0.06	0.21	**-0.01**	0.05
11. Eng T2	0.02	-0.02	-0.06	0.55	0.62	0.65	0.86	**<u>0.60</u>**	0.65	0.74	--	0.15	0.13	0.24	0.05	-0.16	0.07
12. Math SE	-0.25	**0.17**	-0.06	0.15	0.21	0.21	0.15	-0.01	0.10	0.08	0.15	--	0.39	0.28	**0.54**	0.10	0.08
13. Sci SE	-0.08	0.03	0.04	0.17	0.17	0.08	0.10	**<u>-0.14</u>**	0.04	-0.01	0.15	0.50	--	0.43	0.18	**0.53**	0.25
14. Eng SE	-0.12	0.14	0.01	0.03	0.10	0.02	**<u>0.00</u>**	0.05	**0.16**	0.12	0.07	0.36	0.49	--	0.12	0.23	0.62

Table 6. (continued)

M\F	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
15. Math IN	-0.41	0.40	0.25	-0.01	0.33	0.32	0.21	0.24	**0.41**	0.27	0.23	**0.33**	0.15	0.14	--	0.16	0.12
16. Sci IN	-0.22	0.20	0.03	-0.09	**0.17**	0.22	-0.26	0.07	0.13	**0.27**	-0.13	0.07	**0.31**	0.32	0.16	--	0.32
17. Eng IN	-0.05	0.04	0.03	0.01	0.02	0.01	-0.04	-0.01	0.10	0.05	0.01	0.19	0.32	0.62	0.15	0.23	--

Note: Correlations for females (n=163) are indicated above the diagonal; correlations for males (n=153) are indicated below the diagonal. EA = Emotional Arousal, SP = Social Persuasion, VL = Vicarious Learning, MathT1=11^{th} grade Math scores, PhyT1 = 11^{th} grade Physics scores, ChemT1 = 11^{th} grade Chemistry scores, EngT1 = 11^{th} grade English scores, MathT2=12^{th} grade Math scores, PhyT2 = 12^{th} grade Physics scores, ChemT2 = 12^{th} grade Chemistry scores, EngT2 = 12^{th} grade English scores, Math SE = Math Self-Efficacy, Sci SE = Science Self-Efficacy, Eng SE = English Self-Efficacy, Math IN = Math Interests, Sci IN = Science Interests, Eng IN = English Interests.

For males, correlations with a magnitude greater than .21 are significant at $p<.01$ and those greater than .32 are significant at $p<.001$. For females, correlations with a magnitude greater than .23 are significant at $p<.01$ and those greater than .34 are significant at $p<.001$. Correlations in bold indicate differences between males and females significant at the $p<.05$, correlations underlined indicate differences between males and females significant at the $p<.01$

Table 7.

Means and Standard Deviations of Sources of Self Efficacy, Performance Attainment, Self-Efficacy and Interest by Sex and School

School Name		Less Affluent School		More Affluent School		Total	
		M	SD	M	SD	M	SD
Sources of Self-Efficacy							
Emotional Arousal	M	1.44	.65	2.44	.87	1.98	.92
	F	1.61	.86	2.33	.86	1.94	.93
	T	1.54	.78	2.39	.86	1.96	.92
Social Persuasion	M	4.32	.19	3.80	.58	4.04	.52
	F	4.24	.38	3.95	.54	4.11	.48
	T	4.28	.31	3.87	.57	4.08	.50
Vicarious Learning	M	3.65	.32	3.49	.49	3.56	.42
	F	3.68	.34	3.55	.59	3.62	.47
	T	3.67	.33	3.52	.54	3.59	.45
Performance T1							
Math T1	M	67.10	12.90	78.56	9.31	**72.87**	12.58
	F	72.39	10.99	84.10	6.85	**77.97**	10.93
	T	69.84	12.19	81.28	8.62	75.45	12.02
Physics T1	M	43.55	16.95	46.78	15.46	45.07	16.29
	F	44.89	16.87	49.62	16.95	46.28	16.97
	T	44.29	16.87	47.83	16.01	45.65	16.60
Chemistry T1	M	45.27	17.62	46.30	15.76	45.75	16.71
	F	46.56	17.18	50.59	15.06	47.75	16.63
	T	45.99	17.33	47.89	15.56	46.72	16.67
English T1	M	40.32	11.26	52.74	21.05	46.98	18.25
	F	43.54	9.61	62.19	21.16	52.01	18.40
	T	42.11	10.47	57.22	21.56	49.57	18.47
Self-Efficacy							
Math SE	M	4.28	.97	4.52	1.14	**4.41**	1.07
	F	4.70	.94	5.02	.83	**4.84**	.90
	T	4.51	.98	4.76	1.03	4.63	1.01
Sci SE	M	3.68	.91	4.37	1.10	4.05	1.07
	F	4.33	.94	4.41	.95	4.37	.94
	T	4.04	.98	4.39	1.03	4.21	1.02
Eng SE	M	4.13	.91	4.09	1.00	4.11	.96
	F	4.17	.94	4.54	.86	4.34	.92
	T	4.16	.93	4.30	.96	4.23	.94
Interests							
Math IN	M	4.86	.90	4.37	1.12	4.60	1.05
	F	4.51	1.13	4.46	.76	4.49	.98
	T	4.67	1.05	4.41	.96	4.54	1.01
Sci IN	M	4.66	.82	4.35	1.15	4.49	1.02
	F	4.52	1.00	4.12	1.09	4.34	1.06
	T	4.58	.92	4.24	1.12	4.41	1.04

Table 7. (continued)

	School Name	Less Affluent School M	SD	More Affluent School M	SD	Total M	SD
Eng IN	M	4.16	1.06	4.13	.95	4.15	1.00
	F	4.23	1.04	4.35	.88	4.29	.97
	T	4.20	1.04	4.24	.92	4.22	.98

Note. Numbers in bold indicate significant mean differences by sex at the $p < .05$ level, except in the Total column, in which numbers in bold indicate significant mean differences by sex at the $p < .004$ level. Numbers that are underlined indicate significant mean differences by school at the $p < .004$ level. M = male students; F = female students; T = all students (male + female); Less affluent school (male n = 71; female n = 83); Less affluent school (male n = 82; female n = 74); T1 = Time1; SE = Self-Efficacy; IN = Interests.

Table 8.
Means and Standard Deviations of Sources of Self Efficacy, Performance at Time1, Self-Efficacy and Interest by Sex and Track

	Track	MPC		BPC		MEC		Total	
		M	SD	M	SD	M	SD	M	SD
<u>Sources of SE</u>									
Emotional Arousal	M	1.82	.85	2.22	.97	2.51	.99	1.98	.92
	F	1.59	.80	2.53	.86	2.23	.91	1.94	.93
	T	$\underline{1.71}_{a}$	.84	$\underline{2.39}_{b}$	.92	$\underline{2.33}_{b}$	.94	1.96	.92
Social Persuasion	M	4.13	.45	3.81	.57	3.88	.66	4.04	.52
	F	4.20	.40	3.99	.59	4.01	.51	4.11	.48
	T	$\underline{4.16}_{a}$	.42	$\underline{3.91}_{b}$	.58	$\underline{3.96}_{b}$	.56	4.08	.50
Vicarious Learning	M	3.55	.43	3.62	.38	3.53	.47	3.56	.42
	F	3.64	.43	3.54	.56	3.65	.49	3.62	.47
	T	3.59	.43	3.58	.49	3.61	.48	3.59	.45
<u>Performance T1</u>									
Math T1	M	70.71	12.22			84.95	6.13	**72.87**	**12.58**
	F	75.19	11.39			84.81	5.42	**77.97**	**10.93**
	T	$\underline{72.78}_{a}$	12.02			$\underline{84.86}_{b}$	5.61	75.45	12.02
Physics T1	M	48.01	15.67	33.93	13.76			45.07	16.29
	F	51.67	15.45	32.26	12.12			46.28	16.97
	T	$\underline{49.70}_{a}$	15.64	$\underline{33.00}_{b}$	12.79			45.65	16.60
Chemistry T1	M	48.81	15.96	34.18	14.48			45.75	16.71
	F	52.22	15.65	36.11	13.26			47.75	16.63
	T	$\underline{50.39}_{a}$	15.87	$\underline{35.25}_{b}$	13.74			46.72	16.67
English T1	M	41.71	10.52	39.64	11.05	87.21	5.38	46.98	18.25
	F	45.26	9.10	39.20	11.12	80.70	8.90	52.01	18.40
	T	$\underline{43.35}_{a}$	10.02	$\underline{39.40}_{b}$	11.00	$\underline{82.91}_{c}$	8.42	49.57	18.47
<u>Self-Efficacy</u>									
Math SE	M	4.49	1.01	3.88	1.22	4.72	.91	**4.41**	1.07
	F	4.93	.75	4.32	1.15	5.12	.82	**4.84**	.90
	T	$\underline{4.70}_{a}$	.92	$\underline{4.12}_{b}$	1.19	$\underline{4.99}_{a}$	.86	4.63	1.01
Sci SE	M	4.00	1.03	4.14	1.19	4.16	1.15	4.05	1.07
	F	4.26	.95	4.66	.85	4.36	.98	4.37	.94
	T	4.12	1.00	4.43	1.04	4.29	1.03	4.21	1.02
Eng SE	M	4.11	.94	4.21	.95	3.92	1.08	4.11	.96
	F	4.13	.92	4.43	.93	4.78	.76	4.34	.92
	T	4.12	.93	4.33	.94	4.49	.96	4.23	.94

Table 8. (continued)

	Track	MPC		BPC		MEC		Total	
		M	SD	M	SD	M	SD	M	SD
Interests									
Math IN	M	4.74	.89	3.94	1.44	4.78	.85	4.60	1.05
	F	4.58	.99	4.23	1.12	4.50	.77	4.49	.98
	T	$\underline{4.67_a}$	.94	$\underline{4.10_b}$	1.27	$\underline{4.59_a}$	.80	4.54	1.01
Sci IN	M	4.56	.89	4.96	.77	3.44	1.29	4.49	1.02
	F	4.26	1.02	5.01	.81	3.92	1.08	4.34	1.06
	T	$\underline{4.42_a}$	.96	$\underline{4.98_b}$	.79	$\underline{3.76_c}$	1.17	4.42	1.04
Eng IN	M	4.18	.98	4.22	.95	3.88	1.17	4.15	1.00
	F	4.07	.99	4.68	.88	4.45	.84	4.29	.97
	T	4.13	.99	4.47	.93	4.26	.99	4.22	.98

Note. Numbers in bold indicate significant mean differences by sex at the $p < .05$ level, except in the Total column, in which numbers in bold indicate significant mean differences by sex at the $p < .004$ level. Subscripts in the rows indicate significant mean differences from each other among the corresponding majors at the $p < .05$ level. Numbers that are underlined indicate significant mean differences by major at the $p < .004$ level. M = male students; F = female students; T = all students (male + female); MPC = Track [Math, Physics, Chemistry, English 2nd Language] (male n = 106; female n = 91); BPC = Track [Biology, Physics, Chemistry, English, 2nd Language] (male n = 28; female n = 35); MEC = Track [Math, Economics, Commerce, English, 2nd Language] (male n = 19; female n = 37); T1 = Time1; SE = Self-Efficacy; IN = Interests.

Table 9.
Fit Indices for the Different Models

Fit Indices	Model1 MathSE	Model2 MathSE	Model1 MathAch	Model2 MathAch	Model1 SciSE	Model2 SciSE	Model1 SciAch	Model2 SciAch	Model1 English	Model2 English
Standard χ^2	32.24	12.03	164.17	38.07	77.34	48.58	194.13	142.97	38.07	23.02
Scaled χ^2	26.08	11.27	135.90	43.43	74.48	42.26	158.94	126.21	27.12	22.98
df	6	6	5	5	9	9	8	8	11	11
N	253	253	253	253	260	260	260	260	316	316
CFI	.97	.99	.40	.78	.90	.96	.83	.88	.98	.99
SRMR	.04	.03	.15	.07	.08	.06	.13	.09	.03	.03

Note: CFI = comparative fit index; SRMR = standard root-mean-square residual.
The notation $\text{Model1}_{\text{subscript}}$ represents a model that includes school as an exogenous variable. $\text{Model2}_{\text{subscript}}$ represents a model that includes track as an exogenous variable. The subscript in these notations will indicate the endogenous variable being predicted (subject-specific self-efficacy or academic achievement at Time2).

Table 10.
Bootstrap Analysis of Magnitude and Statistical Significance of Indirect Effects

Indirect Effect IV → Mediator → DV	β Standardized Indirect Effect	Mean Indirect Effect (h)	S.E. of Mean	95% CI Lower	95% CI Upper	*N*
Math SE → Math IN → Math T2	(.33) x (.19) = .063	.5599	.0097	.0142	1.2113*	253
Sci SE → Sci IN → Phy T2	(.38) x (-.10) = -.038	-.0370	-.0116	-.7377	.7359	260
Sci SE → Sci IN → Chem T2	(.38) x (.00) = .000	.5949	.0144	-.2539	1.5028	260
Eng SE → Eng IN → Eng T2	(.62) x (-.03) = -.019	.6567	.0220	-.7348	2.0197	316

Note: CI = Confidence interval; SE = Self-efficacy; IN = Interests; T2 = Time2; Math = Mathematics; Sci = Science; Eng = English; Phy = Physics; Chem = Chemistry.
* $p < .05$ (excluding zero)

APPENDIX A: CONSTRUCTS AND THEIR MEASUREMENT

Construct	Measured by
A: Sources of Self-Efficacy	
Performance Attainment	*See "B: Performance Attainment"*
Vicarious Learning	VL subscale of the Sources for Academic Self-Efficacy Scale
Social Persuasion	SP subscale of the Sources for Academic Self-Efficacy Scale
Emotional Arousal	EA subscale of the Sources for Academic Self-Efficacy Scale
B: Performance Attainment	
Mathematics	11^{th} grade annual exam scores of mathematics courses
Science	11^{th} grade annual exam scores of science courses
English	11^{th} grade annual exam scores of English courses
C: Self-Efficacy	
Mathematics SE	Fouad-Smith mathematics SE subscale
Science SE	Fouad-Smith science SE subscale
English SE	Fouad-Smith English SE subscale
D: Interests	
Mathematics Interests	Fouad-Smith mathematics Interests subscale
Science Interests	Fouad-Smith science Interests subscale
English Interests	Fouad-Smith English Interests subscale
E: Academic Achievement	
Mathematics Achievement	12^{th} grade half-yearly exam scores of mathematics courses
Science Achievement	12^{th} grade half-yearly exam scores of science courses
English Achievement	12^{th} grade half-yearly exam scores of English courses

APPENDIX B: DEMOGRAPHIC QUESTIONNAIRE

INSTRUCTIONS

1. Use a HB pencil in order to complete this form. Please do not use pens to fill this form.
2. Fill in the space labeled **"NAME"** on the bubble sheet and using a HB Pencil, fill in the corresponding bubbles under your name. Fill in your Surname first, leave a space and then fill in your first name. For example if your name is **Sanjay Reddy**, then write it as REDDY SANJAY.
3. Fill in your college identification number in the section labeled **"IDENTIFICATION NUMBER"**.
4. Leave the section marked **"SPECIAL CODES"** blank.
5. Fill in your gender in the section labeled **"SEX"**.
6. Fill in your **MONTH, DAY** and **YEAR OF BIRTH** in the space labeled **"BIRTH DATE"**.

ANSWER QUESTIONS 1 – 13 ON THIS QUESTIONNAIRE IN THE SPACE PROVIDED FOR THEM

Please fill in the following information. If the question presents a choice, please circle all the applicable choices.

1. Please indicate what **branch** you are in:

   ____

   Please specify the classes you take

   ____

   ____

   ____

2. How many hours a week do you spend studying for your classes? ________________
3. What are your educational aspirations? Circle the highest degree you want to attain:

   Intermediate   Polytechnic   Bachelors Degree   Masters' degree   Ph.D.

M.B.B.S. L.L.B Other________________________________

4. What branch or field of study do your parents wish you to pursue after your Intermediate?

____

5. What branch or field of study would you prefer to pursue after your Intermediate?

____

6. What branch or field of study are you going to pursue after your Intermediate?

   (a) I have no idea
   (b) I have some idea _____________________________
   (c) I know what I am going to pursue _____________________________

7. What career do your parents wish you to have?

____

8. What career would you prefer to have?

____

9. <u>(Please answer this question only if you are **female**)</u>

   After you get married, who will decide whether you work or not?

   (a) I will not work after getting married

   (b) I will decide whether I will work or not

   (c) My husband and I will decide this together

   (d) My husband will decide this

   (e) My husband's family will decide this

   (f) I don't know

10. Religion

   (a) Hindu (b) Muslim (c) Christian (d) Sikh (e) Jain

   (f) Parsi (g) Buddhist (h) Jew (i) Other _______________

11. Household Income (per month). Please circle one.

    (a) Less than Rs.5000 (b) Rs.5000-Rs.15000 (c) Rs.15000 – Rs.25000

    (d) Rs.25000-Rs.50000 (e) More than Rs.50000

12. I have lived most of my life in:

    (a) Village (b) Town (c) Small City (d)Large City
    (b) Other ____

13. Parental Educational Attainment Level

    Mother (circle highest attained level)

    Uneducated High-school Intermediate Polytechnic Bachelors Degree

    Masters Ph.D. M.B.B.S. L.L.B Other______________

    Father (circle highest attained level)

    Uneducated High-school Intermediate Polytechnic Bachelors Degree

    Masters Ph.D. M.B.B.S. L.L.B Other_______________

14. Occupation of Parents.

    Mother (please specify occupation) ___________________________

    UNEMPLOYED FULL TIME PART TIME (circle one).

    If your mother works, please indicate number of hours per week? ________

    Father (please specify occupation) ___________________________________

    UNEMPLOYED FULL TIME PART TIME (circle one).

    If your father works, please indicate number of hours per week? _________

15. If you would like to receive a descriptive summary of your answers on this questionnaire, please enter your email address here:

    ____

APPENDIX C: MODIFIED SOURCES OF SELF-EFFICACY SCALE

Following are some sample items:

Please answer ALL the following questions using the following scale:

1= Strongly Disagree
2= Disagree
3= Neutral
4= Agree
5= Strongly Agree

Thinking about studying maths/science classes makes me nervous.

Studying maths/science makes me feel uncomfortable and nervous.

Older people have told me that I have good maths/science study skills.

My parents encourage me to be a good maths/science student.

My friends tend to avoid maths/science excellence.

I don't know many people who get good marks in maths/science.

APPENDIX D: UNMODIFIED SOCIAL SOURCES SCALE

Following are some sample items:

Please answer the following questions using the following scale:

1= Strongly Disagree
2= Disagree
3= Neutral
4= Agree
5= Strongly Agree

Making friends always made me nervous

Social situations made me feel uneasy and confused

I received strong encouragement to socialize as a child

My parents encouraged me to develop my social skills

My friends tended to avoid social situations

I knew few people who were talented socially

APPENDIX E: CHANGES MADE TO SCALES TO REFLECT INDIAN USAGE

Indian Usage	**American Usage**
Branch	Educational Major
Maths	Math
Marks	Grades
Percentage	GPA
Municipal Council	City Council
Earn more than 75%. (*Students who earn more than 75% marks are considered to be in a "merit" category*)	Earn an A
Central Govt. Budget	Federal Budget
Student Council	Student Government

APPENDIX F: FOUAD-SMITH SELF-EFFICACY AND INTERESTS SCALES

Following are some sample items:

SELF-EFFICACY SUBSCALE

Please answer ALL the following questions using the following scale:

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

I feel confident that with the proper training I could:
Earn more than 75% in an art or music class.

Compare and contrast two distinct styles of art.

Collect fees and determine how much to spend for a social club.

Create an advertising display.

Compose a melody.

INTERESTS SUBSCALE

Please answer ALL the following questions using the following scale:

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

Reading a novel.

Making a music video.

Touring a science lab.

Working with plants and animals.

Working with clay.

APPENDIX G: LETTER OF INFORMATION

Dear Student,

My name is Asha Stephen. I am an Indian. I was born and brought up and also did my schooling here in Hyderabad. After finishing my intermediate in Hyderabad, I went to L.B.S. College of Engineering in Kerala to get my B.Tech in Computer Science. I decided which branch to join based mainly on my parents' wishes and the job market situation at that time. After completing my B.Tech in computer science in India, I went abroad to U.S.A. to get my Masters degree in Computer Science. However, when I completed my M.S. in computer science, I started feeling that this was not the right profession for me because I was not very interested in it. At that point in time, after 7 years of higher education in Computer Science, I made the decision to switch my field of study to counseling psychology based on my own interests and what I really enjoyed doing. This got me thinking about the ways in which high school and junior college students make decisions about their branch – whether it is based on their interests and confidence or whether it is based on other factors. I am really interested to learn more about this. And this is what the study I am conducting is all about.

I am now a graduate student in the Department of Psychology at Iowa State University, U.S.A. My professor, Dr. Lisa M. Larson (a Professor, Department of Psychology, Iowa State University) and I are conducting a study to assess the effect that interests, academic confidence and performance expectations of 2nd year intermediate students in India have on their academic performance. This study also concerns differences in the confidence, performance expectations and interests of male and female students in subjects that are nontraditional for women (mathematics, science) and those that are more typically more *traditional* for women (social studies, etc.). These issues are related to academic and career choices of Indian college students.

The University Institutional Research Board (IRB) at Iowa State University has approved this study. It will take about 30 minutes to complete the questionnaire related to your interests, confidence and outcome expectations in various different subjects and some demographic information about yourself. The researchers will contact your college in January 2006 in order to obtain the half-yearly results and the 11th class/1st year Intermediate annual examination marks of all the students who participate in this study. Your answers from the completed questionnaire will be used to study the effect of your interests, confidence and academic expectations on your examination marks.

If you are a minor (less than 18 yrs of age), then we will require a letter of consent from one of your parents before you can complete the questionnaire. You will be given a consent form that your parents can review and sign if they consent to allow you to participate in this study. I will return to this classroom two days later on DATE X. If you and your parents consent to your participation in this study, please bring the signed parental consent form back to this classroom. This form is to be turned in along with the completed questionnaire you will take on the same day (DATE X). You will also be given a similar consent form to review and sign. By signing the consent forms, you grant us permission to use your answers on the questionnaire in our study as well as obtain your marks records from your college

Your participation is voluntary and all information is kept confidential. Teachers will not have access to your scores. Your decision to participate or to not participate in this study will not influence your evaluation or grade in this class. You may skip any question that you do not wish to answer. Also, you are free to stop completing the survey at any point without any penalty. There are no foreseeable risks at this time from participating in this study. There are no costs associated with this study. If you decide to participate in this study, you will benefit by learning more about your interests and becoming more aware of your confidence and performance expectations specific to different subject areas. You will be given a descriptive summary of your subject-specific scores of your confidence, interests and performance expectations as calculated by your responses on the questionnaire that you answer. It is hoped that the information gained in this study will benefit society by helping researchers and practitioners better understand the knowledge of interests, confidence and performance expectations of college students in India.

You are encouraged to ask questions at any time during this study. For further information about the study contact Asha Stephen (515-294-1742 or asha@iastate.edu) or Dr. Lisa M. Larson (515-294-1487 or lmlarson@iastate.edu) If you have any questions about the rights of research subjects, please contact the Human Subjects Research Office, 1138 Pearson Hall, Ames, IA, 50011 (515) 294-4566; austingr@iastate.edu or the Research Compliance Officer, Office of Research Compliance, 1138 Pearson Hall, Ames, IA 50011, (515) 294-3115; dament@iastate.edu.

APPENDIX H: PARENTAL CONSENT DOCUMENT

Title of Study: Gender Differences in Subject-Specific Academic Performance of 12^{th} Grade Indian Students

Investigators: Asha Stephen, M.S. (515-294-1742 or asha@iastate.edu)
Lisa M. Larson, Ph.D. (515-294-1487 or lmlarson@iastate.edu)

Please take your time to review the information below. This is a research study. If you would like your child to participate, please sign your name at the bottom of this form in the space provided.

INTRODUCTION

Your child is invited to be in a research study about expectations regarding the effect that interests, confidence and academic performance expectations of 2^{nd} year Intermediate students in India have on their academic performance. This study also concerns differences in the confidence, expectations and interests of male and female students in various subjects such as mathematics, science and social studies. These issues are related to academic and career choices of Indian college students. Your child was selected as a possible participant because your child is 2^{nd} year Intermediate student in India.

DESCRIPTION OF PROCEDURES

If you agree to allow your child to participate in this study, your child will be asked to complete a questionnaire about his/her interests, confidence and academic performance expectations. This questionnaire will take about 30 minutes to complete

During the study you may expect the following study procedures to be followed.

The researcher will come to your child's classroom on ***DATE X*** and will hand out a questionnaire consisting of some demographic questions and some simple questions about your child's interests, confidence and academic performance expectations. Your child may skip any question that he/she does not wish to answer or that makes him/her feel uncomfortable. After completing the questionnaire, your child will return the completed questionnaire to the researcher along with this signed form.

The answers from the completed questionnaire will be used to study the effect of participants' interests, confidence and academic expectations on their examination marks. The researchers will also contact your child's college in January 2006 in order to obtain the half-yearly results and the 11^{th} class/1^{st} year Intermediate annual examination marks of all the students who participate in this study. By signing this form, you grant us permission to obtain the marks records of your child from the college.

RISKS/BENEFITS

There are no foreseeable risks at this time from participating in this study. If you decide to allow your child to participate in this study, your child will benefit by learning more about his/her interests and becoming more aware of his/her confidence and performance expectations specific to different subject areas. Your child will be given a summary of his/her subject-specific scores of their confidence, interests and performance expectations as calculated by his/her responses on the questionnaire they answer. It is hoped that the information gained in this study will benefit society because this information will be useful to both personal and career counselors as it will increase their knowledge of the outcome of this measure with an Indian population. Also the field of psychology will be able to increase its knowledge of the constructs of confidence, performance expectations and interests.

COSTS AND COMPENSATION

There are no costs for participating in this study. The only compensation for this study is a descriptive summary of the subject-specific scores of the confidence, interests and performance expectations of your child as calculated by his/her responses on the questionnaire that he/she answered. Should your child wish to receive this descriptive summary, he/she may indicate so on the questionnaire.

PARTICIPANT RIGHTS

Your decision whether or not to allow your child to participate in this study is completely voluntary and you may refuse to allow your child to participate or leave the study at any time without any penalty.

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, federal government regulatory agencies and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy these records for quality assurance and data analysis.

Any identifying information of your child will be kept on our records for the duration of this study until 12/15/2011 after which it will be erased. To ensure confidentiality to the extent permitted by law only the two researches listed at the top of this form will have access to these records. If the results are published, your child's 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 Asha Stephen (515-294-1742 or asha@iastate.edu) or Dr. Lisa M.

Larson (515-294-1487 or lmlarson@iastate.edu) If you have any questions about the rights of research subjects or research-related injury, please contact Ginny Austin Eason, IRB Administrator, (515) 294-4566, austingr@iastate.edu, or Diane Ament, Research Compliance Officer (515) 294-3115, dament@iastate.edu.

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PARENT/GUARDIAN SIGNATURE

Your signature indicates that you voluntarily agree to allow your child 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 will receive a copy of the signed and dated written informed consent prior to your child's participation in the study

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Name of student (in capital letters)

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Name of Parent/Guardian or Legally Authorized Representative (in capital letters)

______________________________ ________________

(Signature of Parent/Guardian or Legally Authorized Representative) (Date)

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INVESTIGATOR STATEMENT

I certify that the participant's parent/guardian or legally authorized representative 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 he/she understands the purpose, risks, benefits and the procedures that will be followed in this study and has voluntarily agreed to allow the participant to participate.

______________________________ ________________

(Signature of Person Obtaining Informed Consent) (Date)

APPENDIX I: INFORMED ASSENT DOCUMENT

Title of Study: Gender Differences in Subject-Specific Academic Performance of 12th Grade Indian Students

Investigators: Asha Stephen, M.S. (515-294-1742 or asha@iastate.edu)
Lisa M. Larson, Ph.D. (515-294-1487 or lmlarson@iastate.edu)

Please take your time to review the information below. This is a research study. If you would like to participate, please sign your name at the bottom of this form in the space provided.

INTRODUCTION

You are invited to be in a research study about expectations regarding the effect that interests, academic confidence and academic performance expectations of 2nd year Intermediate students in India have on their academic performance. This study also concerns differences in the confidence, expectations and interests of male and female students in various subjects such as mathematics, science and social studies. These issues are related to academic and career choices of Indian college students. You were selected as a possible participant because you are a /2nd year Intermediate student in India.

DESCRIPTION OF PROCEDURES

If you agree to participate in this study, you will be asked to complete a questionnaire about your interests, confidence and academic performance expectations. This questionnaire will take about 30 minutes to complete

During the study you may expect the following study procedures to be followed.

The researcher will come to your classroom on ***DATE X*** and will hand out a questionnaire consisting of some demographic questions and some simple questions about your interests, confidence and academic performance expectations. You may skip any question that you do not wish to answer or that make you feel uncomfortable. After completing the questionnaire, you will return the completed questionnaire to the researcher along with this signed form and the parental consent form.

The answers from the completed questionnaire will be used to study the effect of participants' interests, confidence and academic expectations on their examination marks. The researchers will also contact your college in January 2006 in order to obtain the half-yearly results and the 11th class/1st year Intermediate annual examination marks of all the students who participate in this study. By signing this form, you grant us permission to obtain your marks records from your college.

RISKS/BENEFITS

There are no foreseeable risks at this time from participating in this study. If you decide to participate in this study, you will benefit by learning more about your interests and becoming more aware of your confidence and performance expectations specific to different subject areas. You will be given a summary of your subject-specific scores of your confidence, interests and performance expectations as calculated by your responses on the questionnaire that you answer. It is hoped that the information gained in this study will benefit society because this information will be useful to both personal and career counselors as it will increase their knowledge of the outcome of this measure with an Indian population. Also the field of psychology will be able to increase its knowledge of the constructs of confidence, performance expectations and interests.

COSTS AND COMPENSATION

There are no costs for participating in this study. The only compensation for this study is a descriptive summary of the subject-specific scores of your confidence, interests and performance expectations as calculated by his/her responses on the questionnaire that he/she answered. Should you wish to receive this descriptive summary, you may indicate so on the questionnaire.

PARTICIPANT RIGHTS

Your decision whether or not to participate in this study is completely voluntary and you may refuse to participate or leave the study at any time without any penalty.

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, federal government regulatory agencies and the Institutional Review Board (a committee that reviews and approves human subject research studies) may inspect and/or copy these records for quality assurance and data analysis.

Any information that identifies you will be kept on our records for the duration of this study until 12/15/2011 after which it will be erased. To ensure confidentiality to the extent permitted by law only the two researches listed at the top of this form will have access to these records. 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 Asha Stephen (515-294-1742 or asha@iastate.edu) or Dr. Lisa M.

Larson (515-294-1487 or lmlarson@iastate.edu) If you have any questions about the rights of research subjects or research-related injury, please contact Ginny Austin Eason, IRB Administrator, (515) 294-4566, austingr@iastate.edu, or Diane Ament, Research Compliance Officer (515) 294-3115, dament@iastate.edu.

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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 will receive a copy of the signed and dated written informed assent prior to your participation in the study.

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Name of Participant (in capital letters)

____________________________________ ____________________

(Participant's Signature) (Date)

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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 J: DEBRIEFING

Thank you very much for your participation in this study. The aim of this study is to assess the effect that interests, confidence and academic performance expectations of 2^{nd} year intermediate students in India have on their academic performance. We also hope to be able to study whether confidence, interests and performance expectations of male and female students are meaningfully different in subjects that are less traditional for women (mathematics, science) and those that are more traditional for women (social studies). We hope these results can help us to better understand how Indian students go about the process of making career decisions.

Again, thank you very much for your participation.

ACKNOWLEDGEMENTS

Thanks and gratitude are due to my family without whose love, support and encouragement, I would not have made it this far. My father, who worked hard and made great sacrifices so that I could pursue my dreams. You are my greatest strength and constantly instill hope in my heart. Without your help, I would never have been able to finish this thesis. My mother, who taught me to be curious and engendered the love for learning in me. You are an incredible woman, and you inspire me to challenge myself. And Nisha, my little sister, who believed in me even at times when I did not. You are God's greatest gift to me. Thank you for being there for me through all the hard times.

To Dr. Lisa M. Larson, my major professor, who guided me through each stage of this thesis from conception to completion. I am very indebted to you for giving me the benefit of your profound academic experience. Your patience, insight and fortitude cannot be overestimated.

To my committee members, Dr. David Vogel and Dr. Dan Russell for their valuable insight and comments. To Ms. Tsui-Feng Wu, my friend and colleague who helped and supported my research. To all my colleagues and friends at Iowa State University who supported me through this lengthy process.

Amat victoria curam!