Sources and Effects of the Self-Efficacy Beliefs of Men with Careers in Mathematics, Science, and Technology

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An Abstract of
A dissertation submitted to the Faculty of the Graduate
School of Emory University in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy

Division of Educational Studies

2000

Abstract

The purpose of this study was to explore the personal stories of men who selected careers in mathematics, science, or technology to better understand the ways in which their self-efficacy beliefs were created and subsequently influenced their academic and career choices. Analysis of 10 narratives revealed that mastery experience was the primary source of the men's self-efficacy beliefs. These results differ from those of a previous investigation in which researchers traced the sources of the self-efficacy beliefs of women who also pursued careers in these areas. For women, social persuasions and vicarious experiences were the primary sources of self-efficacy beliefs. Together, these findings suggest that different sources are predominant in the creation and development of the self-efficacy beliefs of men and women who pursue mathematical, scientific, or technological careers: The self-efficacy beliefs of men in these gender-friendly domains are created primarily as a result of the interpretations they make of their ongoing achievements and successes; women, on the other hand, rely on relational episodes in their lives to create and buttress the confidence that they can succeed in gender-unfriendly, male-dominated, domains. These contentions are in concert with those made by C. Gilligan (1982) and E. Erikson (1968), whose theoretical insights can enrich the tenets of social cognitive theory as regards the genesis of mens' and women's confidence beliefs. Findings regarding the influence of self-efficacy beliefs on the men's academic and career choices were consistent with the theoretical tenets of A. Bandura's (1986) social cognitive theory. Implications and recommendations are included.

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CHAPTER 1
INTRODUCTION AND THEORETICAL FOUNDATION

The participation of women in mathematical, scientific, and technological careers is disproportionate to that of men. Although enrollment has increased such that women currently make up the majority of the college student population, women earn fewer degrees in mathematics and science than do men (National Center for Education Statistics, 1997). Researchers continue to examine this phenomenon, but those who embrace a social cognitive perspective suggest that the underrepresentation of women in mathematics-related careers may be due in large part to the self-beliefs that they hold about their capabilities (Betz & Schifano, 1999; Hackett, 1995; Lent & Hackett, 1987).

Self-beliefs are a critical component of most modern theories of human motivation. The central construct in Albert Bandura's (1986, 1997) social cognitive theory is self-efficacy, which he defined as people's judgments of their capabilities to produce designated levels of performance. According to the tenets of social cognitive theory, people are more likely to perform tasks they believe they are capable of accomplishing and less likely to engage in tasks about which they feel less competent. Individuals' perceptions of their competencies are powerful motivators that affect the choices they make, the effort and persistence they put forth, and the resilience they show in overcoming obstacles. Self-efficacy beliefs also play a mediational role in that they serve as filters between prior achievements or abilities and subsequent behavior. For example, students who interpret the results of their test scores favorably may use that

interpretation to fuel their effort to study hard so as to perform well on subsequent exams.

Beliefs about one's own capabilities influence the choice of activities that are selected. Tasks and activities that people believe they are unable to do well are typically avoided, whereas those activities that people believe they can do are more likely pursued. The cumulative effect of performing tasks about which a person already feels efficacious will result in increasing competencies. Self-efficacy beliefs also influence how much effort people will expend on an activity or task and how long they will persist in the face of difficulty. Strong perseverance typically results in higher performance attainments. People who are plagued with low confidence in a given situation are likely to give up easily, unconvinced that sustained efforts will result in increased capabilities. Moreover, people who judge themselves efficacious in a given context are likely to be resilient to obstacles and will not perceive minor setbacks to be insurmountable hindrances.

People form their self-efficacy perceptions by interpreting information from four sources: (a) authentic mastery experiences, (b) vicarious experiences, (c) verbal persuasions, and (d) physiological indexes (Bandura, 1997). The most influential source of information comes from the interpreted results of past performance, which Bandura called mastery experiences. These past performance accomplishments can create a strong sense of efficacy to accomplish similar tasks in the future. Alternatively, repeated failure can lower efficacy perceptions, especially when such failures occur early in the course of events and cannot be attributed to lack of effort or external circumstances.

The second source of self-efficacy information is the vicarious experience that individuals undergo when they observe others performing tasks. By observing the

successes and failures of others, people gather the information necessary to make judgments about their own capabilities. The models whom individuals observe exercise the greatest influence when they are perceived to be similar to the observer, especially in situations in which the observer has little experience.

Social or verbal persuasions—convincing people that they possess the skill to accomplish a task—is hypothesized to exert the most positive influence on those who already have a strong sense of self-efficacy. Social messages can encourage people to exert the extra effort to succeed, resulting in development of skills and personal efficacy. According to Bandura (1986), however, these persuasions can also work to undermine efficacy beliefs when used to convince people that they lack capabilities. Derogatory statements about one's competence in a particular area are believed to have the most detrimental affect on the confidence judgments of those who already lack confidence in their capabilities. For example, when women receive social messages that they do not belong in a male-dominated field such as mathematics, they may be especially vulnerable to believing that they are not and cannot be competent in that area.

People look to their physical and emotional states as a fourth source of information about their capabilities. Powerful emotional arousal, such as anxiety, can effectively alter individuals' beliefs about their capabilities. Signs of stress and tension may be interpreted as indicators of susceptibility to failure. The significance of an individual's perceptions and interpretations of physical signals is important. People may view a state of arousal as an energizing factor that can contribute to a successful performance, or they may view arousal as completely disabling.

In the educational arena, self-efficacy has been used to explain academic motivational processes and achievement. Research in academic settings has followed three primary lines of inquiry: (a) the self-efficacy beliefs that teachers hold about their effectiveness, (b) the academic motivation and performance of students, and (c) the effect of self-efficacy beliefs on career choice and development. In the first area, researchers have demonstrated that the self-efficacy beliefs of teachers, or teacher efficacy as it has come to be called, correlate with teachers' classroom management approaches and with perceived control over students (Woolfolk, Rosoff, & Hoy, 1990). Teacher efficacy also correlates with a number of psychological and educational variables, such as persistence with difficult students, participation in system-wide decisions, maintenance of a supportive classroom environment, and student achievement (Tschannen-Moran, Hoy, & Hoy, 1998). In the second area, researchers examining the self-efficacy beliefs of students have reported that perceptions of capability exercise a powerful influence on academic achievement and on motivational constructs (Pajares, 1996, 1997; Schunk, 1991).

The idea that people actively select or eliminate future activities through their own cognitive mechanisms has provided a heuristic model toward understanding career decisions. Hackett and Betz (1981) first applied the self-efficacy construct in the area of career choice and adjustment. They postulated that self-efficacy beliefs played an important role in the gender differences typically found in career-related behaviors and occupational goals. Specifically, they suggested that women and men develop different efficacy expectations about themselves through the varied ways in which they experience the four antecedents of self-efficacy. For example, when considering performance

accomplishments as a significant source of self-efficacy development, Hackett and Betz suggested that boys were more likely to gain experiences in a wide variety of areas outside the home, whereas girls traditionally gained experiences inside the home. Experience with tasks of a mechanical, scientific, and technical nature were typically characteristic of the early experiences of boys, leading them to develop stronger self-efficacy expectations toward careers that require those skills.

Since then, the career self-efficacy beliefs of men and women in mathematically-oriented domains have received extensive study. Researchers have demonstrated that students' career self-efficacy makes an independent contribution to career selection and can influence their direction as profoundly as cab performance and achievement (see Hackett, 1985; Hackett & Betz, 1989; and Lent & Hackett, 1987, for a review). Findings have also revealed that women's perceptions of their abilities to successfully fulfill the educational requirements and job duties of mathematics and related areas are significantly lower than are those of men (Betz & Hackett, 1981, 1983; Lent, Lopez, & Bieshke, 1991, 1993). Women who are aptly competent in mathematics often fail to pursue mathematics-related careers because they have low self-efficacy perceptions about their competence (Betz & Hackett, 1997).

Researchers who have investigated the sources of career self-efficacy perceptions have focused on Bandura's (1986) hypothesized sources. Lent, Lopez, Brown, and Gore (1996) factor analyzed a sources scale and reported that a four-factor model of the latent structure of the efficacy sources underlay the instrument. Lent et al. (1991) reported that each of the four sources correlated with mathematics self-efficacy. After controlling for mastery experience, however, vicarious experience, social persuasions, and physiological

indexes did not explain significant additional variance. Matsui, Matsui, and Ohnishi (1990) found that verbal persuasion was the only source that did not make a significant contribution to mathematics self-efficacy beliefs. Although these findings support Bandura's (1986) contention that mastery experience is the most important source of efficacy information, researchers have reported some interesting gender differences. For example, although male students report more mathematics-related performance accomplishments than do women, women report more vicarious learning and persuasive experiences than do men (Lent, Lopez et al., 1996). Lent, Brown, Gover, and Nijjer (1996) found that mastery experience was the self-efficacy source that college students believed accounted for their mathematics-related efficacy perceptions, but women tended to cite physiological reactions and teaching quality considerations much more often than did men.

The more prominent contribution of mastery experience to individuals' self-efficacy perceptions may be due to several reasons. The forced-choice structure of survey scales typically used to assess self-efficacy sources does not allow for elaboration or for examples of instances in which the source variables worked independently or together. Also, it is possible that past performance accomplishments may be the most relevant to students at the time surveys are administered. As Hackett (1995) noted, “memories tapped in retrospective research of this type are heavily influenced by current attitudes. Individuals are far more likely to recall their own successes and failures than to remember comments of others or observational experiences” (p. 246). Although this line of research has demonstrated how much of each source of self-efficacy has contributed to the overall efficacy perception, it has not painted a holistic picture. Intricacies of self-

efficacy development, as well as the importance of each source to different stages in academic and career paths, still remain largely unexplored.

Zeldin and Pajares (2000) employed qualitative methodology to discover the role played by self-efficacy beliefs in the career and academic paths of 15 women with mathematically-related careers. They developed an interview protocol based on the theoretical sources of self-efficacy that allowed participants to explore they ways in which they felt their confidence was developed without leading them to speak specifically about any one source in greater frequency than another.

An analysis of narratives revealed that verbal persuasions and vicarious experiences were critical sources of the women's self-efficacy beliefs, and they recalled those types of incidents to a greater extent than they recalled other performance accomplishments. The mathematics self-beliefs of the women were nurtured by familial, academic, peer, and work-related influences, and those influences were recalled primarily in terms of encouragement or vicarious experiences. Those self-beliefs in turn helped to develop the effort, persistence, and resilience required to overcome personal, social, and academic obstacles.

Women consistently recalled experiences that involved an influential person, often during a critical time, who helped them develop their beliefs about their capabilities while they also developed their competencies. The vicarious experiences influenced both their ideas regarding mathematics-related areas and their philosophies about women in male domains. Although women recalled obstacles such as negative social messages about themselves and about their career or academic pursuits, their experiences with positive

messages and models proved influential during the selection and retention of career and academic behaviors.

Contrary to previous findings that past performance accomplishments was the most significant source for developing self-efficacy, the findings of Zeldin and Pajares (2000) suggested that the perceived importance of vicarious experiences and verbal persuasions might be stronger for women in male domains than for individuals operating in traditional settings. Recall that there have been instances on the quantitative scale in which female students have scored higher on the social persuasions and vicarious experiences variable than have male students (e.g., Lent, Brown et al., 1996). Thus, there is evidence of possible gender differences in the attention to and integration of the sources of self-efficacy that should be more closely examined by researchers.

Statement of the Problem

Quantitative inquiry in the area of career self-efficacy has demonstrated that the perceptions that men and women develop about their competencies in mathematical domains may differ. Quantitative methodology, however, has traditionally asked participants to project their self-efficacy beliefs and answer questions about how capable they perceive themselves to accomplish tasks or fulfill goals. This type of inquiry has not encouraged participants to reflect on their own academic and career histories so as to provide the deep personal insights necessary to aid in understanding the creation and maintenance of self-efficacy beliefs. Researchers in the area of self-efficacy have agreed that quantitative studies need to be complemented by qualitative inquiry to provide the opportunity for rich description that is available through narrative (Pajares, 1996b, 1997; Schunk, 1991).

Some researcherst have looked at the career development of women from a qualitative perspective. Stage and Maple (1996) used a narrative approach to study the educational and career paths of seven women who chose to leave the mathematics/science pipeline to pursue a doctorate in education. They found that women who were deterred from their goals to have a career in a mathematics-related area were hindered by the conflict of their beliefs about themselves and about mathematics. Although findings provided insight into the ways in which self-beliefs can result in the abandonment of mathematically-related careers for women, it did not increase understanding of the self-beliefs that are more adaptive in helping women pursue their desired career goals.

Researchers have also examined the career development of highly achieving African American and White women from a qualitative perspective (Richie, Fassinger, Prosser, & Robinson, 1997). Grounded theory results demonstrated that the women were relationally oriented and persistent in the face of obstacles and were passionate about their work. Although participants reported a career history of having to deal with sexism and racism, only 2 of the 12 women had careers in male-dominated, mathematics-related fields. The theme of interconnectedness and relational orientation was evident in the development of career-related self-beliefs, in contrast to the individualism often thought to be necessary to achieve success in high-profile careers. The authors suggested that their findings ran contrary to career-related behaviors that were typically attributed to successful men.

Similarly, Zeldin and Pajares (2000) argued that the pattern of women's self-efficacy development in male-oriented domains may differ from patterns suggested by

theoretical tenets. But it has yet to be determined whether these patterns also differ from those that men follow in similar domains. In other words, it is “essential to discover whether the process that characterizes girls development in our culture is relevant to the development of boys” (Harter, Waters, & Whitesell, 1997, p. 156). To better understand this process, it is necessary to include the voices of men in investigations that trace the sources of self-efficacy. It may be that men and women follow quite different paths to the development of their confidence. As Zeldin and Pajares have suggested, women's sense of confidence may be especially affected by the encouragement or discouragement received from people they deem important in their lives. Alternatively, as social cognitive theory posits, men may be less affected by the persuasions of others and may be especially sensitive to their own individual performance attainments. In either case, it is only by permitting individuals to express their personal stories that researchers can better understand the important role that self-efficacy beliefs play in career development.

Purpose of the Study

The purpose of this study was to explore the personal stories of men in mathematics, science, and technology to better understand the ways in which their self-efficacy beliefs were created and subsequently influenced their academic and career choices. Although previous research findings suggest that self-efficacy beliefs are influential arbiters in the development of human competence and that past accomplishments are generally the strongest source of self-efficacy development, the voices of individuals who have pursued mathematics-related careers and encountered success in mathematics-related domains have not been prominent in self-efficacy investigations (Pajares, 1996b, 1997; Schunk, 1991). Consequently, I sought to better

understand the contribution made by the four sources of self-efficacy information to the development of self-efficacy beliefs and to gauge the subsequent contribution made by these beliefs to the development of mathematics-related academic and career competence. In addition, I sought to compare the development of the self-efficacy beliefs of men in the present investigation with that of women's self-efficacy beliefs as described by Zeldin and Pajares (2000).

In keeping with the methodological conventions of qualitative inquiry, I attempted to paint a holistic picture of the creation and function of self-efficacy beliefs by exploring the contextual components of their development. A main objective of this study was to allow an opportunity for men to have a reflective voice and provide empirical evidence about their career development.

Research Questions

The following questions provide the framework on which data are analyzed and on which findings are grounded:

1. What factors enhance or inhibit the development of the self-efficacy beliefs of men in mathematical, scientific, or technological careers?

2. How do self-efficacy beliefs influence the academic path and career choice of men who have pursued mathematical, scientific, and technological careers?

3. What are the similarities and differences between men and women in mathematics-related careers in how their self-efficacy beliefs were created and employed?

Significance of the Study

As confidence is developed and maintained through various sources and experiences in peoples' lives, so are people's identity created through the formation of their self-beliefs. The attention to and effects of sources of self-efficacy may differ by gender and thus may result in differing developmental paths that men and women take toward how their confidence contributes to what they choose to become.

According to Gilligan (1982), "the elusive mystery of women's development lies in its recognition of the continuing importance of attachment in the human life cycle" (p. 23). This suggests that women's confidence, created from social sources and maintained within relational contexts, may differ fundamentally from that of men. Erikson (1959/1980, 1968) argued that men form their identity primarily from independent, work-related achievements, whereas women rely for their identity formation on the intimacy of the relationships in their lives. It may thus be that men's and women's confidence travels along two developmentally different roads: one paved by mastery experiences, the other by relational episodes.

Because students use their self-efficacy beliefs as "critical filters" (Sells, 1980) through which they pursue or eliminate academic courses, majors, and subsequent careers, it is essential that educators gain insight as to the manner in which these filters are developed and maintained. As they develop strategies and interventions, teachers, counselors, and school administrators could benefit from understanding which of the self-efficacy sources are especially critical for individual students. These understandings are crucial in helping educators to ensure that students are strengthened by their self-beliefs as they face the challenges and opportunities presented by pursuing a career in mathematics, science, and technology.

Limitations of the Study

Issues of sampling, representativeness, and generalizability are important in qualitative research, particularly when there exists implications for educational policy and practice (Maxwell, 1992). Clearly, the men interviewed for this investigation cannot speak for all men in mathematical, scientific, and technological careers. Although safeguards were taken to maximize reliability and validity of findings, caution must be exercised when making inferences about other individuals in similar situations.

Because the qualitative design of this investigation required the researcher to be the primary instrument for gathering data (Merriam,1988), it is important to offer a caution regarding the potential for bias in the participants' responses (and in my own interpretations). With this potential in ind, efforts were made to ensure reliability and validity, and I tried to safeguard against this issue in the research design. However, it bears noting that the responses of the men in the study may have been influenced by the fact that they were being interviewed by a woman.

Because the qualitative design of the present study requires the researcher to be the primary instrument for gathering and analyzing data (Merriam, 1998), it is important to note possible researcher bias. I created and designed the present study and protocol with a strong social cognitive lens, and I searched for patterns in the results with a theoretical orientation. Subtleties of information that would support alternative theoretical positions were not explicitly explored.

CHAPTER 2
REVIEW OF LITERATURE

Because self-efficacy has its theoretical foundation in Bandura's (1986) social cognitive theory, I begin this chapter with an overview of that theory. I then synthesize research findings in the area of career self-efficacy, both in the domains of content of career selection and in the process career decision-making. I highlight measurement issues, gender differences, early explorations of career self-efficacy, career self-efficacy and other motivational variables, and I include studies that address pre-collegiate populations. I then synthesize research that examines the sources of career self-efficacy and conclude with the way these research findings in career self-efficacy relate to the basis of this study.

Overview of Social Cognitive Theory

In Social Foundations of Thought and Action, Albert Bandura (1986) explained human functioning in terms of a model of triadic reciprocality in which behavior, cognitive and other personal factors, and environmental events all influence each other interdependently. In this social cognitive theory, people are active agents and exercise control over their thoughts and behavior through five basic human capabilities. According to Bandura, people's capability to symbolize helps them to create meaning. In this way, people represent their environment cognitively and can therefore anticipate the future. The capacity for forethought motivates people to adapt in the present to what they anticipate their future environment to be. The ability of individuals to learn by

observation is also central to human development. Vicarious experiences allow people the opportunity to learn how to behave and to perform tasks without direct participation.

Social cognitive theory highlights the importance of two other capabilities: self-regulation and self-reflection. People regulate their behavior by developing standards by which they evaluate their actions. Although environmental influences affect self-regulation, people continuously determine their own courses of behavior. In fact, people not only regulate themselves and their actions but also reflect on their experiences and their own thought processes. Through self-reflection, people gain understanding about the world around them. Individuals monitor themselves, analyze past events, and determine subsequent actions through reflection.

Because it emphasizes the dynamic interactions between people and their environments, Bandura's (1986) social cognitive theory provides a way to view career development contextually. As one of the most prominent cognitive mechanisms of personal agency, self-efficacy beliefs may be especially explanatory when attempting to understand the complexities of individual career development and selection. According to Hackett (1995), "there is now persuasive empirical evidence for the role of cognitive mechanisms, perceived self-efficacy in particular, in career choice and development" (p. 234).

The application of self-efficacy to career development was initially employed to explain the underrepresentation of women in higher status and male-dominated fields. Hackett and Betz (1981) first brought the construct of self-efficacy to the career development literature in a model suggesting that women limited their career options in part as a result of their lack of strong self-efficacy beliefs in relation to career-related

behaviors. Although they acknowledged social and externally imposed barriers on the limitations of women's career development, they were especially interested in discovering the specific mechanisms by which societal expectations became internalized by women and translated into career choice behavior.

Hackett and Betz (1981) contended that men were more likely than were women to be exposed to models relevant to career-related efficacy. Consequently, women were less likely to develop efficacy expectations for nontraditional female careers. This socialization-based difference between the genders worked to lower women's self-efficacy for success in traditionally male careers and contributed to their failure to realize their full capabilities, talent, and potential in career-related pursuits. The researchers called for clarification of the potential utility of self-efficacy to the understanding of career development by proposing the following three major research questions:

1. To what extent are expectations of self-efficacy related to the individual's perceived range of career options, to effective decision making, and to effective and persistent pursuit of career plans?

2. To what extent to gender differences in the level, strength, and generality of career-related efficacy expectations contribute to the understanding of gender differences in vocational behavior?

3. Do counseling interventions focused on increasing career-related self-efficacy expectations change vocational behavior, including satisfaction with and success in occupational pursuits?

Career Self-Efficacy and Career Development

Since Hackett and Betz's (1981) conceptual article that introduced the self-efficacy construct to career selection, researchers have supported the significance of self-efficacy to career development. They have emphasized the mediational role that self-efficacy plays between prior achievement and career selection, as well as the independent contribution it makes to the selection of college courses, majors, and career alternatives when combined with other motivational variables (Hackett & Betz, 1989; Lent et al., 1991, 1993).

In this section, I define career self-efficacy and then examine how the construct is typically operationalized and measured. Because understanding the seminal studies is foundational to understanding the career self-efficacy line of inquiry, I include the early explorations of career self-efficacy. Recall that self-efficacy was initially brought to the career literature to explain the underrepresentation of women in traditionally mathematics-related college courses, majors, and careers. Researchers have demonstrated that the lack of participation by women in male-dominated careers may have been due in part to their low mathematics self-efficacy (Hackett, 1985; Lent, Brown, & Larkin, 1984, 1986; see also Betz & Hackett, 1997; Hackett, 1995; Lent & Hackett, 1987). Consequently, I synthesize the research that focused on gender differences in career self-efficacy and the career development of women.

Because researchers typically combined self-efficacy with other motivational variables to provide a more complete model of career development, I review studies in which the relationship between career self-efficacy and other career motivational constructs has been investigated. Although most career self-efficacy researchers

concentrated on college students, they increasingly focused on career self-efficacy from a developmental perspective. Thus, I will also review research on the career self-efficacy of precollegiate students. More recently, attention has been paid to the processes of career decision-making itself and how decision making self-efficacy beliefs are created and maintained (Luzzo, 1993; Solberg, Good, & Fischer, 1995), and so studies are included in which career decision-making self-efficacy are a focus.

Measurement of Career Self-Efficacy

Career self-efficacy is typically defined as judgments of personal efficacy in relation to the wide range of behavior involved in career choice and adjustment (Lent & Hackett, 1987). In general, there are two lines of inquiry under the umbrella of career self-efficacy: one deals with the content of career selection (e.g., self-efficacy to have a successful career in a specific area); the other deals with the process of career selection (e.g., self-efficacy to investigate different occupational domains) (Betz, 1992). Career choice content refers to content domains such as, mathematics, writing, and science. Career choice process refers to those behavioral domains that are important to the choice and implementation of any career area such as, self-efficacy for career decision-making and self-efficacy for combining home and career (Stickel & Bonnet, 1991).

Recall that self-efficacy was initially used in vocational domains to understand the underrepresentation of women in male-dominated careers and, as such, Betz and Hackett (1997) offered two fundamental assumptions underlying the need for assessing career-related self-efficacy beliefs. The first assumption was that self-efficacy beliefs influenced educational and occupational choice as well as performance and persistence in implementing those choices. The second, which was also embedded within career self-

efficacy theory, was that differential background experiences associated with gender role socialization might have led to gender differences in self-efficacy and confidence with respect to specific domains of career behavior.

The first empirical investigation that applied self-efficacy theory to career development also included the creation of the Occupational Self-Efficacy Scale (Betz & Hackett, 1981). The original scale asked participants to rate their self-efficacy to fulfill the educational requirements and job duties of 20 commonly known occupations such as engineer and social worker. Based on the percentages of women in the occupations, job titles were categorized as traditional or nontraditional (10 occupations for each category). Participants were asked to rate their confidence for each of the 20 occupations both with a "yes/no" response, referred to as level of self-efficacy, and by a confidence rating (0-10, completely unsure to completely sure) referred to as strength of self-efficacy. Educational requirements and job duties were rated separately. In a revised format, which is more commonly used today, the assessment asked only for a confidence rating ranging from 0-9 (no confidence at all to complete confidence). Self-efficacy scores were the sum of the confidence ratings across the desired subscale items (e.g., traditional vs. nontraditional occupations).

Since the development of the Occupational Self-Efficacy Scale, researchers have found it a reliable and valid measure of career self-efficacy. Test-retest reliability of the overall Occupational Self-Efficacy Scale level and strength scores were .55 and .70, respectively, over a one-week retest period as reported by Hackett and Campbell (1987).

Most researchers who have examined the career self-efficacy of students have used Betz and Hackett's Occupational Self-Efficacy Scale or a modified version (Hackett,

1995). Although the Occupational Self-Efficacy Scale has been used to successfully determine specific beliefs of students in the occupational domain, there is some debate over the way in which career self-efficacy should be measured. Some researchers believe that to make appropriate judgments about their perceived career competencies, individuals need more information than that provided by the job title only (Osipow & Temple, 1986; Rooney & Osipow, 1992).

The Task-Specific Occupational Self-Efficacy Scale (TSOSS) was developed to provide a skill-oriented measure of career self-efficacy (Osipow & Temple, 1996). The creators of the TSOSS provided a rationale suggesting that task-specific self-efficacy would have some advantages over the more general approach (i.e., the Occupational Self-Efficacy Scale) in that it was more in keeping with Bandura's (1986, 1997) contention that specific approaches were likely to be more productive than general approaches. It appeared that it would be more useful to ask individuals about their confidence for specific career skills (for example, I can speak effectively to groups) than about their confidence for succeeding in an occupation (confidence in becoming, for example, a teacher). The original form of the TSOSS was composed of 230 skill and knowledge items selected from the United States Department of Labor's Selected Characteristics of Occupations Defined in the Dictionary of Occupational Titles (Part A). Items included career-oriented tasks such as, "Lift and carry items," "Use scientific and technical knowledge," and "Show interest and desire to help others." Participants were asked to indicate their confidence to perform each activity using a 5-point scale ranging from 1 (no confidence) to 5 (absolute certainty).

Based on results obtained from a factor analysis, the Task-Specific Occupational Self-Efficacy Scale (TSOSS) short form was developed from the original and included 60 items. Four factors of 15 items comprised each of four subscales: (a) verbal interpersonal skills, (b) quantitative, logical, and business skills, (c) physical strength and agility, and (d) aesthetic skills (Osipow, Temple, & Rooney, 1993). The TSOSS short form has been used in several research studies, but Osipow and Temple (1996) concluded that, because predicted relationships were either small or relatively weak, much work needed to be done before the measure could be assumed to be valid.

One problem with the TSOSS was that, although it represented a wide sampling of career-related tasks, responses from college undergraduates tended to be skewed negatively. That probably resulted from the fact that several of the tasks in the TSOSS were easy and most college students felt efficacious about completing them (Rooney & Osipow, 1992). Results of another study utilizing the TSOSS did not successfully support its usefulness in predicting a relationship between self-efficacy perceptions and career indecision. Researchers measured the relationship between task-specific career self-efficacy and career indecision for female college students classified as possessing either high or low egalitarian sex-role attitudes (Temple & Osipow, 1994). Results offered minimal support for the hypothesis that there would be a significant relationship between self-efficacy (as measured by the TSOSS) and career indecision depending on sex-role attitudes. However, college women who scored high on the sex-role attitude survey reported higher self-efficacy for the first two factors of the TSOSS than did women who scored low on sex-role egalitarianism.

A more recent task-specific career self-efficacy scale was designed for the purpose of eradicating some of the problems of the TSOSS. According to Lucas, Wanaberg, and Zytowski (1997), the TSOSS had not been based on any current career interest theory or model, reducing its potential utility. Lucas et al. (1997) developed the Kuder Task Self-Efficacy Scale (KTSES) to correspond to the Kuder Occupational Interest Survey, based on the 10 career interest areas of artistic, musical, mechanical, scientific, outdoor, clerical, computational, literary, social service, and persuading. Analysis of the KTSES resulted in a 30-item assessment across the10 interest areas. Initial support for the validity of the KTSES was provided by the relationships between the task scale and measures of self-esteem, career decision-making self-efficacy, and occupational self-efficacy.

Although the relationships between the KTSES, self-esteem scale, and career-decision-making self-efficacy scale were positive, the relationships were only moderate for self-esteem ($\underline{r}$ = .21) and for career decision-making self-efficacy ($\underline{r}$ = .28). Moreover, the KTSES had a positive relationship with occupational self-efficacy. The scale that measured occupational self-efficacy, however, was developed from the same 10 interest types used to develop the KTSES. Participants were asked to indicate the extent to which they were confident that they could complete the job duties of 30 occupations on a regular basis if they received some training. Results indicated that 9 of the 10 subscales on the KTSES had their highest correlations with their corresponding occupations. Furthermore, gender differences were found insofar as men indicating higher self-efficacy for traditionally masculine tasks and females indicating higher self-

efficacy on traditionally feminine tasks. Men also indicated higher overall task self-efficacy than did women.

There have been two more measures of career self-efficacy at the task-specific level, and both have been based on the six career interest types created by Holland (1973). According to Betz et al. (1996), those interest types—realistic, investigative, artistic, social, and enterprising—have been among the major individual differences variables used in career theory, assessment, and counseling. Matsui and Tsukamoto (1991) provided Japanese undergraduate students with a list of 60 work-related activities (10 activities for each of the 6 Holland types) and asked them to indicate the extent to which they would feel confident of their capability to successfully accomplish each type of activity if they were to receive some training. Participants were also provided with a list of 30 types of occupational titles (5 occupations selected from each of the 6 Holland types) and asked about their confidence to successfully complete the job duties of each. Results indicated that for 28 of the 30 occupational titles used, self-efficacy measures in relation to occupational titles were consistent with self-efficacy for work activities included in the respective occupations.

The development of the Skills Confidence Inventory (SCI) was the most recent addition to a self-efficacy scale based on the six Holland interest themes (Betz et al., 1996). Researchers developed the scale with 10 discrete skill items for each of the six Holland theme areas. Called the General Confidence Themes (GCT), each GCT scale consists of 10 activities, tasks, or school subjects relevant to each Holland theme. Sample activities and school subject items were as follows: (a) build a dollhouse, industrial arts (realistic); (b) perform a scientific experiment, calculus (investigative); (c) design sets for

a play, art (artistic); (d) meet new people, counseling methods (social); (e) sell a product to a customer, public speaking (enterprising); and (f) organize systems for filing information, accounting (conventional). Respondents were instructed to indicate their degree of confidence in their abilities to complete the activity or task on a scale ranging from 1 (no confidence at all) to 5 (complete confidence). In a sample of 113 college students, test-retest reliability over a three-week period ranged from .83 (realistic) to .87 (social) (Parsons & Betz, 1998). Construct validity of the SCI was also supported by significant correlations between realistic, investigative, enterprising, and conventional confidence with self-efficacy with respect to male-dominated occupations. Betz, Schifano, and Kaplan (1999) also provided evidence of construct validity of the SCI by comparing the similarly named scales to those on the TSOSS. Relationships between the scales, TSOSS-Verbal/interpersonal with SCI-Social, TSOSS-Quantitative with SCI-Investigative as examples, were high and ranged from $\underline{r}$ = .50 to .80.

Results of investigations using the SCI with college students demonstrate that men score higher on self-efficacy for the realistic, investigative, enterprising, and conventional scales, whereas women report higher self-efficacy than men for tasks related to the Social theme. Also, because confidence for and interest in a theme are moderately correlated, the use of a confidence measure for Holland's themes would add great benefit when assessing interest of an individual for various career types (Betz et al., 1996). Similarly, the SCI was found to be a distinct measure from interest but similar in structure, and added incremental validity to interest for adult employees (Donnay & Borgen, 1999).

Career self-efficacy research has continued to expand over recent years, and there are researchers who choose to operationalize career self-efficacy according to their

specific investigation. For example, Wheeler (1983) asked participants to report their self-efficacy perceptions about occupations as a perceived match of ability ranging from (1) "my abilities don't fit requirements for this occupation" to (7) "my abilities are well matched to this occupation," and as perceived ease of success for each occupation ranging from (1) "very hard to succeed in this occupation" to (7) "could easily succeed in this occupation." Lenox and Subich (1994) devised a 30-item scale based on Holland's interest themes and asked participants to rate their confidence on a 10-point scale from (1) completely unsure to (10) completely sure. Items asked participants to report their confidence about occupational abilities and work-related tasks.

Clemet (1987) examined occupational self-efficacy in 121 current and prospective university students in Great Britian and designed a scale assessing self-efficacy by job description. The Occupational Questionnaire included 20 job descriptions of 90-110 words and described the amount and type of training and studying required and the job duties of each occupation. Students were then asked three questions about the occupation. The first asked them to rate their efficacy on a 10-point scale, stated, "How confident are you that you could competently do the job of a . . . ?" Students were also asked how much they liked the occupation, as well as to the extent to which they had considered entering the occupation. Results demonstrated that women reported lower self-efficacy for nontraditional occupations than did men, yet they considered entering seven of the occupations as seriously as the men. For the three remaining occupations, results of a regression analysis demonstrated that the reluctance to seriously consider those was not directly attributable to self-efficacy perceptions.

In addition, the Career Attitude Scale (CAS) was also designed using descriptions of specific careers rather than occupational titles (Stickel & Bonnet, 1991). Careers were divided into 10 traditionally female occupations (e.g., occupational therapist and elementary school teacher) and ten traditionally male occupations (e.g., electrical engineer and chemist). Descriptions were written that equated the traditional and nontraditional occupations on characteristics such as physical demands, danger, stress/emotional demands, required knowledge of science and/or math, work schedule/flexibility, and educational requirements. Participants were asked to rate themselves along the following three dimensions for each career: (a) perceived ability to pursue the given occupation, (b) perceived ability to combine the occupation with home/family responsibilities, and (c) degree to which the occupation had ever been considered. Each participant received six scores, rating traditional and nontraditional careers along each of those dimensions. Results of 130 undergraduate students revealed that women had greater confidence that they could competently handle traditional versus nontraditional careers and that they could combine a traditional career with family and home activities.

The discussion of the measurement of career self-efficacy continues among researchers, particularly the debate over what level of specificity provides the most useful measure. In a study examining the relationship between the TSOSS (Rooney & Osipow, 1992) and the Occupational Self-Efficacy Scale (Betz & Hackett, 1981), findings suggested that, although occupational and task-specific self-efficacy were related, they were not redundant (Williams & Betz, 1994). There was evidence that suggested that the TSOSS might have been less useful for counseling purposes for women as there existed less differentiation of the factors for female students. Important to note was the

observation that providing occupational information in the form of work-related tasks might have been an intervention in itself (Hackett, 1995). Individuals may very well make career decisions based on stereotypic information, or what they think a particular job entails. According to Bandura (1997), people generally consider certain occupations and eliminate others based on their conceptions, which may or may not be accurate. He added that "to target personal efficacy to subskills of occupations can lower the predictiveness of efficacy for beliefs for the occupations people choose to pursue" (p. 423). It is not self-efficacy for isolated tasks, but perceived efficacy to use them together under various circumstances, that predicts the choices individuals make. Thus, the influence of the occupational information inherent in the assessment of career self-efficacy by job descriptions or specific tasks as opposed to assessment by job titles should be examined.

Early Explorations of Career Self-Efficacy

Inspired by the phenomenon of the underrepresentation of women in nontraditional careers, the line of inquiry for career self-efficacy had its start in examining the differences in career selection by men and women. Betz and Hackett (1981) conducted the first empirical investigation that examined the relationship of career self-efficacy expectations to perceived career options for 235 college men and women. They selected 20 occupations to represent a range of interest areas and to represent a range on the basis of the percentage of women employed in those occupations. Occupations were designated as either traditional (high percentage of women employed) or as nontraditional (low percentage of women employed).

Career self-efficacy was assessed by asking participants if they could fulfill both the educational requirements and job requirements for each of the twenty occupations. Participants were instructed to respond with a yes or no, and the authors referred to that assessment as level of self-efficacy. Strength of self-efficacy perceptions was assessed by asking participants to rate their confidence to complete the educational and job requirements on a 10-point scale for those items that participants responded "yes" to initially. The authors referred to level of self-efficacy expectations (the yes or no response) simply as self-efficacy and considered it to be directly related to the range of career options and the major variable under consideration in the study. Students were also asked to rate their degree of interest for each occupation as well as to rate how seriously they considered pursuing each occupation. Finally, measures of ability were assessed by the score reports for each participant on the English and mathematics subtest on the American College Test (ACT).

Results demonstrated that, taken together, the total level of self-efficacy for men and women for the educational requirements and the job duties of the twenty occupations showed no significant gender differences. When mean scores were separated by traditional and nontraditional occupations, however, there were significant and consistent gender differences. Women demonstrated significantly greater self-efficacy for traditionally female occupations than did men, whereas men demonstrated significantly greater self-efficacy for traditionally male occupations than did women. Specifically, women demonstrated much lower efficacy perceptions for traditionally male occupations than traditional female occupations, whereas men demonstrated consistency in self-

efficacy estimations across the traditionality of occupations. Thus, gender differences were due to the women's response to the traditionality of the occupation.

Although there were gender differences in self-efficacy found for most occupations traditionally dominated by men, there were none for physician and lawyer. According to the authors' explanation there were in fact a small minority of women participants in both those occupations at the time of the study, whereas there were no visible representation of women in the other male-dominated careers such as engineer and mathematician.

Findings also revealed no significant gender differences in ability as measured by the English and mathematics subtest on the ACT. Therefore, the differences in self-efficacy with regard to traditionality of careers did not correspond with actual achievement performance. Finally, self-efficacy was related to expressed interest and range of perceived career options for both men and women. In fact, both interest and self-efficacy were the strongest predictors of range of perceived career options, and self-efficacy and interest were themselves related.

Findings from this seminal study are important in that they hold critical implications for academics and counseling and also for the career self-efficacy line of inquiry. Results not only suggest that career self-efficacy is a valuable construct that is able to be operationalized and measured, but also demonstrate that perceptions of self-efficacy are extremely important to the career selection process.

The fact that there exists a lack of correspondence between the measure of ability and perception of ability is important to note. It is especially pertinent to the finding that the females in this study demonstrated lower self-efficacy for non-traditional careers than

for traditional careers. For women, the lack of correspondence between their self-efficacy for nontraditional careers and their measured ability seems to be a problem of self-perception. The authors recommended that those who avoided pursuits yet demonstrated apt ability in those areas related to those careers would benefit from exploring the sources of those maladaptive self-beliefs.

Although the exact relationship between interests and self-efficacy was unclear, social cognitive theorists tend to view the relationship as reciprocal, and both interests and self-efficacy affect the range of career options considered by both women and men. Avoiding certain areas as a result of low self-efficacy may result in preventing development of interests for these same areas. Counselors may provide a variety of activities to expand interest range for students as well as help suggest experiences for students to differentiate content areas that do not interest them from those in which they lack self-efficacy.

The authors called for further development and refinement of methodologies to assess career self-efficacy. Recall that participants rated their self-efficacy on the basis of job titles only. It could be self-efficacy responses would change if assessed by asking participants to rate their confidence with respect to specific career-related behaviors.

Betz and Hackett (1981) set the stage for fruitful research in the area of career self-efficacy in a number of ways. They called for research attention to clarify the relationship between self-efficacy, interests, ability, and other motivational variables, and those relationships still inspire researchers interested in the career development of students today. Most important, the authors discovered that career self-efficacy made an empirical contribution and that the concept, along with other motivational constructs such

as ability and interests, aids in the understanding of why the underrepresentation of women in nontraditional fields continues.

In their next collaboration, Betz and Hackett (1983) investigated the applicability of self-efficacy to the domain of mathematics and career selection with college undergraduates. They tested two hypotheses taken from the Hackett and Betz (1981) model of a self-efficacy approach to the career development of women. The hypotheses stated, (a) that the mathematics self-efficacy expectations of college males are stronger than those of college females and (b) that mathematics self-efficacy expectations are importantly related to career-decision making and, in particular, to the extent to which college students select science-based majors (p. 331).

Betz and Hackett (1983) developed the first Mathematics Self-Efficacy Scale (MSES) for use with their study. The scale consisted of 52 items asking respondents to indicate their confidence on a 10-point scale for three mathematics-related subscales: (a)ability to successfully perform a mathematics-related task (math tasks), (b) solve a math problem (math problems), or (c) obtain a grade of "B" or better in a mathematics-related college course (college courses). A revised version of an "attitudes toward mathematics" assessment was used, including such scales as math anxiety, confidence in learning mathematics, perceptions of the usefulness of math, perceptions of math as a male domain, and effectance motivation in mathematics (Fennema & Sherman, 1976). Additionally, the Bem Sex Role Inventory (BRSI) (Bem, 1974) was used to examine the relationship between sex role variables, gender, and mathematics self-efficacy expectations. Finally, participants' college major preferences were assessed according to a

science-nonscience continuum (Goldman & Hewitt, 1976). Participants consisted of 153 female and 109 male undergraduate students enrolled in introductory psychology courses.

As predicted, the mathematics self-efficacy expectations of college students were related to their choice of science-based majors. Students reporting stronger mathematics self-efficacy on the MSES were more likely to select science-based college majors than those who reported weaker mathematics self-efficacy expectations. As also predicted, the mathematics self-efficacy expectations of female students were consistently and significantly weaker than those of the male students. Male students reported stronger self-efficacy expectations on all three subscales of the MSES as well as on the total scale than did females. There existed only three item-level means that were higher for female respondents than for males, and those were on the math task subscale and involved traditionally female activities such as cooking and sewing. Analysis demonstrating the relationship between mathematics self-efficacy expectations to other mathematical attitudes revealed that students who reported stronger mathematics self-efficacy expectations also reported lower levels of math anxiety, higher levels of global math confidence and effectance motivation, and higher levels of perceived usefulness of mathematics. Mathematics self-efficacy expectations were also found to be positively related to the degree of masculinity on Bem's Sex Role Inventory, but were unrelated to the degree of femininity.

Betz and Hackett (1983) suggested that the results of that study might contribute to the explanation and understanding of the underrepresentation of women in scientific and mathematics-related careers. Cognitions concerning mathematics-related activity were suggested to be moderators of gender differences in major and career choice

behaviors. The lowered mathematics self-efficacy perceptions leading to avoidance of mathematics-related coursework and majors in sciences demonstrated by the female students in the study consequentially resulted in lowered participation in scientifically relevant occupations. Because the MSES is behaviorally relevant (asks about tasks, courses, and problems) it provides a structure for interventions that has an advantage over other cognitions that had been assessed in the past (general math confidence and math anxiety), it shows specific behaviors with which to begin and from which to progress with those interventions. The authors concluded that "further examination of the effects of individual's mathematics self-efficacy expectations in particular and career-related self-efficacy expectations in general on the kinds of educational and career decisions they make should have both theoretical and applied utility" (p. 344).

Researchers since then have replicated and extended those findings (Hackett, 1995; Lent & Hackett, 1987). In general, they confirm the importance of self-efficacy as a significant and valuable research tool toward increasing understanding about the career selection process. Researchers have primarily looked at the importance of career self-efficacy to the selection of careers according to the content of that career as well as the educational and task requirements of a particular occupation. Additionally, many researchers have examined self-efficacy in a college student population because of the immediacy of career selection. Results of studies that examine the occupational choices of college students confirm the importance of self-efficacy as a significant mediator and predictor of college major, occupational consideration, and career choice (Hackett & Betz, 1989; Lent et al., 1984, 1986). In a path analysis by Hackett (1985), for example, mathematics-related self-efficacy was predictive of both math anxiety and mathematics-

related major choice for college undergraduates. Hackett also found that math self-efficacy mediated the affects of gender and math achievement on the selection of college major, demonstrating the central role of mathematics self-efficacy in the development of mathematics-related careers.

Gender Differences in Career Self-Efficacy

The exploration of gender differences and the focus on the career development of women have permeated the career self-efficacy research, particularly in studies that examine career selection according to career content. Results suggest that gender differences in career self-efficacy are found at the occupational level (Bonnet & Stickel, 1992; Matzeder & Krieshok, 1995), educational level (Hackett & Betz, 1989; Post-Kammer & Smith, 1986; Seymour and Hewitt, 1997), and job task level (Hackett, Betz, O'Halloran, & Romac, 1990). Overall, gender differences in college students adhere to the patterns demonstrated by the earliest career self-efficacy studies (e.g., Betz & Hackett, 1981, 1983). In other words, college women typically demonstrate lower self-efficacy for careers that are traditionally male, and they also demonstrate lower self-efficacy for college courses and tasks that are mathematics-related.

When college men and women were asked to rate their efficacy for accomplishing specific occupational tasks, results showed that men were more efficacious about mechanical and physical work, whereas women were more efficacious about working with people and tasks that required social interaction (Lucas et al., 1997). Wheeler (1983) found that there were differences in self-efficacy perceptions for male and female students related to the proportion of males in a specific occupation. Although both

women and men perceived male-dominated careers to be more difficult for success, the relationship was much stronger for women than for men.

The exception to the typical gender differences in career self-efficacy that are usually found in college student populations are from samples that are made up of homogeneous students, from students who are high achieving, or from students who have already progressed in advanced studies (Clemet, 1987; Lent et al., 1986; Schaefers, Epperson, & Nauta, 1997). For students who participated in a career-planning course on science and engineering fields, there were no gender differences found in self-efficacy for educational requirements or job duties of different scientific and technical careers (Lent et al., 1984). In that sample, both female students and male students were already considering careers of a scientific nature and thus might have demonstrated less variance in their self-efficacy perceptions and background experiences. Likewise, for students who participated in a pre-matriculation session for those that had selected a mathematics-oriented major at a university that emphasized engineering and the applied sciences, no gender differences in mathematics and career self-efficacy were found (Cooper & Robinson, 1991). In fact, both women and men perceived similarly high parental and teacher support for their intended career choice.

Researchers have also looked at all female samples to explore the existence of various self-efficacy beliefs within gender. They have examined the traditionality/nontraditionality continuum of careers and emphasized the usefulness of examining beliefs from a within-group perspective (Brown, Eisenberg, & Sawilonsky, 1997; Read, 1994; Schaefers et al., 1997; Scheye & Gilroy, 1994). There is a difference in self-efficacy for nontraditional and traditional careers among college women majoring

in mathematics-oriented fields (Brown et al., 1997). Women who major in engineering expect greater success in nontraditional careers than do women who major in mathematics education. Similarly, women in technical college show differences in vocational self-efficacy (Read, 1994). Those women who participate in a training program for nontraditional occupations rate themselves higher on a vocational self-efficacy scale that assess attitudes such as expectations of success in school, finding employment, and confidence in solving problems, than those who participate in training programs for traditional or gender-neutral fields. Nauta, Epperson and Kahn (1998) investigated a model of predictors of higher level career aspirations among two groups of female college students: (a) women in mathematics, physical science, and engineering and (b) women in biological science. Results demonstrated that the relationships between ability and self-efficacy and between positivity of role-model influence and self-efficacy were significantly stronger for women in mathematics, physical science, and engineering then they were for women in biological science.

Gender differences in career self-efficacy that are found among mostly white Americans seem also to exist in studies that examine the self-efficacy of students in other countries (Clemet, 1987; Matsui et al., 1990; Wheeler, 1983). In a line of inquiry by Matsui and associates, Japanese undergraduates demonstrated similar gender differences to American undergraduates with female students reporting lower self-efficacy than male students for male-dominated careers, and higher levels of self-efficacy for female-dominated occupations (Matsui, 1994; Matsui, Ikeda, & Ohnishi, 1989).

Gender differences in self-efficacy also are found in African American college freshman, with men reporting stronger mathematics self-efficacy perceptions than do

women (Gainor & Lent, 1998). Post, Stewart, and Smith (1991) found that, although all students reported lower self-efficacy, confidence, interest, and consideration of mathematics/science occupations than for non-mathematics/science occupations, both self-efficacy and interests predicted consideration of a mathematics/science major for African American men, but only interests predicted consideration of a mathematics/science major for women. Males also reported greater confidence, self-efficacy, interests, and consideration for mathematics/science careers than did females. Females reported greater interest, however, for non-mathematics/science careers than males. According to the authors, these findings support the assertion that gender, rather than race, might be the reason that African American females are underrepresented in careers of a mathematic and scientific nature.

Career Self-Efficacy and Other Motivational Variables.

Although researchers in career development consider vocational interests to be a primary determinant of career choice, the correspondence between career self-efficacy and career interest remains an area of researcher concern (Hackett, 1995). Self-efficacy theory "posits a reciprocal but asymmetric relationship between perceived efficacy and occupational interests, with efficacy beliefs playing the stronger determinant role"(Bandura, 1997, p. 424). For the most part, researchers support the theorized relationship between occupational interests and career self-efficacy for college students (Lent, Larkin, & Brown, 1989). Occupational self-efficacy makes an independent contribution to the prediction of technical grades, persistence, and range of career options considered even when the variance from vocational interest is removed in a regression equation (Lent et al., 1986). Researchers also report that interests and self-efficacy are

related so that strong self-efficacy beliefs are correlated with strong interests for a given occupational area (Betz & Hackett, 1981). Studies expanding on that relationship have demonstrated a causal ordering that places students' self-efficacy beliefs before the development of vocational interests (Lent et al., 1991, 1993; O'Brien, Martinez-Pons, & Kopala, 1999). The direction of influence between self-efficacy and interests makes sense theoretically because people tend to form lasting and robust interests in areas in which they feel most efficacious and have experienced positive outcomes. According to Lent et al. (1994), the process of career development includes a reciprocal model in which self-efficacy and outcome expectations influence interests. Those vocational interests, in turn, determine goals for activity involvement, selection, and practice. The results of those activities give rise to performance attainments culminating in the reinforcement or revision of self-efficacy perceptions.

In a study testing the theoretical path of self-efficacy and vocational interests and their effect on declaring a mathematics or science college major, Lapan, Shaughnessy, and Boggs (1996) surveyed college students both before they had entered college and then after they had declared a major three years later. Included in their analysis were students' mathematics self-efficacy, mathematics basic interest, self-efficacy for investigative occupations (science-related careers) and interest for artistic vocations, high school math courses, and ACT math test scores. Results revealed that the students' desire to enter a math or science major had solidified before they had begun attending college and had influenced greatly their entry into a math/science major years later. The researchers found support for both the effect of gender and ability/achievement on vocational interests through the self-efficacy beliefs of students. The authors suggested

that choosing a mathemtics/science major was largely a function of self-efficacy and vocational interests that predated student entry into college.

If it is true that self-efficacy influences the development of vocational interests, the import of findings from a self-efficacy perspective is that the influence of early self-efficacy perceptions is critical (Lent et al., 1989). Vocational interests, although powerfully motivating, cannot fully account for the ultimate persistence that is sometimes required to persevere through obstacles. Interests and self-efficacy must work together so that they can result in the fulfillment of students' career potential.

Self-efficacy and vocational interests are most commonly combined with outcome expectations (beliefs about the consequences of performance) to design models of career development. In a line of inquiry by Lent and his colleagues (1991, 1993), outcome expectations, as determined by items reflecting various positive outcomes that might result from taking future mathematics courses (e.g., "My friends would respect me if I enrolled in math classes") did not improve over self-efficacy alone in predicting grades and did not moderate the relation of self-efficacy to enrollment intentions or grades. Outcome expectations, however, provided unique variance in predicting interests and enrollment intentions. Thus, the authors concluded that outcome expectations might complement self-efficacy in explaining certain criteria and was a valuable motivational concept to include in a social cognitive model of the career development process.

It is important to note that outcome expectations are similar to self-efficacy beliefs only in that they tap into individuals' judgments about future events. The two constructs differ insofar as outcome expectations only look at the effects that a certain behavior or activity will generate (What will happen if I enroll in an advanced mathematics course?).

Self-efficacy beliefs assess how well people believe they can perform that behavior or activity (Can I successfully complete an advanced mathematics course?). According to Bandura (1984), self-efficacy beliefs in large part determine outcome expectations. Students with high self-efficacy beliefs have the confidence to assume that they will perform well in a college major and therefore can expect their major to lead to a successful career.

There are two studies that compare a self-efficacy model of career choice and development to alternative models. Lent, Brown, and Larkin (1987) compared the effects of self-efficacy beliefs on career development to a model of person-environment congruence (Holland, 1985) and consequence thinking (Janis & Mann, 1977). The person-environment fit model predicted that career choices and achievements would depend on a good fit between the individuals' career interests and the career environment. That congruence was typically operationalized as a match between a person's occupational interests and those of the people who had selected the same academic major or career. Alternatively, Janis and Mann's (1977) theory of decision-making purports that the more people thought about the potential consequences of their choices and generated possible negative outcomes, the more likely they would be to commit to and persevere in their ultimate career selection because potential obstacles had been foreseen.

The contributions of self-efficacy, interest congruence, and consequence thinking to the prediction of academic performance (grades), persistence in technical majors, perceived career options, and career indecision were assessed for a sample of college undergraduates considering science and engineering fields (Lent et al., 1997). Results of a multiple regression analysis demonstrated that self-efficacy added a unique predictive

variance beyond academic ability and previous academic achievement for academic performance, persistence, and perceived career options. The match between peoples' interests and the working environment does not alone encourage them to perform and persist in an area where they doubt their capabilities for success. Similarly, anticipating possible negative outcomes may not fuel enough confidence to persist along a career path that may require strong self-efficacy perceptions to perform well.

Wheeler (1987) compared self-efficacy with an expectancy model to determine which had the strongest relation to occupational preferences for college students. The expectancy model described occupational preferences as a function of the types of outcomes occupations provided and the value of those outcomes to the individual. Students were asked to judge their capabilities to fulfill the requirements of various occupations and to rate the outcomes and value of occupations. The range of outcomes used included a chance to learn new things, a chance to benefit society, an opportunity for advancement, high prestige and social status, and a chance to use special abilities. Results demonstrated that both perceived efficacy and expectancy outcomes contributed to the prediction of occupational preferences, but self-efficacy perceptions were more highly related. Again, these results reinforce that the value of peoples' judgments of their capabilities to successfully complete occupational requirements is a strong predictor of what type of career they might select. This seems to be the case even when they are convinced of the outcomes of selecting one career over another and believe those outcomes are important.

Career Self-Efficacy and Precollegiate Students

Although the primary population for examining career self-efficacy continues to be college students, some researchers have taken an interest in career self-efficacy from a developmental standpoint and have sampled pre-collegiate students. Studies conducted with samples of younger students generally support similar findings to those of college students. In other words, self-efficacy makes a significant contribution when considering specific careers and when selecting or eliminating academic paths leading to certain occupations (Bores-Rangel, Church, Szendre, & Reeves, 1990; Hannah & Kahn, 1989; Vondracek & Skorikov, 1999).

In addition to self-efficacy, vocational interest is a significant variable for predicting consideration of certain occupations for disadvantaged high school students (Post-Kammer & Smith, 1986), rural high school students (Lapan, Hinkelman, Adams, & Turner, 1999), rural high school students of diverse backgrounds (Lauver & Jones, 1991), high school equivalency students (Bores-Rangel et al., 1990), and middle school students (Fouad & Smith, 1996). A program attempting to provide mastery experiences in technology was predicted to improve career decision-making of 169 British seventh and eighth grade students (Dawes, Horan, & Hackett, 2000). Although no treatment effects were found for technical and scientific self-efficacy, an experimental demand measure did show greater valuing of the technology education program. In general, findings that examine self-efficacy and interest again replicate those from college student populations, suggesting that self-efficacy and interests are both significant predictors for career consideration, although self-efficacy was especially relevant to those of a mathematic and scientific nature (Post-Kammer & Smith, 1986).

In one of the first studies to replicate that of Hackett and Betz (1981), Post-Kammer and Smith (1985) examined career self-efficacy, consideration, and interests for eighth and ninth grade students. Students demonstrated gender differences in educational and job requirements for only two of the nontraditional occupations, whereas the college undergraduates in the previous study (Hackett and Betz) revealed gender differences for six of the nontraditional careers. Furthermore, junior high students' interests were more strongly related to the consideration of occupations than to their career self-efficacy. The authors explained those differences from a developmental standpoint: junior high school students may have been too young to have experienced as much gender socialization, therefore the young girls and boys perceived themselves as similar in ability and may have used fewer reasons than do undergraduates for considering careers.

To explain the seemingly contradictory findings of those two studies, Hackett (1995) argued that the sample of junior high students used by Post-Kammer and Smith (1985) was particularly homogeneous. Students were drawn from a private, suburban school and were uniformly above average in ability. Restricting range in ability and self-efficacy could have accounted for the absence of gender differences and the limited effect of the traditionality of the potential careers. Because of the homogeneity of the population, it might not have been surprising that results mimicked those of the studies comprised of college students who already considered a mathematical and/or scientific career (Lent et al., 1984, 1986).

Results of subsequent studies support the magnitude of gender differences in career self-efficacy that college students demonstrated (Ahrens & O'Brien, 1996; Hannah & Kahn, 1989; Lapan & Jingeleski, 1992). As early as grade 7, students perceive

employment pattern differences between men and women, and for the most part, their efficacy and interest patterns mirror this understanding (Lapan, Adams, Turner, & Hinkelman, 2000). Lauver and Jones (1991) found gender differences in perceived self-efficacy and career options in a higher proportion of occupations for rural high school students than those typically found for older college students. In another study, socio-economic status (SES) along with gender was discovered to be a factor in high school students' career self-efficacy (Hannah & Kahn, 1989). High school senior girls who were high in SES had higher self-efficacy and were more likely to consider nontraditional, higher status careers than high school girls who were low in SES.

Church, Teresa, Rosebrook, and Szendre (1992) found gender differences in self-efficacy for occupations in a minority high school population. For careers identified as male-dominated, gender-balanced, and female-dominated, both female and male students reported greater self-efficacy for occupations dominated by their own gender. Students also reported a greater willingness to consider occupations typically dominated by their own gender, although female students did so to a greater extent than did male students.

Evidence of gender differences in precollegiate student populations support the idea that gender socialization practices that influence students at a younger age may likely affect later ability perceptions. The reciprocal role of interest and self-efficacy contribute to career beliefs that may harden over the years and become difficult to change long before decisions about career paths have to be made. It is therefore critical that attention be paid to students' perceptions of their abilities as students are developing them. According to Lapan and Jingeleski (1992), "we encourage the development of career

counseling interventions that promote the proactive shaping of choices as opposed to allowing students to passively adapt to solidifying patterns" (p. 89).

Career Decision-Making Self-Efficacy

Interest in the process dimension of career choice, or how decisions are made about careers, was originally coupled with self-efficacy by Taylor and Betz (1983). Borrowing from Crites's (1978) model of career maturity, the authors defined and operationalized skills required for career decision-making as follows: (a) accurate self-appraisal, (b) gathering and occupational information, (c) goal selection, (d) making plans for the future, and (e) problem-solving. Those areas of competency were subsequently developed into five subscales on the Career Decision-Making Self-Efficacy (CDMSE) Scale. Taylor and Betz devised 10 behavioral task items for each of the subscales that accurately and comprehensively reflected each competency domain. For example, "Choose a career that will fit your preferred lifestyle" was a behavioral item under the competency domain of goal selection, whereas "Find information in the library about occupations you are interested in" fell under the competency domain of occupational information. Self-efficacy was assessed by requesting that participants indicate their confidence in their ability to successfully complete each career decision-making task by using a 10-point scale ranging from complete confidence (10) to no confidence (0).

The CDMSE Scale was administered to two groups of college students, 154 students attending a private liberal arts college and 193 students attending a large state university, along with a measure of vocational indecision. Scores from both the Scholastic Aptitude Test (SAT) and the American College Test (ACT) were available for half of the students in the first group and two thirds of the students in the second group.

Findings revealed that the CDMSE Scale was a reliable measure with respect to the tasks required in career decision-making (Taylor & Betz, 1983). For the total college student sample, levels of self-efficacy did not differ as a function of the competency domain assessed. Further, students demonstrated considerable confidence in their career decision-making abilities (item means ranged from 5.18 to 7.85), and there was no significant difference between students attending private or public universities. There was no relationship found between ability level and self-efficacy expectations with regard to career decision-making tasks. There was also no significant difference found as a function of gender of the students and levels of career decision-making self-efficacy.

Levels of decision-making self-efficacy were significantly predictive of career indecision as students who indicated lower confidence in their decision-making task behavior reported being more vocationally undecided than students who indicated higher decision-making self-efficacy. The authors suggested that career decision-making self-efficacy expectations were strongly related to the components of career indecision, particularly lack of structure and confidence.

According to the authors, the Career Decision-Making Self-Efficacy (CDMSE) Scale provides a way to assess and treat career indecision. The CDMSE Scale measures both a general index of an individual's self-efficacy for tasks and behaviors required for career decision-making as well as an individualized template of tasks toward which intervention strategies might be specifically developed.

Since then, researchers have found the CDMSE Scale to be both reliable and valid (Osipow & Gati, 1998). In Taylor and Betz's (1983) original sample, results of an internal consistency analysis yielded an alpha of .97 for the total score. Luzzo (1993) also

reported a high internal consistency of .93 (total score alpha) and a six-week test-retest reliability of .83. In a psychometric evaluation of the CDMSE Scale, Luzzo (1996) concluded that adequate reliability had been repeatedly demonstrated.

When the CDMSE Scale was subject to factor analysis, however, there was not empirical evidence for the existence of five subscales (Taylor & Betz, 1983; Taylor & Pompa, 1990). In the original analysis, 27 of the items loaded on the first factor, which accounted for 16.9% of the variance. In a subsequent analysis, 17 of the items loaded on the first factor, which accounted for 8% of the total variance. The result of those analyses led researchers to conclude that the CDMSE is a generalized measure of career decision-making self-efficacy.

Over the years, the CDMSE has been used in a number of research studies and found to be related to several vocational development and career process variables such as career indecision and career certainty (Betz, Klein, & Taylor, 1996; Betz & Voyton, 1997; Taylor & Pompa, 1990), vocational identity (Betz et al., 1996; Robbins, 1985), vocational congruence (Luzzo & Ward, 1995), career decision-making attitudes and skills (Luzzo, 1993), trait anxiety and ethnic identity (Gloria & Hird, 1999), career maturity (Anderson, & Brown, 1997; Luzzo, 1995), and career decision-making styles (Niles, Erford, Hunt, & Watts, 1997). Career decision-making self-efficacy has been found to be related to college students' disability status such that students with disabilities reported significantly lower levels of career decision-making self-efficacy than did their peers without disabilities (Luzzo, Hitchings, Retish, & Shoemaker, 1999). Career decision-making self-efficacy was also related to career exploratory behavior and the extent to which students were willing to participate (Blustein, 1989). One hundred and six college

students were administered measures of goal instability, environmental and self-exploratory activity, and career decision-making self-efficacy. Findings from a canonical correlation analysis suggested that career decision-making self-efficacy (structure coefficient at .95) was a stronger predictor of exploratory activity than goal instability (.51), age (.31), and gender (.03). An intervention designed to increase the career decision-making self-efficacy of college women also was effective in increasing vocational exploration and commitment (Sullivan & Mahalik, 2000). College women experiencing career indecision participated in six 90-minute group counseling sessions incorporating the four sources through which self-efficacy is acquired and modified. The intervention also was designed to highlight the socialized barriers and facilitators to women's career development for the group through discussion and exercises. The authors' believed that this type of group intervention would be helpful in its application to other important career development constructs.

Not surprisingly, researchers continually find limited differences by gender in self-efficacy for career decision-making (Bergeron & Romano, 1994; Blustein, 1989; Taylor & Betz, 1983; Taylor & Pompa, 1990). In their review of career decision-making self-efficacy, Betz and Luzzo (1996) made sense of the absence of gender differences by stating that it implied gender homogeneity in the background experiences that developed perceived competency about career decision-making tasks. If the absence of gender differences does not imply homogeneity in background experiences, than some other compensatory experiences must apply, but the specifics have not been determined.

Moreover, career decision-making self-efficacy shows only modest correlations with occupational self-efficacy (Betz & Klein, 1996; Taylor & Pompa, 1990). Recall that

the differences by gender in occupational self-efficacy is due in large part to the individuals' self-beliefs about the educational requirements and job requirements of specific careers. As expected from the consistent similarity of self-perceptions about career decision-making by gender, it follows that actual career decision-making tasks are perceived by individuals to be mostly independent from the content of careers.

The few gender differences discovered by researchers are of limited magnitude and are concerned with the relation of career decision-making self-efficacy to other personal variables. For example, using an all-female sample of college students, Nevill and Scheckler (1988) found that strong self-efficacy expectations and assertiveness were related to the willingness to engage in career-related activities of nontraditional occupations. Women were also more willing to engage in career-related activities of traditional occupations regardless of level of self-efficacy and assertiveness. Career decision-making self-efficacy was also found to be related to the sex-role orientations of college undergraduates. Students who were categorized as androgynous (possessing both masculine and feminine orientations) demonstrated significantly greater levels of confidence in their career decision-making abilities than students categorized as undifferentiated (Gianakos, 1995).

Career decision-making self-efficacy has been of great interest to vocational researchers and, as measured by the CDMSE Scale, has been found to be statistically sound. However, it is important that researchers ensure that they are using the construct effectively. There are studies in which the construct of career self-efficacy would be more appropriately operationalized by a scale that examines career self-efficacy according to the content of the occupation (i.e., Mathieu, Sowa, & Niles, 1993). Moreover, the

inference that increased self-efficacy for career decision-making will increase career exploration activities and therefore will be beneficial to career development remains an inference. The self-regulatory function of career decision-making, fed in part by self-efficacy beliefs, may ultimately result in the types of careers that people choose or eliminate. At this point, however, that conclusion remains a conceptual leap.

Summary

Career self-efficacy, judgments about capabilities to succeed in certain occupations, was developed in a line of inquiry that attempted to explain the lack of female participation in careers of mathematical and scientific natures. In a seminal study by Betz and Hackett (1981), findings demonstrated that both college men and women were making decisions about the content of career choice based on their perceptions of their abilities to fulfill the educational requirements and job duties of given occupations. However, women demonstrated less self-efficacy for careers that were traditionally male-dominated. Studies since then have replicated those findings, establishing that the traditionality of a specific career (whether it was male- or female-dominated) affected college students' self-efficacy for that career. Researchers also came to believe that, in heterogeneous samples of students, women's self-efficacy for careers that were mathematically related and that were traditionally dominated by men was lower than the career self-efficacy of male students.

Therefore, self-efficacy as a construct has infiltrated career literature and established a home in models of career development. Researchers often combine self-efficacy with other motivational variables, such as interests and outcome expectations, to design a complete model of what types of careers students ultimately pursue. Although

there is some debate over the causal relationships of those variables, career self-efficacy shows a robust relationship with outcome variables (generally career choice) and works in concert with other motivational variables to contribute to career selection.

Most career self-efficacy research has focused on college student populations, but because of the interest in the developmental aspect of career selection, research increasingly focuses on pre-collegiate students. Studies found that pre-collegiate students typically demonstrate similar patterns of career self-efficacy and career choice that are evident in college student samples. Gender differences in career self-efficacy also seem to be relevant at the pre-college stage, female students tend to have lower self-efficacy perceptions for occupations of a mathematical nature.

The contribution that self-efficacy has made to the increased understanding of career selection by the content of the occupation has been inspiring. Researchers believe that not only is self-efficacy for certain occupational choices important to career development, but so is the process of career selection, specifically the decision-making process. As researchers have documented the importance of self-efficacy perceptions to what career an individual considers or actually selects, they also have turned their attention to the relationship of self-efficacy to how career decisions are made. In general, findings from studies that examined career decision-making self-efficacy found that it is related to career decision and indecision, career maturity, career exploratory behavior, and a number of other career-related variables. Consistent with theoretical understandings, career decision-making self-efficacy is relatively unrelated to occupational self-efficacy, and few gender differences in career decision-making self-efficacy have been found.

One of the most appealing functions of self-efficacy as a psychological construct is that it was created with strong theoretical underpinnings. Research has continually supported its importance to career development and has repeatedly demonstrated that strong self-efficacy perceptions are beneficial for encouraging individuals to select from a wide assortment of career options and pursue their career-related goals. Career self-efficacy theory also provides a blueprint for interventions and increased understandings by focusing on the sources of self-efficacy, thereby promoting both the development of healthy and the correction of maladaptive self-efficacy beliefs.

Sources of Career Self-Efficacy

According to Betz and Hackett (1997), "the theoretical context of the self-efficacy construct provides not only a means for understanding the development of self-efficacy beliefs, but the means for their modification through interventions incorporating positive applications of the four sources of efficacy information" (p. 385). Researchers have looked at the self-efficacy perceptions of individuals not only in terms of its correlates and effects, but increasingly in terms of its antecedents. The four theorized sources of self-efficacy information - performance accomplishments, vicarious learning, verbal persuasion, and physiological states - have now been examined empirically to help determine their various contributions to self-efficacy perceptions.

Matsui et al. (1990) examined the development of mathematics self-efficacy among 163 Japanese first-year undergraduates. Participants responded to a questionnaire that examined mathematics self-efficacy, the four sources of self-efficacy information with regard to high school math, and locus of control. The mathematics self-efficacy scale was a Japanese version of the Mathematics Self-Efficacy Scale (Betz & Hackett,

1983). The sources of efficacy information measure consisted of the students' high school mathematics grades to assess previous performance accomplishments and a questionnaire with 15 items for the other three source variables (five items for each). The scales provided students with statements about their experiences in high school math and asked them to indicate on a 5-point Likert scale the applicability of each description to themselves. Sample descriptions were as follows: for vicarious experiences, "I had close friends who were excellent in math;" for verbal persuasion, "My teacher often encouraged me by commenting, ‘Very good' on my returned test sheets;" and for emotional arousal, "I often felt blue when I thought of math."

Because there were significant correlations among the sources of self-efficacy, a regression model predicting math self-efficacy was analyzed. Results confirmed that, except for the source variable verbal persuasion, the sources of efficacy each made a unique contribution to mathematics self-efficacy. However, the authors suggested that the high correlation between verbal persuasion and performance accomplishment ($\underline{r}$ = .67 for women and $\underline{r}$ = .68 for men) canceled the unique contribution of verbal persuasion to math self-efficacy.

Although results demonstrated that men reported significantly higher math self-efficacy than did women, the difference was relatively small and there were no significant differences by gender in the four sources of self-efficacy. As evident in the study, however, the limited differences in self-efficacy and sources of self-efficacy by gender could have been due to the relative homogeneity in the sample as all students had passed a highly selective university entrance exam.

Lent and his colleagues have pursued a line of inquiry that specifically examines the sources of self-efficacy. In one of their first explorations (Lent et al., 1991), they examined 138 college students for mathematics self-efficacy, outcome expectations, mathematics-related course interests, career choice, and perceived sources of mathematics self-efficacy. Perceived sources of efficacy was assessed with a 40-item instrument developed specifically for the study (Sources of Math Efficacy Scale, SMES). The measure contained the four hypothesized sources of self-efficacy with 10-items corresponding to each source area (e.g., performance accomplishments: "I received good grades in high school math class"; vicarious learning: "My favorite teachers were usually math teachers"; social persuasion: "My friends have discouraged me from taking math classes"; and emotional arousal: "I get really uptight while taking math tests.").
The emotional arousal scale consisted of the Fennema-Sherman Math Anxiety Scale, as revised by Betz (1978). Participants were asked to rate on a 5-point scale their level of agreement with each statement.

Results highlighted the importance of the contribution of prior performance to mathematics self-efficacy. Although each of the four sources correlated with mathematics self-efficacy, unique variance was not added after controlling for past performance accomplishments, vicarious learning, social persuasion, and emotional arousal. However, it is important to note that, as in Matsui (1990), the source variables were found to be strongly interrelated. The choice of the researchers to utilize a hierarchical regression strategy that entered past performance accomplishments first may have inflated its strong contribution to mathematics self-efficacy.

As did Matsui (1990), Lent et al. (1991) found a significant, yet small gender difference such that men reported both higher self-efficacy for mathematics and higher scores on the mathematics section of the ACT than women. The authors believed that the pattern may have reflected the fact that men tended to enroll in more mathematics classes prior to college, providing a greater opportunity to develop mathematics skills as well as efficacy perceptions. Results of a regression model that entered the source variables and then gender as the last step to predict self-efficacy revealed that gender no longer entered the equation as a significant predictor. That result suggested that the effects of gender on self-efficacy were mediated by differential efficacy-building experiences for men and women, particularly differences in past performance accomplishments.

Lopez and Lent (1992) sought to replicate and extend the previous studies by examining the sources of mathematics self-efficacy for 50 high school students. The authors believed that high school students' perceptions of their math competencies may have been less crystalized than college students', and thus all four sources of self-efficacy might have been influential. Furthermore, mathematics self-efficacy was measured with an instrument tailored to the content of the math course in which students were actively enrolled. Word changes on the 40-item Sources of Math Efficacy Scale (SMES) made the instrument more appropriate for high school students.

Results of a hierarchical regression model supported the unique contribution of past performance accomplishments to mathematics self-efficacy. Similar to previous studies, the source variables were significantly related to one another. Actual course grades and perceived past performance accomplishments accounted for substantial

portions of the variance in math self-efficacy, but of the three remaining sources, only emotional arousal contributed significant variance. To determine if past performance accounted for unique variance independently, another regression was performed by entering vicarious learning, verbal persuasions, and emotional arousal as a set of predictors ahead of performance accomplishments. Results revealed that the first set of the predictors explained 13% of the variance in self-efficacy, and past performance accounted for a significant 24% increase.

Lopez and Lent (1991) found some interesting gender differences. Not only did the high school women exhibit significantly higher math course grades and academic self-concepts than did the men (although mathematics self-efficacy was not significantly higher), they scored significantly higher on the verbal persuasion source scale. All students in the sample were taking an upper-level math course on a voluntary basis, and it could have been that those young women benefitted from social encouragement and verbal persuasion to pursue advanced mathematics from peers, teachers, and parents.

According to the authors, results suggested that past performance accomplishments are the most influential source of math self-efficacy information and explains additional variance beyond what is accounted for by actual course grades. Evidently, perceived performance is as uniquely important to self-efficacy perceptions as is actual performance. Emotional arousal also explained additional variance and demonstrated a positive beta weight, and the authors concluded that when previous course performance and perceived accomplishments are controlled, even slight arousal may predict of mathematics self-efficacy. When interpreting the results of the study, however, it is important to recall the limited sample size ($\underline{N} = 50$) that may have

artificially inflated the unadjusted correlation coefficients, the multicolinearity of the source variables, and the methodological decision to use hierarchical multiple regression.

Gender differences in source variables were found again in a study where researchers examined the mathematics self-efficacy, outcome expectations, and interests in a larger high school population (Lopez, Lent, Brown, & Gore, 1997). That sample was divided by those students enrolled in a geometry class ($\underline{N}$ = 151) and those in an advanced algebra class ($\underline{N}$ = 145) taken as an elective. In the advanced algebra sample, female students perceived more mathematics-related social persuasion ($\underline{r}$ = .21) and vicarious influence($\underline{r}$ = .22) than did the male students. An analysis demonstrating paths to mathematics self-efficacy revealed that when the effects of the sources of self-efficacy variables were controlled (as measured by the Sources of Math Self-Efficacy Scale), objective ability (as measured by Grade Equivalent Scores on the Stanford Achievement Test) did not produce a significant path to self-efficacy. The largest path coefficient was produced by past performance accomplishments (β = .34 for the advanced algebra students and β = .55 for the geometry students), suggesting that objective ability affects self-efficacy through its relation to students' perceptions of their own performance. There was also a significant path from the social persuasion source variable to self-efficacy for the advanced algebra students but not for the geometry students. Taken together, the self-efficacy sources explained 45% of the self-efficacy variance in the advanced algebra sample and 41% in the geometry sample.

Lopez et al. (1997) highlighted the importance of students' perceptions and sources of self-efficacy to mathematics self-efficacy. As demonstrated by the significant path of social persuasion to self-efficacy, advanced math students were especially attuned

to the encouragement from others, which was necessary for the development of self-efficacy perceptions. Social persuasion and vicarious experiences seemed to be especially important for the advanced female students who reported significantly more of those experiences than did their male counterparts.

Because of the interrelatedness of the source variables found in previous studies (e.g., Lent et al., 1991), Lent, Lopez et al. (1996) attempted to confirm the structure of the hypothesized self-efficacy source variables in college and high school samples. Using the Sources of Math Efficacy Scale, they used confirmatory factor analysis to test two-, three-, four-, and five-factor models. In keeping with the theoretical categorizing of the sources of self-efficacy into past-performance accomplishments, vicarious learning, social persuasion, and emotional arousal, the four-factor model offered a good fit to the data in both samples. It also produced a significantly better fit than the two-factor model (grouping performance accomplishments, emotional arousal, and social persuasion for one factor and vicarious learning for another) and the three-factor model (grouping personal performance and social persuasion together and vicarious learning and emotional arousal independently) based on chi-square difference tests. A five-factor model that additionally separated the vicarious learning factor into peer and adult vicarious experiences seemed to provide the best fit for the high school sample.

According to the authors, there was a distinguishable difference between the findings' theoretical and practical significance. Theoretically, the goodness of fit index supported a four-factor model that represented relatively discreet information. However, the prevalent intercorrelations among personal performance, social persuasion, and emotional arousal seemed to suggest a hierarchical, more parsimonious model when those

source variables were grouped because they were acquired from direct experience. Possibly social persuasion and emotional arousal became linked to performance-based indicators in the process of educational development during a highly structured domain such as mathematics. With the following explanation, Lent, Lopez et al. (1996) offered additional support for the theoretical underpinnings of a two-factor model:

> In developing particular academic skills, children and adolescents rely, in part, on social feedback and perceived anxiety (or calm) to infer how well they are performing. Eventually, performance indicators, social encouragement, and physiological state are more likely to provide convergent information about one's efficacy. (p. 305)

The gender differences found in the response to the sources of the efficacy instrument should not go without comment. In the college sample (N = 295), men scored significantly higher than women on the past performance accomplishment variable and the emotional arousal variable. In the sample of high school students (N = 481), women scored significantly higher than men on the vicarious learning and social persuasion variables. Because the source variables did not relate significantly to mathematics self-efficacy by gender, source data was combined with gender for the factor analysis in both samples. The results of the gender differences in response to the source questionnaire begs to test a factor solution that groups past performance accomplishments with emotional arousal for one factor and vicarious experiences with social persuasion for another. Students may answer the self-efficacy source instrument by basing their responses on what they perceive to be independent experiences versus what they perceive to be relational experiences.

The Sources of Math Efficacy measure deserves consideration. The instrument assesses only one kind of physiological state (emotional arousal), whereas it may be more useful to include other types of emotional states that may influence self-efficacy perceptions. Also, in the assessment of vicarious experience, there is no isolation of individual models, rather, models are grouped together (parents, peers, etc.). Although the breadth of the scale attempts to cover types of experiences that influence self-efficacy beliefs, it may be beneficial to use alternative methods to determine how individuals process information to develop their own efficacy estimates.

In an alternative method for examining students' perceived sources of mathematics self-efficacy, Lent, Brown et al. (1996) asked 103 college students to respond to a thought-listing questionnaire. After completing a revised form of the Betz and Hackett (1983) Mathematics Self-Efficacy College Courses Scale, students completed a task instructing them first to "think about the things you considered in making your confidence ratings on the previous page" and then to briefly describe all of the factors influencing their ratings (relative to the five academic courses on the self-efficacy scale). Students were then instructed to rank those factors by order of importance.

Results supported once again the significance of past performance accomplishments, as it was the most frequently listed basis for self-efficacy beliefs and accounted for 58% classifiable responses. Vicarious learning and physiological responses were cited much less often, and none of the participants mentioned social persuasion. Past performance was also listed as the most influential source of efficacy across all courses for both men and women. Gender differences in the results of the thought-listing

procedure indicated that women were somewhat more likely than men to mention physiological reaction and teaching quality considerations, but those findings were based on relatively small response frequencies.

The authors suggested that, for college students who had a long history of mathematics-related experiences, the other three theory-driven sources of self-efficacy might not provide as compelling information as does performance accomplishments. Possibly, those sources were more influential at earlier periods in the students' educational history when students needed more encouragement to pursue mathematics-related endeavors or needed more information to interpret the results of their performances (Lent, Brown et al., 1996). These researchers provided an alternative means of assessing the sources of mathematics self-efficacy to capture more holistically the way in which students weigh, integrate, and value the sources of information that affect their self-beliefs.

Zeldin and Pajares (2000) developed an interview protocol based on the quantitative sources of self-efficacy scale and asked fifteen women with mathematically-related careers to reflect on their academic and career development. Women spoke about influential family members, teachers, peers and supervisors who helped them develop adaptive self-efficacy beliefs. The strong self-efficacy beliefs that these women cultivated were instrumental in the subsequent perseverance, resiliency, and persistence they felt necessary to achieve their career goals in underrepresented fields.

Women consistently recalled experiences that involved an influential person, often during a critical time, who helped them develop their beliefs about their capabilities while they also developed their competencies. The vicarious experiences influenced both their

ideas regarding mathematics-related areas and their philosophies about women in male domains. Although women recalled obstacles such as negative social messages about themselves and about their career or academic pursuits, their experiences with positive messages and models proved influential during the selection and retention of career and academic behaviors.

Contrary to the predominant findings of previous studies that past performance accomplishments was the most significant source for developing self-efficacy, Zeldin and Pajares (2000) suggested that the perceived importance of vicarious experiences and verbal persuasions might be stronger for women in male domains than for individuals operating in traditional settings. Recall that there have been instances on the quantitative scale in which female students have scored higher on the social persuasions and vicarious experiences variable than the male students (e.g., Lent et al., 1996). Thus, there is evidence of possible gender differences in the attention to and integration of the sources of self-efficacy that should be more closely examined by researchers.

Discussion

In 1981, Hackett and Betz introduced Bandura's (1977) construct of self-efficacy to researchers interested in career development. In this conceptual article, they posed three challenges to researchers interested in career self-efficacy. They first called for researchers to explore to what extent self-efficacy expectations are related to individuals' consideration of career options, to effective pursuit of those options, and to effective decision-making. Second, they challenged researchers to study gender differences in career self-efficacy with respect to a number of career-related behavioral domains. They also challenged researchers to examine the effectiveness of counseling and interventions

based on self-efficacy theory. Consequently, researchers have emphasized the importance of self-efficacy beliefs to career-related outcomes and showed that the perceptions students form about their own competencies provide them with powerful motivational fuel. Researchers have also concluded that self-efficacy is related to a number of career-related academic outcomes and works together with other motivational variables, such as interest and outcome expectations.

The psychological construct of self-efficacy can only perform well if the instruments designed to measure it are developed and used in a methodologically appropriate manner. According to Pajares (1996b, 1997), outcome prediction will be enhanced if researchers follow guidelines related to specificity of self-efficacy assessment. Self-efficacy beliefs should be assessed at a level of specificity that corresponds well to the criterial task within the domain of functioning being analyzed. Within a domain as broad as that of career self-efficacy, specificity of measurement can become complicated.

Researchers have measured career self-efficacy both at the occupational level and at the task-specific level. However, there has been little follow up to determine actual career outcomes of the particular group of students whose self-efficacy was assessed. Although some studies demonstrated the relationship of self-efficacy beliefs to academic outcomes at the problem-solving level, course selection level, and college major level, it is only assumed that success at those specific levels lead to successful careers. Although career self-efficacy researchers have turned their attention to the developmental component of career selection, as evidenced by the investigations that focus on the self-efficacy beliefs of pre-collegiate students, it would be beneficial for them to supplement

the literature with longitudinal studies. These types of studies could substantiate that academic choices and paths affected by self-efficacy beliefs in fact translate into career-related outcomes.

In addition, the specificity of measurement must be considered. A debate still exists about the type of information people use when answering queries about their self-efficacy beliefs. Career beliefs assessed at the job task-specific level provide definite criteria about which people make judgments. On the other hand, instruments that assess the self-efficacy beliefs of individuals on the basis of job title allow people to base their judgments on different types of indicators. We simply do not fully understand what types of information people use to make decisions. For example, female students may be scoring lower on self-efficacy for male-dominated careers because, although they may be confident that they can develop the mathematics-related skills to succeed, they are not confident that they can successfully manage both the job duties and a family. Thus, it becomes critical that future research in career self-efficacy makes ample use of qualitative methodology, where individuals are encouraged to reflect on their beliefs and explain how they have come to perceive their abilities.

Recently, the relationship of self-efficacy to career decision-making has received abundant research attention. Assumptions that are inherent in this type of inquiry need to be pushed to the forefront (Krieshok, 1998). Several studies designed and implemented interventions that successfully increased career decision-making self-efficacy (Foss & Slaney, 1986; Fukuyama, Probert, Neimeyer, Nevill, & Metzler, 1988; Luzzo, Funk, & Strang, 1996; see also Betz & Luzzo, 1996, for a review). However, researchers need to reinforce the usefulness of the career decision-making variable to the career development

process by emphasizing its effect on career-related outcomes. Researchers should take caution not to substitute the career decision-making self-efficacy construct for career self-efficacy when the issue of career selection by content is the primary concern.

The second research challenge from Hackett and Betz (1981) encouraged researchers to explore the way in which gender differences in self-efficacy beliefs contribute to the understanding of gender differences in vocational behavior. Gender differences in self-efficacy and in career pursuits have remained an area of passionate inquiry. The majority of research that examines gender-related concerns in career self-efficacy has done so in the area of mathematics and mathematically-related careers. That has not been without social and political implications. Although researchers have documented that both men and women limit their career considerations and ultimate selections by what has been traditionally determined to be stereotypcially appropriate for their gender, the ultimate effects of those decisions appear to be more problematic for women than for men. When men are conditioned to eliminate careers that are female-dominated, they may cheat themselves out of a career that may be personally fulfilling and enriching, and one for which they may be well-suited. However, when women eliminate careers that are nontraditional and male-dominated, they are typically those of a mathematical nature. Careers with a mathematical, scientific, or technological focus have continually been those that can provide high status, powerful decision-making opportunities, and economic stability. When a segment of the population remains underrepresented in those types of careers, they also remain underrepresented in its share of societal equities.

Career self-efficacy has helped us to understand why these inequities continue. Researchers have documented that women's self-perceptions of their capabilities powerfully affect career behavior. Career self-efficacy outcomes and correlates have also been covered extensively, finding that differences exist by gender at various levels of academic development. What still needs to be determined, however, is why these differences in career self-efficacy exist and how these self-efficacy perceptions are specifically created.

Finally, Hackett and Betz (1981) called for research that focuses on determining if counseling interventions increase career-related self-efficacy and thus change vocational behavior. Counseling has found many useful applications from the domain of career self-efficacy. Researchers have suggested that perceived career barriers may be viewed as exerting a direct influence on self-efficacy beliefs (Swanson & Woitke, 1997). Counselors should work to help students identify these barriers and strengthen self-efficacy to overcome them. Researchers have also suggested a need for assessing the ways in which gender role socialization and other restrictions limit the clients' opportunities, not to push a client toward a nontraditional career, but to restore options that may have been removed by stereotyping and other environmental barriers (Betz & Hackett, 1997). According to Juntenen (1996), counseling strategies designed to help women strengthen self-efficacy for nontraditional careers should be done from a feminist perspective. Counselors should provide women with explicit information about the effect of gender-role socialization on career development and should encourage them to pursue nontraditional careers. Informational sessions, that help women to understand the various

experiences contributing to their lowered self-efficacy perceptions for nontraditional careers, would raise their self-efficacy.

There remains a lack of studies that examine how self-efficacy beliefs develop and function for nontraditional populations, and it is imperative that future research address this void. Researchers are just beginning to explore strategies that may strengthen the career self-efficacy beliefs of different cultures and minority groups, such as women of color (Bingham & Ward, 1997), lesbian women and gay men (Morrow, Gore, & Campbell, 1996), and clients with learning disabilities (Reekie, 1995). In general, most researchers have suggested that both counseling and academic interventions be designed with the theoretical sources of self-efficacy at their forefront.

The few interventions that have been implemented have been successful in raising both occupational and career decision-making self-efficacy (Foss & Slaney, 1986; Fukuyama et al., 1988; Luzzo et al., 1996; Speight, Rosenthal, Jones, & Gastenveld, 1995). In general, interventions have utilized one or more of the sources of self-efficacy variables in design. Luzzo, Hasper, Albert, Bibby, & Martinelli (1999) implemented a math/science self-efficacy intervention designed to affect the math self-efficacy, math and science interests, and choice of majors and careers for undecided college students. Students were assigned to 1 of 4 treatment conditions: performance accomplishment only, vicarious learning only, combined treatment (both performance accomplishment and vicarious learning), or the control group. Students from the performance accomplishment group reported increased self-efficacy for math/science related courses immediately after treatment, and reported significantly higher math/science course self-efficacy, occupational self-efficacy, career interests, and math/science relatedness of

courses on a 4-week posttreatment measure. The combined treatment group also reported an increase in math/science career interests on a 4-week posttreatment measure. Results demonstrated the superiority of interventions based on performance accomplishments. It is important to note, however, that the vicarious learning source of self-efficacy information was operationalized in this study by brief, videotaped models who discussed their experiences that led them to math and science-related careers. It could be that the use of live models and interventions over an extended period of time would have been more effective.

Betz and Schifano (1999) designed an intervention for college women who had at least moderate interest in the activities of Holland's Realistic theme (e.g., using tools, assembling, operating machinery), yet also demonstrated low confidence for these type of activities. Twenty four women received an intervention focused on building, repairing and construction activities that was designed to incorporate all four self-efficacy sources over three sessions lasting a total of seven hours. Women received instruction in these activities from both male and female models who then ensured successful completion of the activities. Instructors as well as other participants encouraged each other and breaks were offered where participants affirmed their accomplishments and learned relaxation techniques. Results demonstrated that the self-efficacy expectations of college women significantly increased for the Realistic domain of Holland's vocational theory, and that all four sources of efficacy can be effectively used to increase self-efficacy when incorporated as intervention strategies.

Researchers continue to explore which source of self-efficacy works best for which groups and individuals and in what situations, yet career self-efficacy interventions

do not always achieve intended results. For example, in one study, role models were used to increase the career self-efficacy of Mexican-American high school women (Hernandez, 1995). Although students reported a strong sense of career self-efficacy on a questionnaire, focus group discussion results suggested low career self-efficacy beliefs. Interestingly, although modeling is part of the vicarious experience source of self-efficacy, none of the presenters gave specific directions, provided key strategies, nor encouraged the girls to seek help from others. Furthermore, none of the role models' presentations included the possibility of failure nor the need to learn and not be dissuaded by mistakes.

It is obvious that career self-efficacy researchers need to focus on studies that examine the creation and maintenance of self-efficacy beliefs. Previous research that explored the sources of career self-efficacy was problematic in that it did not allow for the participant self-reflection necessary to paint a holistic picture of the development of self-efficacy beliefs. There is a need for alternative methods of assessment that do not rely on the use of structured, forced choice surveys.

Researchers that have examined the career development of women through qualitative methodology suggest that women draw on different experiences to cultivate beliefs from those that are typically attributed to successful men (Richie et al., 1997; Stage & Maple,1996; Zeldin & Pajares, 2000). Although authors' conclusions were based on what previous vocational researchers suggested, they did not include the male counterparts in their investigations. It was my hope that by allowing men to have a reflective voice about their career development, I would have an appropriate comparison group to the studies that included only women's voices. In this investigation, I aim to

better understand the way in which career self-efficacy beliefs were developed for both men in a gender-friendly domain and for women in a gender-unfriendly domain.

CHAPTER 3
METHODS AND PROCEDURES

The purpose of this study was to discover the role played by self-efficacy beliefs in the academic and career paths of men who pursued mathematics-related careers, and to compare their self-efficacy development to that of women. In this chapter, I first provide a brief rationale for why I selected qualitative, case study methodology for this study. I also discuss the nature of the participants of this study. I then provide a detailed description of the interview protocol, and continue to discuss procedures in terms of data collection and data analysis. I conclude with a discussion of the strategies used to ensure reliability and validity.

Rationale for Methods and Procedures

As research from a social cognitive perspective assumes that the self-beliefs people hold may strongly influence their behavior, so does qualitative inquiry assume that the people individually interpret the world around them (Merriam, 1988). In the present study, self-efficacy beliefs are thought to play an important role in the actual career decisions and behavioral choices of men and women. According to Merriam, "qualitative research assumes that there are multiple realities-that the world is not an objective thing out there but a function of personal interaction and perception. It is a highly subjective phenomenon in need of interpreting rather than measuring" (p. 17). Consequently, I have selected qualitative methodology to obtain the rich description and narrative, the self-efficacy stories, that emerge when individuals explore their natural history.

Case study methodology is especially appropriate when prior theoretical propositions guide data collection and analysis and the researcher wishes to account for and describe contextual conditions (Yin, 1994). Self-efficacy theory has by now specified a clear set of propositions as well as circumstances within which the propositions are believed to be true. A multiple case study was used with the underlying logic of theoretical replication, the case of men and the case of women may produce contrasting results but for predictable reasons. I selected case study methodology as the method to best extend social cognitive theory by exploring how both men's and women's self-efficacy beliefs were developed and maintained.

Participants

Participants were 10 Caucasian men who currently have a career in mathematics, science, or technology (see Appendix A). "Unlike survey research in which the number of and representativeness of the sample are major considerations, in this type of research the crucial factor is not the number of respondents but the potential of each person to contribute to the development of insight and understanding of the phenomenon" (Merriam, 1998, p. 83). The number of participants allowed for a variety of career choices but remained manageable within case-study boundaries. Because I was primarily interested in studying the development of self-efficacy beliefs related to mathematics, I required that the careers of the participants rely on an extensive use of mathematics or have had mathematics as a prerequisite. There exist several careers that fulfilled the criteria for this study: mathematics professors, teachers, and researchers in mathematics-related fields; chemists, physicists, computer software developers, and engineers. Because my aim was to explore the self-efficacy beliefs of individuals who made the

choice to pursue mathematics-related careers that have lesser representation of women, I did not include those people in the medical or health professions. To bound the sample and to provide insights relevant to America's educational system, I selected participants who were schooled in the United States.

Participants in the study were selected by a combination of network selection and primary contacts. I gained access to several software companies through personal contacts who recommended people who were interested in participating in the present investigation. I also found professors in the mathematics and science departments through primary contacts and through the faculty directories at the college and university level. People who agreed to participate in the study were asked to recommend others who might also be interested in participating, and I also asked personal acquaintances to recommend individuals with mathematics-related careers. Through network selection and personal acquaintances, I was also able to gain access to several different technological and scientific based organizations.

Instrumentation

According to Merriam (1988), the purpose of interviewing is to "enter into the other person's perspective" (p. 72). Interviewing also allows for direct focus on the case study topic and provides insight as to perceived developmental inferences, especially important to this study as participants were asked to reflect on the reasons for making their academic choices and selecting specific careers (Yin, 1994).

Previous research in the area of self-efficacy has examined the development of self-beliefs predominantly from the results of structured surveys. To allow for the unique narratives that emerge when individuals reflect on their own development, I designed an

open-ended interview protocol (see Appendix B). The interview protocol is semi-structured, allowing for both the standardization needed to acquire similar information from each participant as well as the flexibility required during individual administration. I also structured the protocol so that the same questions will be asked of each participant in a similar order to remain focused on the participants' self-efficacy beliefs. Furthermore, the structure of protocol ensured that I will ask each participant the same questions, thus minimizing the effect of the protocol itself on the patterns in the findings.

I designed the protocol questions using several strategies. I administered two sample open-ended interviews to ensure that the wording of the refined questions on the protocol were clear and appropriate. Protocol questions were designed in keeping with an understanding of the sources of self-efficacy that was consistent with previous theoretical notions (see Yin, 1994). I accomplished this by examining sources of self-efficacy surveys that assessed the four hypothesized sources of efficacy and consulting with a researcher with expertise in the area of self-beliefs and self-efficacy (see Lent et al. 1996; Lopez & Lent, 1992). To develop a holistic description of participants and their stories, I included questions designed to elicit a variety of information covering the totality of the phenomenon under investigation (Patton, 1980). Questions covered different time dimensions as well as content types (see Appendix C). This was done to provide the most complete picture of the participants' academic and career history and self-beliefs, as well as maximizing response consistency. I attempted to design the protocol such that participants will not be led toward a discussion that would have them emphasize their self-efficacy beliefs in the context of their personal academic and career histories. If themes related to confidence were to emerge from the study, my hope was that they

emerged from the participants' own narratives rather than as prompted responses to leading questions.

As recommended by Merriam (1998), I began the protocol with a question designed to gather demographic information, family background, academic background, and career history. I asked respondents to provide this general background to locate the respondent in relation to others. This information served as a springboard for continued discussion and also helped to establish a comfortable rapport. The second question asked participants to describe their current occupation. It served to help more fully understand participants' careers and to ground other responses that might be particular to those careers.

The four hypothesized sources of self-efficacy were then systematically explored. Question three asked participants to recall experiences that influenced their choices and decisions to pursue their career. My aim was to explore past performance attainments, theoretically the most influential source of self-efficacy. Because participants were free to discuss their past in their own words, they had ample opportunity to explore the varied experiences that they perceived to have guided them along their career path. Question four was designed to discover whether, and how, the individuals in the study observed and learned from others and whether they used these vicarious experiences to help develop their own self-efficacy beliefs. Question five explored the verbal persuasion source of self-efficacy. This source is typically operationalized with survey questions that assess whether or not individuals were discouraged or encouraged by those around them. Consistent with efforts not to lead participants, I explored the content of those types of messages but without a prompt explicitly eliciting encouragement or discouragement. The

fourth hypothesized source of self-efficacy, physiological indexes, was explored with Question six. So that participants will address their emotional reactions to mathematics-related courses, I included probes such as, "How did pursuing mathematics (science or technology) make you feel?"

I explored in additional detail the career development of men by asking for a memorable story that would aid in understanding how participants selected their career. This question guided respondents to tell their own stories and allowed them to provide their own interpretations of what they perceived to be meaningful events to their academic and career success. Because those who currently have careers in mathematics-related fields may provide unique insights into the problem of less representation by women, I asked them to express their own opinions about why so few women pursue such careers, as well as what they thought should be done to alter the situation. Finally, to enhance the participants' analysis of their own personal histories, the last question asked them to comment on whether they would have liked to have done anything differently in their academic and career past.

Data Collection

I contacted the recommended participants by telephone to ensure that they fulfilled the study criteria. At that time, I briefly explained the purpose of the study to be an investigation of men in mathematics-related fields. Participants were told that they will be asked to take part in an in-person interview that will ask them to discuss their academic and career personal histories. I also informed them that the information they share would be kept confidential, including their names, the names of their schools and companies, and the names of the people they might discuss.

All efforts were made to conduct the interview at the participants' place of work. There were two reasons for this: It was my hope that the participants would be more comfortable in their own familiar surroundings and that the work place locale would inspire them to focus on career-related beliefs. I spent the first few minutes trying to establish a rapport with each participant. As Patton (1980) suggested, I tried to assume a presuppositional stance, that is, I presupposed that the respondent has something to contribute, has an experience worth talking about, and has an opinion of interest and value to the present study. At this time, I also told the participants that they will be receiving a copy of the transcript.

All interviews were recorded by an audio cassette recorder. I took notes during the interview to pace the interview and to write down a statement or idea that required further probing so as to not interrupt the respondent at an inappropriate time. Also, I noted any observations or summary points that came to mind immediately after the interview in a researcher's notebook. To provide the most complete data base for analysis, recordings were transcribed verbatim and proofread. So that participants could clarify or add to the transcript any meaning they think is necessary, a complete copy of the interview transcription was sent to each participant and changes were made accordingly.

Data Analysis

Because this study uses a cross-case comparison method, there were two stages of analysis. The first stage, within-case analysis, treated the case of men and the case of women each as a comprehensive case in and of itself. Cross-case analysis then seeks to build abstractions across cases. According to Miles and Huberman (1994), cross-case

analysis should aim to see "processes and outcomes that occur across many cases, to understand how they are qualified by local conditions and thus develop more sophisticated descriptions and more powerful explanations" (p. 172)**.**

Transcriptions were coded by the guidelines set forth by Miles and Huberman (1994). I developed a list of start codes according to the conceptual framework of the study (see Appendix D). Codes were generated from each question on the protocol. Start codes were initially descriptive in nature for the purpose of "chunking" information into smaller units for analysis. So that I did not have to translate the code into the concept, codes were named close to the content that they are describing. I revised the start list during initial coding to add codes that were needed to describe more specific instances or subjects that were not included in the beginning list.

To retain mindfulness and concentration during the coding procedure, I engaged in marginal remarks. Ideas and reactions to the meaning of the information while coding were written on the margin of the document. These interpretations of the descriptive coding were then used to design pattern-based themes. According to Miles and Huberman (1994), whose procedures I followed, first level coding is a device for summarizing segments of data, and pattern coding is way of grouping those summaries into a smaller number of sets, themes, or constructs. Data were check-coded by a colleague both at the stage where start codes were beginning to be applied and when pattern codes were developed. Because the present case study is bounded by participants in the same area, reoccurring phrases and common threads in the participants' academic and career histories were sought. To understand how the self-efficacy beliefs of men influence their academic paths and career choices, I examined commonalities in the

development of their self-efficacy beliefs; to understand the factors that enhance or inhibit self-efficacy, I explored the patterns of relationships between the beliefs described by the participants and the resulting decisions that they made regarding their career and academic paths.

Reliability and Validity

One of the assumptions underlying qualitative research is that reality is holistic, multidimensional, and ever-changing; it is not a single, fixed, objective phenomenon waiting to be discovered, observed, and measured. Assessing the isomorphism between data collected and the reality from which they were derived is thus an inappropriate determinant of validity (Merriam, 1998, p. 202). Threats to the internal validity of this investigation were addressed by trying to represent an honest rendition of how the participants see themselves and how their beliefs functioned in their academic and career development. I sought to maximize internal validity by peer examination and by exposing my own bias (Merriam, 1988, 1998). Because I approached the cross-case comparison from the perspective of self-efficacy theory, and because my primary aim was to shed light on theoretical concerns, I interpreted responses and made inferences within the understandings which that perspective provides. Colleagues well versed in case study methodology were asked to comment on the patterns of the data and the findings as they emerged. Colleagues familiar with educational issues but not with self-efficacy theory were asked to read transcriptions and resulting findings to ensure that alternative theoretical explanations were not ignored.

Reliability in case study methodology is best ensured by standards of qualitative inquiry; "that is, rather than demanding that outsiders get the same results, one wishes

outsiders to concur that, given the data collected, the results make sense—they are consistent and dependable" (Merriam, 1988, p. 172). My main strategy to address threats to reliability were documentation and development of an audit trail. I kept a detailed record of how data was collected, how decisions were made regarding the case, and how many times and under what circumstances participants were contacted. My objective was to maximize the likelihood that subsequent investigators following my procedures in similar domains would obtain similar data and arrive at similar conclusions.

External validity, focusing on the generalizability of the findings, is an important concern in qualitative research. Because I did not use random sampling, the analogy to statistical generalization should be avoided. I addressed validity concerns in keeping with guidelines set out by Merriam (1988). First, I assessed and reported in a detailed manner the ways in which the participants' self-efficacy beliefs played a role in their academic and career development. In this way, the appropriateness of the transferability of the cases can be determined by the readers or practitioners who might apply the study's findings to similar situations and contexts. Second, I attempted to establish the typicality of the cases, so that others can make comparisons with similar situations. By setting definitive sample criteria and providing a report that emphasized the uniqueness of the academic and career histories of the participants in these cases, users should have a strong foundation for comparison. Third, external validity is enhanced though employing cross-case analysis. According to Merriam (1998), the use of predetermined questions and specific procedures for coding enhances the external validity of the findings. Future research could add more cases to strengthen the generalizability of this study. Findings

could be compared with those of other types of cases such as successful men and women in careers that are not mathematics-related.

CHAPTER 4
RESULTS AND DISCUSSION

In this chapter, I first provide an overview of the results of the narratives of women (Zeldin & Pajares, 2000). I then describe the ways in which men developed and maintained their self-efficacy beliefs, and how those beliefs affected their academic path and career choice. Throughout the chapter, I discuss the similarities and differences in how men's and women's self-efficacy beliefs were created and employed.

Results

Zeldin and Pajares (2000) reported that women in mathematical, scientific, and technological careers used vicarious experiences and verbal persuasions as critical sources for the development and maintenance of their self-efficacy beliefs. Participants recalled vicarious experiences and verbal persuasions to a greater extent than they did performance attainments. Women relied on messages and vicarious experiences from family members, teachers and peers to enhance their self-efficacy perceptions. Zeldin and Pajares also found that the self-efficacy beliefs of women in these male-oriented domains, although nourished by sources theoretically posited to be modest sources of confidence, functioned in the way suggested by Bandura's (1986, 1997) social cognitive theory and supported by previous research (e.g., Harter, Lent, and their colleagues). These self-beliefs helped women be resilient to both academic and social obstacles. The women also demonstrated a great amount of persistence and effort while they continued along their academic and career path.

Analysis of the responses of men in mathematically-related fields revealed that the development of their self-efficacy beliefs differed from that of the women in important ways. The recollections of men provided support for Bandura's (1997) contention that performance attainments are powerful sources of self-efficacy information. Men discussed independent mastery experiences as influential to their development of mathematically-related confidence. The men also spoke about vicarious experiences and verbal persuasions, but in a qualitatively different manner than the women in Zeldin and Pajares (2000). Family members, teachers, and peers were used as informational models and reinforcers of self-efficacy perceptions. Men were receptive to academic and career paths of a mathematic, scientific, or technological nature, but they were not especially proactive in their pursuit.

Not surprisingly, men did not recall the same types of academic and social obstacles as did women. Men demonstrated a strong sense of self-efficacy that enabled them to persist through challenges in their academic environment. They did not appear to revisit questions of confidence but used their hardy self-perceptions to fine tune the many career alternatives they perceived to be available to them. Unlike the women in Zeldin and Pajares (2000), they did not struggle with social identity issues. They were, however, sensitive to the struggles that women faced and were insightful in their perceptions about gender differences in the field.

Performance Attainments as Self-Efficacy Sources

According to Bandura (1997), performance attainments are the most influential source of self-efficacy information. Although the women in Zeldin and Pajares (2000) had a history of successful achievements in while pursuing their career, they did not

consider these attainments to be particularly significant to the development of their self-efficacy. Instead, women were far more aware of the verbal persuasions and vicarious experiences from significant others in their lives and spoke about these influences to a greater extent than they did about their mastery experiences. Zeldin and Pajares concluded that experiences of a mastery nature did not seem to be influential to women pursuing underrepresented careers.

The men in this study, however, accentuated their performance attainments as they reflected on the development of their confidence to pursue mathematically-relevant careers. Their recollections often included mastery experiences and stories of self-motivation, and they spoke in terms of having a natural ability, inclination, or talent for math, science, and technology ("Math came easy to me for the most part;" "science is the easiest subject for me;" "So basically I was self-taught in terms of computing"). These men attributed their success to a combination of sources, and prevalent among them were independent mastery experiences. Matt, a 48-year-old chemistry professor, for example, did not discount the influence that others had on him, but he also gave himself credit for his perseverence.

> People have had an influence on me certainly, but most of my motivation, I feel, comes within my own self. My desire to find answers, to accomplish things—what keeps me going is that I want new things. I'm constantly wanting to do new things. Constantly. And that is my biggest motivation.

William, a 64-year-old physics professor, felt that he had a natural ability that blossomed because he engaged in a great amount of reading, studying and playing with tools:

> I liked science and math in school and did well in it. I certainly have an inclination. I was a bookish kid. I read a lot and enjoyed reading and studying and learning things. So it was kind of natural that I was mechanically inclined, and then liking to tinker and play with tools.

The men in the sample spoke of their past accomplishments as important influences on their desire to continue along their academic and career path. Chris, a 24-year-old software designer, credited having a computer and working in the computer lab in college as integral to his ultimate career as a software developer. Jeff, the engineer in the sample, and Gary, a computer consultant, considered hands-on work experiences and achievements on the job as significant influences in their development:

> I went to work for my father after I graduated college, I had really no background in what I was doing, so I pretty much learned everything from a hands-on point of view.

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> As far as winding up working in computers, probably the key thing that got me in this direction is probably my internship. That was really a fateful six-month stint.

Jake, a computer software designer in his middle 30's, reviewed his experiences in the military where he learned skills that were instrumental in his decision to enroll in college and pursue a career in a technical field. By demonstrating to himself that he could be successful in tasks of a technical sort, he appraised these experiences positively and developed a sense of mathematically-related self-efficacy.

> When I got to my second duty station, after about two years, I realized that I didn't like working for a system like the military. In the military you get promoted for time-in—not whether you actually know what you're doing or are good at what you're doing. That's my opinion. So basically, the person that was in charge of our shift, we would . . . I would work out of a truck, basically go out to the aircraft and fix it. Me and another gentleman would basically tell this guy to sit in the back of the truck and we'd take over everything because he was in charge of us. So I didn't quite like that idea and I decided, well, I'm not going to go through 20 years of this and if I'm not going to go through 20 years of this I'm going to get an education and do something with my life. That's when I decided I actually liked engineering.

The following quote demonstrates succinctly how a college professor attributed his decision to enter teaching at the university level to a combination of sources, and how the fact that he could successfully perform without putting forth too much effort provided confidence affirming information:

> And so I felt, Well, gees. I wonder if I could do this for a career because it is a discipline I know really well, have lots of fun, people tell me I'm doing a good job, and I don't have to work very hard to do that.

Vicarious Experiences and Verbal Persuasions

The women in Zeldin and Pajares (2000) relied heavily on the sources of self-efficacy information that they gleaned from listening to the messages and observing the behavior and skills of significant others in their lives. The powerful persuasions they

received from members of their families, their teachers, and their peers served as self-efficacy building blocks so that they could later rely on those perceptions to help them persist through obstacles. Women recalled the profound effect that these sources of self-efficacy had on them as women in underrepresented fields and how the beliefs that others demonstrated in them were critical to their success.

When asked about how and why they pursued their academic paths and arrived at their career decisions, the men also spoke about people whom they considered influential. Observations about family members, teachers, and peers were easily recollected. Important to note, however, is that men spoke about these influences in a substantially different manner than did the women. Men interpreted the vicarious experiences they witnessed as those that would provide entree into a mathematics-related career. Models both introduced them to mathematics-related areas and provided reinforcement for strengthening their developing sense of self-efficacy. Men did not seem to recall the significant people in their lives to be especially direct or proactive in their encouragement, and they described themselves as passively receptive to this stimulus.

Family

Ten out of fifteen women in the previous study had family members that either had a career in a mathematics-related area or modeled mathematically-related skills on a regular basis. Women recalled persuasions and encouragement that dealt directly with women pursuing mathematics-related areas. Note the active provocation on behalf of one of the women's father in his helping her and what that did to create her strong self-efficacy perception:

> [My] pursuit of mathematics is definitely due to my dad. He was very supportive, and I never got the impression that I couldn't do math from my dad. I never got that math anxiety, and in fact when I would not understand something, he would just get up with me in the morning and he would explain it to me and we would work through the problems together and he really emphasized that it just takes practice. You just practice and pretty soon you start to see a pattern.

Recall also that women relied on messages from their family members that dealt primarily with encouraging women to pursue the challenges of entering underrepresented areas. A nuclear physicist credited her father and her strong "feminist" mother with the formation of her self-efficacy beliefs and with a mental toughness that would surely help her resiliency to overcome obstacles.

> I was just born to be who I was. I then had other kinds of things that, you know, gave me the gumption and the drive and the will to do something different than what was traditional for a woman to do. And that came from my parents. Both of my parents, really. My father never expected his girls to be soft and female. We were raised to be tough.

Five of the men in the sample had family members in mathematically-related careers and they perceived these family members to be influential in terms of the informational modeling that they provided. When men were making decisions about their future academic and career path, they drew on close-to-home observations. Mathematics, science, and technology appeared to be natural areas for men to pursue as they saw that these domains were also accessible to their family members ("My brother, the statistician,

was influential;" "I guess I was influenced by my family certainly in the push toward engineering and science as a way to make a living, which they all took as axiomatic and guaranteed to be true because my dad was an engineer, my brother's an engineer, so they thought, ‘This has got to be good for everyone, so you ought to go in that direction."). The information provided by family models affected the academic direction that men pursued. Abe, a 61-year-old chemistry professor and later a university dean, discussed how the observations of his older brother influenced him to pursue a career in the same area, even when he had aspirations toward a different occupation.

> I guess most of my early education and youthful development was to emulate my brother, who was very, very, very bright. So consider it part competition—more an emulation than competition, I knew that I couldn't compete with him because he was extremely bright. He was one of those people who excels in academics. He was just the scholarly type. The kind of guy who sits down and read a book in three hours because he reads fast and he understands things and is quick at picking up concepts. I was more of a plugger—I had to work hard to understand things. But it was sort of fascinating to be around a chemist. It was something glamourous and there was an allure to it. My brother was doing it and I used to visit him occasionally in his laboratories and it was interesting stuff. So I thought, well, I may as well become a chemist, although my career aspiration was really to become an architect.

Information that was readily available to men by watching family models persuaded them to give the same area a try, even when they did not have a strong interest or passion for

the area. Note how William, a physics professor for over 30 years, discussed how he was influenced by watching both his father and his brother engage in mechanical and scientific activities.

> And then my father was quite mechanical–he was very good with his hands and at repairing things, so there was always some tinkering in the basement with some tools. Then my brother, who was six years older than me, was interested in science and since he is six years older than me, that means he is in twelfth grade, I'm in sixth, and he's studying chemistry and I'm sort of looking over his shoulder and he brings home chemical things and that got me interested. Then he went on to do engineering. . . I didn't know what engineering was. It had to do with science and math, and my brother had done it. I didn't know one from another. He was a metallurgical engineer so when I went I said, "Well, I'll try it." I just chose metallurgical—I didn't have a good reason to do that.

Few men remembered being helped directly with mathematically-related activities by people in their family. Encouragement to pursue areas that were specific to mathematics, science, and technology was dispersed passively by observation. Jeff, a 32-year-old engineer, attributed his decision to enter his field to his father. The fact that his father owned a business in the same area was enough of an influence for Jeff to follow suit. He did not, however, discuss what it was specifically about his father that directly influenced him.

> My career path–my father was really the biggest influence. Because the company I went to work for, again, was his and I really wasn't all that

> interested in what he did but I thought that I would give it a shot working for him and then I became really involved with this one specific area of my job. My father didn't really have any background in it and I became really engrossed in it and went on from there. But if there was one professional influence in my life, the biggest influence was definitely my father.

Men also articulated family member influences that encouraged persistence and effort, but these influences were not related to nontraditional career pursuits as they were for the women in Zeldin and Pajares (2000). As evident in the recollections of two chemistry professors, men felt encouraged and supported by family even if it was not specific to their career area of choice.

> Family has always been very, very supportive of whatever I want to do. I got clear messages from time to time that they didn't understand at all what I was doing, but they wanted to support it.

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> I certainly had a very supportive family and childhood and basically we were raised in an environment that believed that (1) education is everything, and (2) that you could accomplish anything you wanted to accomplish. My father was sort of an example, going back to college after he had four kids. It took a lot of hard work and we realized that if you work hard, you can do what you want to do.

Teachers

Without exception, the women in Zeldin and Pajares (2000) highlighted the importance of teachers who encouraged them along their academic path. All women spoke about teachers whom they believed to be highly influential in the development of both their competence and confidence. Women felt that their teachers, whom they met at various points in their career development, were influential because of both their passion for their subject matter and their encouragement of women in male domains. The powerful effect that women perceived their teachers to have on their self-efficacy is demonstrated clearly by the recollections of Jean, a 32-year-old chemical engineer who observed that she had been

> brainwashed by a high school mathematics teacher. I found that if you were a female who was good at math and science, this particular teacher really believed in getting women into scientific degrees. So every year for two years that I was in his physics class, he said, "Marry a doctor, be an engineer." When I came to college and I was pre-med, I hated physics though that is what I had planned to major in. Well, somewhere at this point this saying kept going through my head . . . just marry a doctor and be a chemical engineer, and I went into chemical engineering.

In contrast, only half of the men spoke about their teachers as influences on their academic development. Men found their teachers to be inspiring but did not receive messages that acted as catalysts for their decision to pursue their given careers. Rather, teachers served as models of enthusiasm and passion for their subject matter. Note how Gene, a 38-year-old chemistry professor reflected on what he considered to be the real

influence for him to pursue science when his interest was enhanced by a dynamic teacher early in his academic life.

> My decision to pursue science started actually when I was pretty young and that was fueled by the fact that I did well in it and I thought, "Well, hey, this is something that I may have a natural talent for. But more than that, I think that it actually had to do with the teachers that I had when I was young, specifically when I was in grammar school. There was a young teacher that I had for two years for science courses. He was just a fantastic teacher, full of energy and was always very encouraging of extra work that I wanted to do.

Matt, another chemistry professor, also recalled his admiration of expert teachers and how he incorporated that admiration into the motivation to excel in science:

> I always admired my high school chemistry teacher–I always admired how he had such command of the knowledge that I wanted to have command of and hoped that someday I would have that. And that was part of my aspiration, I can't deny that. The same was true in college. I just couldn't imagine the command that my college professors had of the discipline and I was pretty sure that I would never be what they were, but I wanted to try.

Two of the men spoke about the confidence they received from teachers to pursue accelerated studies. The actions on the part of these teachers put forth an avenue of which these men were unaware, and thus served as reinforcers of students'

confidence. Chris, the computer software designer, discussed a teacher in middle school who encouraged him to enroll in an accelerated mathematics class.

> In seventh grade, the teacher there suggested that I go into an accelerated math course in eighth grade and at that time I remember thinking, "Why me?" I didn't think I had any particular interest in it. But she felt that I did, and I passed and in eighth grade I was more interested in it, I think. I guess it was because someone thought that I could do it, or something. I remember thinking in seventh grade, "Why me? Why did she pick me?" I didn't think that I was better than anyone else. But in eighth grade, I definitely had an interest in math.

Similarly, Abe credited advisors and mentors for encouraging him to enroll in a doctoral program.

> It turns out that I had enough affinity for it that I was willing to pursue it and those people who were advisors and mentors were very encouraging – more so than I thought I deserved at the time. One anecdote was when Smith said that I shouldn't waste my time being a chemist, I should do a PhD. I had people that I was working with who were very supportive and this was the first positive reinforcement that I ever had in my academic life. And that positive reinforcement was very important to me, and I really reveled in it. That someone had enough confidence to think that I could go through a PhD program and be successful! They had enough insight to think that I had the capability both academically and creatively, that I thought it was worth pursuing.

Peers

The women in Zeldin and Pajares (2000) described the importance of peers and the influence of social groups on their developing confidence. Often, they spoke in terms of support once they had made their decision to pursue a mathematics-related major or had entered that career pipeline. Group membership was especially beneficial to women as they provided social experiences, and they found it important to meet like-minded colleagues and form relationships. Here is a particularly illustrative example from one of the chemists as she acknowledged the importance of membership in a university chemistry club.

> I can remember this woman saying, "Well, everyone has always told me that women don't do well in math and science, so I'm just going to push forward with that." And I remember thinking that it was such a good feeling that she had kind of confronted this whole image but wasn't going to allow it to detract from the way she really felt about herself. I think this actual group of women also not only cemented my love of science and knowing that this is what I wanted to do as a job or as a career, but it made science social to me.

Men also seemed to thrive in group learning situations and partnerships. Support provided from their colleagues and friends augmented their developing competence and their confidence to persist in what could be considered highly challenging academic arenas. I want to emphasize that many men discussed the importance of collaborative strategies and working in groups that they seemed to enjoy in the past and look forward to the times when those types of situations will be available to them in the future. They

credited these groups with enhancing learning situations which they remembered as enjoyable components of their academic life. Matt described the benefit of belonging to an academic group in college:

> In graduate school, there were about 50 biochemistry students in the program and 20 so faculty members and we were a close knit group. We did everything together. We were all colleagues, and that was where I really started to get a sense of the scientific community and people working together and supporting one another. It was a fun time. I enjoyed it. I loved it.

Although men did talk about partners and friends in terms of academic and career influences, they did not look to them as crucial social supports. The reinforcement that men perceived came to them in terms of academic learning, and they concluded that they achieved more working with others than they would have independently. Note how Chris discussed how a friend provided an academic resource for him in high school:

> This was more in high school—a friend of mine was a programmer and he got me interested—well, I don't think he got me interested, he was a great resource to go to. If I got stuck somewhere, he would help me through it. He made things easier.

Jim, a 38-year-old physics professor, credited his peer group in college as instrumental in his learning of physics.

> I think another influence was just peers in college—one of the differences I see for students here versus students at where I went to school is that there was a large number of physics majors. I found the people with

> whom I liked to work, other people who are also good at this, and liked these kind of things. So that was clearly influential in getting me to learn a lot of physics.

In addition, Jim credited a specific friend with whom he worked closely as one who increased his knowledge of physics.

> I often tell the story of one guy I worked with particularly a lot, where he and I would just start problems from very different points of view and he would just have this really deep knowledge of what to do and he would look at me like I was a magician because he had never thought to do something that way. So I think we learned a lot from each other.

With a focus on academic achievement, men discussed the influences that others have had on them in their academic path. A study partner was integral to Gary's success during his undergraduate studies in mathematics.

> In math it was mostly men. But I had a study partner that I met the first semester of my sophomore year and we took every single math class together. She was an African American female and she and I pulled each other through. We helped each other get one full grade above where we would have been without the other person. It was a total synergistic experience.

Resiliency to Obstacles

Women found themselves resilient to both academic and social obstacles. Fueled by the vicarious experiences and verbal persuasions from significant relationships in their lives, they managed to combat academic and social hurdles. All women perceived

significant obstacles that had to do with positioning themselves as women in a male-oriented domain. Because their confidence was developed through significant others at the same time their competencies were being developed, the women in the previous study formed strong self-efficacy beliefs that carried them through hurdles that could have been potentially devastating. This is perhaps best illustrated by one of the women who discussed the perseverence required when she remembered how frightening her first physics class was in college:

> I can tell you one thing that I will always remember all my life was my first physics class—walking in the door—now, of course, I am a freshman which is kind of scary anyway, right? Away from home for the first time. And I walked in the door and when I looked at all the sea of faces and all you could see was men. Men with beards. We're not talking about boys. Now it was men. And standing at the threshold of that door and thinking, "I don't want to go in there." But I did, you know? I did. Forced my way in and went to the back and sat—but I remember that, that momentary terror of not really believing that maybe I really–I don't belong here. There's not one of me here, you know? But it turned out that there was. But not too many.

I expected that the men in this sample would not recall obstacles of the same severity as did women who were embarking on a path in which they were underrepresented. Clearly, there are hurdles to overcome for anyone pursuing a highly challenging academic field, but it appeared as if the men did not question their ability to

persevere successfully. Men's robust sense of self-efficacy enabled them to view hurdles in their path as challenges instead of dangerous obstacles.

Academic resiliency

Men did not recall incidents that were true threats to their optimal career goals. They did discuss areas in which they had to put forth effort to improve or to achieve, but they did not even consider the possibility that they would not emerge victorious. There was no real need for men to reappraise their perceptions of their ability to succeed. For example, Gary, the computer consultant, spoke of the effort required to make good grades in college. Although he recognized that the subject came easier for others, rather than being deterred from his path he simply worked harder and continued to receive a degree in mathematics.

> In high school, I didn't have to study really, up until calculus. When I really started getting humble is when I got to college. That's when I realized–there were people who still would not study in college and get an A–I was struggling and getting A's and sometimes B's and I had to do the work. I didn't have to work that hard, but I had to do the work. And I didn't always get A's.

Because men had a strong foundational sense of self-efficacy, and were continually reinforced by previous attainments, vicarious experiences, and verbal persuasions, they maintained their robust sense of confidence. As illustrated in the following quotations, men's strong sense of self-efficacy was fully integrated into their cognitive appraisals. Their hardy self-efficacy precepts served a liberating function as they did not have to revisit the question of, "Can I," but could expend their energies

toward developing interests and determining what it was that they really wanted to do. For example, Jake discussed how he worked for many years as a bartender and how he struggled with the decision to give up the immediate and great financial rewards that it provided and go back to school.

> I've always been interested in computers. I remember when I got out of the military, at that time I was under the impression that you had to have a degree to get a good position. So I was like, "Alright, I have to go to college." Then I kind of shied away because here I was bartending and making a hell of a lot of money, but I was still interested in computers. When I decided that my life was not going anywhere with bartending, I knew I couldn't do this for another 25 years and retire, I decided I wanted to go back to school. That was something at the time I really wanted to do.

On his career path toward becoming a chemistry professor, Abe reflected on a critical time in his life when it required that he put forth a great deal of effort to determine if he had the not only the foundation, but the interest in dedicating himself to a challenging academic and later career opportunity. Note, however, that Abe did not appear to question his ability to succeed, but devised a plan to help him gage his true interest.

> Then I got my degree and I really didn't know with a bachelor's degree whether chemistry was for me. Maybe that's why I never really did well– I did O.K., but I didn't do super. So it was that year, that critical point. That transition occurred during that first year post-graduate. Around the first

> year. And when I graduated, and even married, I decided at that point that I had to make a career decision: Do I really want to do chemistry? But I really didn't know enough to make that decision. That's why during that first year I didn't work except little part-time jobs. I spend that year studying, seven days a week, morning to night. I expended an enormous amount of effort learning the chemistry that I didn't learn in undergraduate school. That was four years of chemistry that I learned in one year. I find that difficult to believe today, but I did spend that full year working my ass off. I read every textbook that I had during the undergraduate work, I did every problem in the back of every textbook I studied so that I knew chemistry and then I had to decide whether I liked it or not.

Consider the confidence demonstrated by Steve, a 48-year-old mathematics and computer science professor as he described his approach to graduate study. Similar to his male colleagues, he did not even question his ability to surmount financial hurdles nor succeed in a teaching capacity in which he had no prior experience.

> I went to one university and looked around–it's an expensive place. I couldn't afford to go there, right? So I went over to the second university and talked to the department chair. I walked into his office and sat down and said, "I'm looking to do some graduate work in mathematics, what can you do for me?" . . .They gave me a job, gave me a syllabus, gave me a textbook and said, "You're teaching calculus next week." So here I am, having never taught a calculus course, being given basically complete control over the course. It's my responsibility to go in and make sure that

> the syllabus gets covered and it's just a list of topics. How I structure it is completely up to me. And, by the way, here's a key to that office over there and here's your office mate. Just like that. I'm like, "O.K. I can do this. I can do this." So I just proceeded to be a regular T.A. teaching math courses and making the usual mistakes and working my way through learning how to teach mathematics basically, taking graduate courses at the same time.

Social resiliency

The voices of the women in Zeldin and Pajares (2000) provided penetrating insight as they discussed the challenge of positioning themselves both as women and as mathematicians and scientists. Reflecting on the sociocultural messages and their own self-efficacy development caused women to explore issues of gender differences and identity. ("I think that mostly what you got from male peers was either they thought that you'd never make it, or they thought, I don't want to do anything socially with this person. I don't want to have to do that."). Several women discussed sensitivities about their femininity and suggested that the juxtaposition between those conceptions and that of mathematically-related areas were problematic. All women could speak of instances in which they received negative sociocultural messages about women in their field, but they either ignored them or developed coping strategies and did not let these negative verbal persuasions deter them from their ultimate goal.

It is not surprising that most men did not mention being affected by negative social messages. Not having experienced minority status in their given area, they simply did not seem to face obstacles of the social identity sort. The few men that did notice

relevant messages dealing with people in their specific field did not find them to be particularly bothersome. Men considered themselves to be atypical individuals in the field and were not threatened by messages that they perceived did not apply to them directly. Gary, for example, reflected on the group of peers with whom he went to college, but did not believe himself to be part of that specific group. He maintained a strong self-perception while becoming successful in mathematics, and did not struggle with issues relating to social identity.

> It was kind of an odd group of people to begin with, the math majors. I would say that I was probably– and I use the term loosely because I don't consider myself that normal– but I was probably the most normal out of most of the people, there were a few others. There were a few normal people and everybody else was kind of weird. . . just off-centered, not social. Ever hear the joke, how do you tell if an actuary is outgoing or extroverted? He looks at YOUR feet when he's talking to you instead of his own. And that's to some degree with math majors. So I felt like I could do that math stuff and be fairly normal and social and I don't think a lot of people were.

Steve, the computer science professor, articulated similar thoughts when he viewed his position from the perception of the students that he teaches.

> "Well, these are a bunch of dweebs." That doesn't bother me. I mean, that probably is true and it still doesn't bother me. But it is interesting that they're [his colleagues] certain that that's not true. And I'm not certain that

> that's not true. I think from the outside we probably do look like that. I don't care. I mean, I really don't care.

Although men did not face the same barriers nor risk internalizing the same sociocutural messages as did their female counterparts, they made poignant observations and offered interpretations about what women may experience in their career area. Several of the men in the sample provided commentary about what they felt to be discriminatory practices:

> As a matter of fact, I saw this time and time again– math teachers in my classes literally just systematically discouraging the girls in the class from studying math and science. They would minimize their answers to them, they would call on boys, they would try and humiliate boys in the class to do better if the girls were actually scoring higher on the exams. "Come on you wimps, Suzie here scored the highest grade in the class. What's wrong with you guys?" I mean, I saw that sort of stuff all the way through my grade school, junior high, high school and in college and basically by sheer wear and tear and being discouraged, women did not persist. I would not have persisted. Had I been so systematically discouraged, I wouldn't have persisted I don't think, although I tend to be combative about this sort of thing. But I'm not sure that I would have persisted.

_____

> I think that there are other– there are established members of my profession who are not as supportive of women, who I have known. I would have just as soon not as known, but it's a fact of life. . .

One man in the sample even reflected on his own prejudices, and provided an honest and insightful rendition of what he thought may be typical of men in his genre:

> I went to a seminar and they were trying to hire somebody as– it was a new specialty in the department and they had one of their candidates there. She was beautiful, just very pretty, and had on a very pretty cashmere sweater and a nice plaid skirt and she was sitting in this room with only men and she was just beautiful, attractively dressed. These are all my prejudices coming out. She was very good. – I thought she gave a great talk. Then they were asking her questions and she was quick and it was an amazing kind of a scene there. It was almost like drama/theater and like someone set this up– these little gray beards, people in the field who knew all kinds of stuff, and she was just handling them so very well. Well– so why should I be surprised? Why is that strange for me? It's because I have this structure in my mind between that and the physicist. You have these prejudices, you sort of associate this with that and that with that and not these two with each other. So certainly I am not immune to this notion that women just aren't as good as men at some things–physics being one of them I suppose. You can't but hold that prejudice when you're in a profession that's all men and just a few women here and there. You naturally assume women can't do this.

Men discussed the development of confidence and competence and how these issues might differ by gender. Jim was especially insightful in his reflections on how men and women have different ways in which they express confidence. Note also that his

recollection well demonstrates the pattern of male self-efficacy development found in this sample–they did not have to reconsider questions of confidence and thus could concentrate on what it was they "want to do."

> There are a lot of women who say, "I'm a fraud. I look good on the outside, but really. . ." And there are men who feel that way too but, as a friend of mine puts it: 80:20. I've seen more of it with some of my female friends than male friends. Some of it, if I try to think of it a little bit analytically, it's coupled with some level of competitiveness that I have. So the point then, your drive is to be better than other people which will make you concentrate on certainly at least appearing confident to everybody else. But then there comes a point where you're not really doing it out of competition with other people and I don't know where that transition. . .well, actually I do know where that transition came. I think it came very consciously for me somewhere about the beginning of college. I want to do what I want to do.

Perhaps Abe, the former university dean, most elegantly expressed the importance of nurturing students and stressed the significance of patient and careful guidance so that everyone's confidence will have a chance to thrive and flourish.

> You've got to know when the person will blossom, when things will be right for them to work. So, if you don't know, then why should you judge now? You judge later on, when it is all done. So you have to keep helping people in the hope that they will eventually blossom to a beautiful flower. It takes a while. It is sort of a sixth sense. You sometimes know whether

> the person has the capability. If you feel that way, you should encourage them to keep on pushing and trying and working and if you're not sure, you should encourage them to keep on pushing and trying and working anyway; Because you don't know whether that time has been reached.

Summary

In summary, the mathematics self-efficacy beliefs of the men in this study differed in several significant ways from those of the women in Zeldin and Pajares (2000). Bandura (1997) suggested that "cultural practices that convey lower achievement expectations for women, model stereotypic gender roles, constrain sex typing of career aspirations, and constrict opportunity structures require of women a robust sense of efficacy to pursue non-traditional vocations" (p. 436). The women in Zeldin and Pajares used vicarious experiences and verbal persuasions to develop the robust sense of efficacy that Bandura suggested is necessary to pursue careers in male-dominated fields. Family members, teachers, and peers provided women with the building blocks necessary to create a strong sense of self-efficacy that was critical for them to become resilient to the obstacles they encountered. Social messages, verbal persuasions, and modeling significant others proved influential during the selection and retention of career and academic behaviors. When women were faced with the many and varied academic and social hurdles that they recalled, they revisited the confidence-building episodes and messages that they experienced with important people in their lives. The proactive encouragement given from the significant relationships in women's lives was necessary for them to develop confidence in themselves.

In keeping with the theoretical assumptions of self-efficacy (Bandura, 1997), men highlighted the importance of mastery experiences as sources of confidence information. Men spoke in terms of independent achievements, and attributed their confidence to independent, personal attributes. When men spoke of the vicarious experiences and verbal persuasions from others in their lives, they did so in terms of the reinforcement that these relationships provided. They recalled family members, teachers, and peers as models of career information.

Men did not question what they could or could not do in their specific career area, rather, their questions were related to choices they would make about where they wanted to be most successful. The clear pattern of the strong self-efficacy precepts leading the way for interest development supports previous research suggesting that individuals become interested in areas in which they believe they can be successful. Further, men believed that doors were open to them, and it was not a question of whether or not they belonged in that area, but whether or not they wanted to be there. Certainly the men in this sample demonstrated that once their self-efficacy beliefs were set for success in mathematically-related areas, there was little that could be done to undermine them.

CHAPTER 5
DISCUSSION AND IMPLICATIONS

The purpose of this study was to explore the personal stories of men who selected and continue to excel at careers in areas of mathematics, science, and technology to better understand the ways in which their self-efficacy beliefs were created and subsequently influenced their academic and career choices. Analysis of 10 narratives from men were compared with the narratives of women in mathematics, science, and technology from a previous investigation (Zeldin & Pajares, 2000). Because the sources of self-efficacy provide the key means through which self-efficacy beliefs may be strengthened, I was especially interested in understanding the manner in which men created, developed, and used these self-beliefs. I also wanted to do so from a qualitative perspective so that participants would be free to reflect on their academic and career histories in their own voices.

There were two important findings that emerged from the analysis of the participants' responses and the comparison to the previous investigation. The first finding was that men accentuated mastery experiences as a critical foundation of self-efficacy beliefs, whereas women relied on vicarious experiences and verbal persuasions as crucial sources of their self-efficacy beliefs. The second finding illustrated the importance of self-efficacy as a construct that is foundational to career selection and development. For men, strong self-efficacy beliefs enabled them to be persistent and allowed them to determine what it was that they most wanted to do, rather than struggle with their confidence about

becoming and remaining successful in a mathematics-related domain. For women, self-efficacy beliefs developed from the significant relationships in their lives made them resilient to the many obstacles they perceived in their academic and career paths.

The most important finding of this investigation was that men highlighted their mastery experiences as the most significant source of self-efficacy development. This finding is in keeping with the theoretical framework of Bandura (1986, 1997) who suggested that enactive mastery is the most important and influential self-efficacy source because it provides the most authentic evidence of information about success in a specific domain. Bandura also argued that mastery experiences produce stronger and more generalized self-efficacy beliefs than do other modes of influence such as vicarious experiences, cognitive simulations, or verbal instruction. The manner in which people create and alter their self-efficacy expectations through mastery experiences depends on various factors. These include their preconceptions of their capabilities, the perceived difficulty of the tasks, the amount of expended effort, the amount of aid received from others, the circumstances under which they perform, the chronological pattern of their successes and failures, and the manner in which these mastery experiences are cognitively organized (Bandura, 1997).

Men referred to these factors through their recollections of the mastery experiences that helped form their positive appraisals of their capabilities. For example, they spoke repeatedly about their personal characteristics in relation to mathematics-related achievements. Statements such as "I was good at it," and "it came easy for me" illustrated positive conceptions of their capabilities and demonstrated that they did not perceive mathematics-related tasks to be difficult, nor did they find it difficult to enter

mathematics-related domains. Men also spoke about the aid they received from others in terms of informational modeling. Mathematics-related areas were easily accessible to them, and they did not require that others help them directly.

Previous researchers who have examined the sources of self-efficacy have supported Bandura's (1986, 1997) contention that mastery experiences consistently makes the strongest contribution to mathematics self-efficacy. Participants in the present study demonstrated that this contention is warranted. The finding that men used independent mastery experiences to develop their self-efficacy beliefs is especially important in light of the finding by Zeldin and Pajares (2000), who suggested that women form their self-efficacy perceptions primarily from their vicarious experiences and the social and verbal persuasions they receive from others. Seeing people similar to oneself perform successfully typically raises self-efficacy beliefs in observers because they come to believe that they themselves possess the capabilities to successfully perform comparable activities. Women persuaded themselves of the fact that, if others could do it, so could they. Women experienced vicarious learning from their family members, teachers, and peers. Bandura (1997) contended that it is easier to sustain a sense of self-efficacy, especially when struggling with challenges, if significant others express faith in one's abilities. Zeldin and Pajares provided evidence that the persuasions of others were critical to the women selecting and continuing to pursue paths of a mathematical, scientific, and technological nature.

Although men also spoke about significant others in their lives, they did not attribute the influence of others as instrumental to their career decisions and academic paths in the same way as did women. Men spoke of the significant people in their lives as

providing reinforcement to their already developing sense of confidence that was created by their own mastery experiences. In essence, then, findings from the present study and those of Zeldin and Pajares (2000) suggest that men and women who go on to pursue careers in a mathematical, scientific, or technological domain form their confidence beliefs on quite different antecedents.

The fact that men recalled mastery experiences as the prominent source of their self-efficacy beliefs illustrates that the development of these self-beliefs may mirror the development of identity suggested by Erik Erikson (1959/1980, 1968). According to Erikson, men, while forming their identity in an "outer space," do so primarily in terms of their accomplishments. The dominant male identity is based on a fondness for "what works," and what a man can "make." Erikson (1968) added that " the majority of men have always consolidated their identity needs around their technical and occupational capacities . . ." (p. 127). Men and women establish for each gender what range of attributes and attitudes "come naturally" for most of its members in terms of predispositions, predilections, and inclinations. These inclinations are a function of differences by gender, and they affect identity development profoundly.

Erikson (1968) argued that women form their identity while existing in their "inner space." Women's natural tendency is to rely on the intimacy of the relationships in their lives, and they are interlinked with those whose existence are interdependent on them. As Zeldin and Pajares (2000) suggested, the idea that women form their self-efficacy beliefs as a result of their relational experiences is in keeping with the theoretical assumptions of Carol Gilligan (1982), who argued that women use the relationships in their lives as a

foundation on which to ground their behavior. Gilligan also argued that the developmental order of identity formation for women may differ from that of men.

> While for men, identity precedes intimacy and generativity in the optimal cycle of human separation and attachment, for women these tasks seem instead to be fused. Intimacy goes along with identity, as the female comes to know herself as she is known, through her relationships with others. (p. 12)

As the women in Zeldin and Pajares (2000) developed their mathematical-related skills and competencies, they allowed significant others in their lives to help them appraise these competencies positively. Because women perceive themselves at the center of an intricate relational web (Gilligan, 1982), they used their relationships from family members, teachers, and peers as identity forming and enhancing. They believed they were competent in underrepresented domains through the beliefs that others shared with them about their capabilities. Women's relationships with people with whom they cared about and who cared about them were not used to merely reinforce their confidence. Instead, these relationships were required for their perseverance, and they aided in helping women define themselves as mathematicians and scientists. Gilligan argued that the concept of identity should include women's experience—that of interconnection. Bandura (1986, 1997) gave primary theoretical focus to self-efficacy built on mastery experiences, and that focus fit the male participants in the present study.

Although my results indicate that there were differences in the use of self-efficacy sources by gender, social cognitive theory does not ascribe motivating properties to gender (Bussey & Bandura, 1999). Indeed, it is likely that gender cannot in and of itself

explain the differences in cognition and behavior of individuals. Some researchers have suggested that gender differences in human motivation and behavior may be more aptly explained by differences in people's beliefs about gender rather than by gender itself (Hackett, 1985; Harter et al., 1997; Matsui, 1994; Matsui & Onglatco, 1991; Pajares & Valiante, in press; Schunk & Pajares, in press). Researchers have found that the stereotypic beliefs about gender that individuals hold, or gender orientation, contribute to differences in social and academic variables (Eisenberg et al., 1996). As a matter of fact, gender differences in variables such as moral voice and empathy are rendered nonsignficant when gender orientation beliefs are controlled (Harter et al., 1997; Karniol, Gabay, Ochion, & Harari, 1998). Likewise, gender differences in writing self-efficacy are also rendered nonsignificant when gender stereotypic beliefs are accounted for (Pajares & Valiante, in press).

According to a model of academic choice developed by Eccles and her colleagues (Eccles, 1987a, 1987b, 1994; Eccles, Adler, & Meece, 1984), academic choice and achievement is based both on the expectations for success that individuals hold and the value they attribute to a task, activity, or domain. This is especially relevant to gender differences evident in mathematics-related domains. Men and women consistently sex-type mathematics as a masculine domain. Consequently, boys demonstrate higher achievement expectancies in mathematics than do girls (Betz & Hackett, 1983; Eccles, 1987b; Eccles, Adler, & Meece, 1984). In their early academic years, students begin to hold stereotypes about the gender appropriateness of specific academic tasks and domains. Later, they learn to assign value to those tasks and domains (Meece & Courtney, 1992). Similar to models of career self-efficacy (see Hackett & Betz, 1981),

the academic choice model posits that previous achievements, gender-role socialization, and the cultural milieu influence students's subsequent interpretations and achievements. Eccles and her colleagues concur that women in American society are typically stereotyped as less competent than men and these sex-typed beliefs can lead girls to have less confidence than do boys in their intellectual abilities, especially in domains traditionally dominated by men. Theorists of the academic choice model contend that gender alone does not adequately explain differences in students' achievement patterns; rather it is students' perceptions and interpretations of their achievement experiences that explain these differences (Eccles, 1987a, 1987b, 1994; Meece & Courtney, 1992).

With this in mind, it is possible, indeed likely, that the gender differences I discuss regarding the manner in which men and women attend to the sources of self-efficacy may be a result of their self-beliefs about gender—their gender orientation— rather than of gender. As Bandura (1986) proposed (and see Bussey & Bandura, 1999), the most important way in which individuals learn gender stereotypes is by observing the behaviors of male and female models in their own surroundings. Women provided evidence that the models who helped create their self-efficacy perceptions were those who provided a nontraditional approach toward the career achievement for women. Men also spoke of exposure to models in their environment, but it was models who reinforced their already created self-efficacy beliefs and, I might add, taught them to be invested in achieving in a traditionally male domain. Nonetheless, I dare not make assumptions about the gender orientation beliefs of the participants in either this investigation or that of Zeldin and Pajares (2000) as that construct was not examined in either study. What can be said with some degree of certainty, however, is that both the men in the present investigation and

the women in Zeldin and Pajares persevered in a traditionally masculine domain and believed that they belonged and deserved to be there due in large part to their strong self-efficacy beliefs.

The second finding of this investigation was that participants' self-efficacy beliefs were powerful contributors to their selection of and success in mathematics-related occupations. However their self-efficacy beliefs were created and nurtured, participants beliefs functioned as Bandura (1986, 1997) suggested they should. The men's strong self-efficacy perceptions enabled them to consider a variety of domains as viable career alternatives. They never questioned whether or not they would be successful. Rather, they concentrated their effort on determining what it was that they really wanted to do. The men in this study provided support for the contention that self-efficacy beliefs influence occupational interest. With their self-efficacy beliefs firmly established, men were able to create interests through engrossment in occupational activities.

Zeldin and Pajares (2000) reported that, for women, hardy self-efficacy beliefs allowed them to be resilient and persistent. Although women revisited questions of confidence as they continued along the mathematics-related academic and career pipeline, they were undeterred in their achievement of their career goals. Because women had to be especially proactive in their career pursuits in nontraditional areas, career self-efficacy beliefs may also subsume for them beliefs in capabilities to surmount major hurdles (Bandura, 1997).

Findings from the present investigation lead to several research and educational implications. First, they lend support to the contention that men and women base their confidence on different sources of self-efficacy. Thus, a student's gender must be

considered when designing interventions to address self-efficacy beliefs. Researchers have created interventions to raise self-efficacy for a given task or subject area focusing on one or two of the theorized self-efficacy sources. Some of these interventions have successfully increased the self-efficacy beliefs of students (see Hackett, 1995; Schunk, 1984, 1991, 1995; Schunk & Swartz, 1993). Given the cumulative and developmental nature of career self-efficacy, however, lasting and robust self-efficacy beliefs must be promoted. Including all four sources of self-efficacy beliefs—mastery experiences, vicarious experiences, verbal persuasions, and emotional arousal—in career choice interventions will have the best opportunity to address the needs of all students. Interventions that rely solely or primarily on guided mastery experiences may be missing the opportunity to influence the self-efficacy beliefs of some girls. As Hackett (1995) suggested, "it is likely, for example, that career-related modeling, encouragement, and lowered anxiety and arousal not only enhance efficacy directly, but also facilitate successful performance attempts in occupationally related areas" (p. 248).

It is critical that parents, teachers, counselors, school administrators, and policy makers be aware of the self-efficacy beliefs, interests, and gender orientation beliefs that may be at work as students select or reject academic paths and occupational domains. According to Betz (1992), counselors serve important functions by identifying areas in which low perceptions of self-efficacy serve as a barrier to individual career options. She argued that many women are socialized in such a way that they do not have access to the information necessary to develop the self-efficacy beliefs required to actively pursue male-dominated careers. In these case, this information must be provided. Clearly, students develop perceptions of capabilities while they learn skills and select academic

paths. Assessing these self-beliefs can provide teachers and counselors with important information, and this information can help students make informed choices about their future (Hackett & Betz, 1989; Pajares, 1997). This is especially critical given the academic prerequisites required to develop the competencies needed for a challenging mathematics-related career.

Some cautions are in order. First, it bears emphasizing that more variation exists within gender groups than between them. It would be imprudent to expect that all men and all women in mathematically-related fields have developed the same belief system, have nurtured their self-efficacy beliefs through the same sources, or would make similar career-related decisions. Second, although self-efficacy researchers have suggested that teachers should pay as much attention to students' perceptions of competence as to actual competence, as it is these perceptions that may more accurately predict students' motivation and achievement (Hackett & Betz, 1989), those who design interventions must endeavor to promote competence and confidence in tandem. Moreover, teachers and schools are responsible for helping students develop their competence and confidence as students progress through school. Bandura (1986) argued that

> educational practices should be gauged not only by the skills and knowledge they impart for present use but also by what they do to children's beliefs about their capabilities, which affects how they approach the future. Students who develop a strong sense of self-efficacy are well equipped to educate themselves when they have to rely on their own initiative. (p. 417)

The participants in the present study were highly capable people who had the corresponding skill to achieve their academic and career aims. As Pajares (1996) has suggested, "students cannot accomplish tasks beyond their capabilities simply by believing that they can" (p. 566). Self-efficacy beliefs exercise an influence on academic achievement through the effort, persistence, and perseverence that students put forth to develop their competencies and fulfill their academic and career goals.

Several recommendations for future research are warranted. I urge career self-efficacy researchers to use qualitative methodology to complement findings from quantitative perspectives. Researchers who require participants to reflect on their personal histories, especially as these histories address the development of their self-beliefs, should provide an open ended forum for participants to address the complex interrelationships of self-efficacy's antecedents.

Given the issues expressed earlier in this discussion, it seems wise that researchers should include measures of gender orientation in career self-efficacy assessments. Given that it seems clear that career self-efficacy development differs as a function of gender, it would be beneficial to determine if that difference results from students' beliefs about gender rather than from gender itself. In addition, various researchers have suggested that it is necessary to address students' stereotyping of what men and women are capable of accomplishing as well as the extent to which attitudes and self-beliefs affect their own career-related behavior.

Ethnic and racial minorities are underrepresented in mathematics-related occupations, and self-efficacy researchers should focus investigations on this issue. Lucas (1997) suggested that, for minority students growing up in a majority culture, identity

exploration and commitment may involve a different process than that which majority groups undergo. I suggest that identity development for minorities may have much in common with the self-efficacy development of the women participants in Zeldin and Pajares (2000). In both cases, confidence and motivation may be fueled by individuals' attachment to family members, peer groups, and significant others. The effects of culture and ethnic identity on career self-efficacy and career development is ripe for exploration.

There are few decisions as important to an individual's well being as the career that one will select. Clearly, strong self-efficacy beliefs for occupational domains have significant benefits both for men and for women. Robust career self-efficacy beliefs provide people with the motivation needed to be persistent, resilient, and devoted to their academic and occupational goals. Strong career self-efficacy is especially critical for women in what could be perceived as gender-unfriendly, masculine domains such as mathematics, science, and technology. Although people create and refine their beliefs about themselves and their capabilities throughout their life, it seems crucial that self-beliefs be addressed early, while they are in what William James (1958) referred to as the "plastic stage." Comprehensive career exploration should be a part of educational systems at all academic levels so as to ensure that students do not foreclose on an occupational identity prematurely. Freud's oft-quoted maxim is that love and work are the cornerstones of humanness. If this is indeed the case, researchers, parents, and educators have the responsibility to ensure that all young people are equipped with the competence and confidence required to pursue meaningful and worthwhile work.

REFERENCES

Ahrens, J. A., & O'Brien, K. M. (1996). Predicting gender-role attitudes in adolescent females: Ability, agency, and parental factors. Psychology of Women Quarterly, 20, 409-417.

Anderson, S., & Brown, C. (1997). Self-efficacy as a determinant of career maturity in urban and rural high school seniors. Journal of Career Assessment, 5, 305-315.

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.

Bem, S. L. (1974). The measurement of psychological androgyny. Consulting and Clinical Psychology, 42, 155-162.

Bergeron, L. M., & Romano, J. L. (1994). The relationships among career decision making self-efficacy, educational indecision, vocational indecision, and gender. Journal of College Student Development, 35, 19-24.

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

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. E., Harmon, L. W., & Borgen, F. W. (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.

Betz, N. E., & Klein, K. L. (1996). Relationships among measures of career self-efficacy, generalized self-efficacy, and global self-esteem. Journal of Career Assessment, 4, 285-298.

Betz, N. E., Klein, K. L., & Taylor, K. M. (1996). Evaluation of a short form of the career decision-making self-efficacy scale. Journal of Career Assessment, 4, 47-57.

Betz, N. E., & Luzzo, D. A. (1996). Career assessment and the Career Decision-Making Self-Efficacy Scale. Journal of Career Assessment, 4, 413-428.

Betz, N. E., & Schifano, R. S. (1999). Evaluation of an intervention to increase realistic self-efficacy and interests in college women. Journal of Vocational Behavior, 56, 35-52.

Betz, N. E., Schifano, R., & Kaplan, A. (1999). Relationships among measures of perceived self-efficacy with respect to basic domains of vocational activity. Journal of Career Assessment, 7, 213-226.

Betz, N. E., & Voyten, K. K. (1997). Efficacy and outcome expectations influence career exploration and decidedness. Career Development Quarterly, 46, 179-189.

Bingham, R. P., & Ward, C. M. (1997). Theory into assessment: A model for women of color. Journal of Career Assessment, 5, 403-418.

Blustein, D. L. (1989). The role of goal instability and career self-efficacy in the career exploration process. Journal of Vocational Behavior, 35, 194-203.

Bonnet, R, M., & Stickel, S. A. (1992). A psychometric analysis of the career attitude scale. Measurement and Evaluation in Counseling and Development, 25, 14-26.

Bores-Rangel, E., Church, A. T., Szendre, D., & Reeves, C. (1990). Self-efficacy in relation to occupational consideration and academic performance in high school equivalency students. Journal of Counseling Psychology, 4, 407-418.

Brown, M. T., Eisenberg, A. I., & Sawilowsky, S. S. (1997). Traditionality and the discriminating effect of expectations of occupational success and occupational values for women within math-oriented fields. Journal of Vocational Behavior, 50, 418-431.

Bussey, K., & Bandura, A. (1999). Social cognitive theory of gender development and differentiation. Psychological Review, 106, 676-713.

Church, A. T., Teresa, J. S., Rosebrook, R., & Szendre, D. (1992). Self-efficacy for careers and occupational consideration in minority high school equivalency students. Journal of Counseling Psychology, 39, 498-502.

Clement, S. (1987). The self-efficacy expectations and occupational preferences of females and males. Journal of Occupational Psychology, 60, 257-265.

Cooper, S. E., & Robinson, D. A. G. (1991). The relationship of mathematics self-efficacy beliefs to mathematics anxiety and performance. Measurement and Evaluation in Counseling and Development, 24, 4-11.

Crites, J. A. (1978). Career Maturity Inventory. Monterey, CA: CTB/McGraw-Hill.

Dawes, M. E., Horan, J. J., & Hackett, G. (2000). Experimental evaluation of self-efficacy treatment on technical/scientific career outcomes. British Journal of Guidance and Counseling, 28, 87-99.

Donney, D. A. C., & Borgen, F. H. (1999). The incremental validity of vocational self-efficacy: An examination of interest, self-efficacy, and occupation. Journal of Counseling Psychology, 46, 432- 447.

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

Eccles, J. S. (1987b). Bringing young women to math and science. In M. Crawford & M. Gentry (Eds.), Gender and thought: Psychological perspectives (pp. 36-58). New York: Springer-Verlag.

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., & Meece, J. (1984). Sex differences in achievement: A test of alternative theories. Journal of Personality and Social Psychology, 46, 26-43.

Eisenberg, N., Martin, C. L., & Fabes, R. A. (1996). Gender development and gender effects. In D. C. Berliner & R. C. Calfee (Eds.), Handbook of Educational Psychology (pp. 358-396). New York: Simon and Schuster Macmillan.

Erikson, E. (1959/1980). Identity and the life cycle. New York: W. W. Norton.

Erikson, E. (1968). Identity: Youth and crisis. New York: W. W. Norton.

Fennema, E. & Sherman, J. A. (1976). Fennema-Sherman Mathematics Attitude Scales: Instruments designed to measure attitudes toward the learning of mathematics by females and males. JSAS Catalog of Selected Documents in Psychology (ms. No. 1225), 6, 31.

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

Foss, C. J., & Slaney, R. B. (1986). Increasing nontraditional career choices in women: Relation of attitudes toward women and response to a career intervention. Journal of Vocational Behavior, 28, 191-202.

Fukuyama, M. A., Probert, B. S., Neimeyer, G. J., Nevill, D. D., & Metzler, A. E. (1988). Effects of Discover on career self-efficacy and decision making of undergraduates. Career Development Quarterly, 37, 56-62.

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.

Gianakos, I. (1995). The relation of sex role identity to career decision-making self-efficacy. Journal of Vocational Behavior, 46, 131-143.

Gilligan, C. (1982). In a different voice: Psychological theory and women's development. Cambridge, MA: Harvard University Press.

Gloria, A. M., & Hird, J. S. (1999). Influences of ethnic and nonethnic variables on the career decision-making self-efficacy of college students. Career Development Quarterly, 48, 157-174.

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

Hackett, G. (1985). Role of mathematics self-efficacy in the choice of math-related majors of college women and men: A path analysis. Journal of Counseling Psychology, 32, 47-56.

Hackett, G. (1995). Self-efficacy in career choice and development. In A. Bandura (Ed.), Self-efficacy in changing societies (pp. 231- 258). New York: Cambridge University Press.

Hackett, G., & Betz, N. E. (1981). A self-efficacy approach to the career development of women. Journal of Vocational Behavior, 18, 326-339.

Hackett, G., & Betz, N. E. (1989). An exploration of the mathematics self-efficacy/mathematics performance correspondence. Journal for Research in Mathematics Education, 20, 261-273.

Hackett, G., & Campbell, N. K. (1987). Task self-efficacy and task interest as a function of performance on a gender-neutral task. Journal of Vocational Behavior, 30, 203-215.

Hackett, G., Betz, N.E., O'Halloran, M. S., & Romac, D. S. (1990). Effects of verbal and mathematics task performance on task and career self-efficacy and interest. Journal of Counseling Psychology, 37, 169-177.

Hannah, J. S., & Kahn, S. E. (1989). The relationship of socioeconomic status and gender to the occupational choices of grade 12 students. Journal of Vocational Behavior, 34, 161-178.

Harter, S., Waters, P., & Whitesell, N. (1997). Lack of voice as a manifestation of false self-behavior among adolescents: The school setting as a stage upon which the drama of authenticity is enacted. Educational Psychologist, 32, 153-173.

Hernandez, A. E. (1995). Do role models influence self-efficacy and aspirations in Mexican American at-risk females? Hispanic Journal of Behavioral Sciences, 17, 256-263.

Holland J. L. (1973). Making vocational choices: A theory of careers. Englewood Cliffs, NJ: Prentice Hall.

Krieshok, T. S. (1998). An anti-introspectivist view of career decision making. Career Development Quarterly, 46, 210-229.

James, W. (1958). Talks to teachers on psychology: And to students on some of life's ideals. New York: Norton.

Janis, I. L., & Mann, L. (1977). Decision making: A psychological analysis of conflict, choice, and commitment. New York: Free Press.

Juntunen, C. (1996). Relationship between a feminist approach to career counseling and career self-efficacy beliefs. Journal of Employment Counseling, 33, 130-143.

Karniol, R., Gabay, R., Ochion, Y., & Harari, Y. (1998). Is gender or gender-role orientation a better predictor of empathy in adolescence. Sex Roles, 39, 45-59

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.

Lapan, R. T., Adams, A., Turner, S., & Hinkelman, J. M. (2000). Seventh graders' vocational interest and efficacy expectation patterns. Journal of Career Development, 26, 215-229.

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

Lapan, R. T., & Jingelski, J. (1992). Circumscribing vocational aspirations in junior high school. Journal of Counseling Psychology, 39, 81-90.

Lauver, P. J., & Jones, R. M. (1991). Factors associated with perceived career options in American Indian, White, and Hispanic rural high school students. Journal of Counseling Psychology, 38, 159-166.

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

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

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

Lent, R. W., Brown, S. D., & Larkin, K. C. (1984). Relation of self-efficacy expectations to academic achievement and persistence. Journal of Counseling Psychology, 31, 356-362.

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

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., 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, 292-308.

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

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

Lucas, M. (1997). Identity development, career development, and psychological separation from parents: Similarities and differences between men and women. Journal of Counseling Psychology, 44, 123-132.

Lucas, J. L., Wanberg, C. R., & Zytowski, D. G. (1997). Development of a career task self-efficacy scale. Journal of Vocational Behavior, 50, 432-459.

Luzzo, D. A. (1993). Reliability and validity testing of the career decision-making self-efficacy scale. Measurement and Evaluation in Counseling and Development, 26, 137-142.

Luzzo, D. A. (1995). The relative contributions of self-efficacy and locus of control to the prediction of career maturity. Journal of College Student Development, 36, 61-66.

Luzzo, D. A. (1996). A psychometric evaluation of the Career decision-making self-efficacy scale. Journal of Counseling and Development, 74, 276-279.

Luzzo, D. A., Hasper, P., Albert, K. A., Bibby, M. A., & Martinelli, E. A. (1999). Effects of self-efficacy enhancing interventions on the math/science self-efficacy and career interests, goals, and actions of career undecided college students. Journal of Counseling Psychology, 46, 233-243.

Luzzo, D. A., Hitchings, W. E., Retish, P., & Shoemaker, A. (1999). Evaluating differences in college students' career decision-making on the basis of disability status. Career Development Quarterly, 48, 142-156.

Luzzo, D. A., Funk, D. P., & Strang, A. (1996). Attributional retraining increases career decision-making self-efficacy. Career Development Quarterly, 44, 378-386.

Luzzo, D. A., & Ward, B. E. (1995). The relative contributions of self-efficacy and locus of control to the prediction of vocational congruence. Journal of Career Development, 21, 307-317.

Mathieu, P. S., Sowa, C. J., & Niles, S. G. (1993). Differences in career self-efficacy among women. Journal of Career Development, 19, 187-196.

Matsui, T. (1994). Mechanisms underlying sex differences in career self-efficacy expectations of university students. Journal of Vocational Behavior, 45, 177-184.

Matsui, T., Ikeda, H., & Ohnishi, R. (1989). Relations of sex-typed socializations to career self-efficacy expectations of college students. Journal of Vocational Behavior, 35, 1-16.

Matsui, T., Matsui, K., & Ohnishi, R. (1990). Mechanisms underlying math self-efficacy learning of college students. Journal of Vocational Behavior, 37, 223-238.

Matsui, T., & Onglatco, M. L. (1991). Instrumentality, expressiveness and self-efficacy in career activities among Japanese working women. Journal of Vocational Behavior, 39, 241-250.

Matsui, T., & Tsukamoto, S. I. (1991). Relation between career self-efficacy measures based on occupational titles and Holland codes and model environments: A methodological contribution. Journal of Vocational Behavior, 38, 78-91.

Matzeder, M. E., & Krieshok, T. S. (1995). Career self-efficacy and the prediction of work and home role salience. Journal of Career Assessment, 3, 331-340.

Maxwell, J. A. (1992). Understanding and validity in qualitative research. Harvard Educational Review, 62, 279-297.

Meece, J. L., & Courtney, D. P. (1992). Gender differences in students' perceptions: Consequences for achievement-related choices. In D. H. Schunk & J. L. Meece (Eds.), Student perceptions in the classroom (pp. 209-228). Hillsdale, New Jersey: Lawrence Erlbaum.

Merriam, S. B. (1988). Case study research in education: A qualitative approach. San Francisco: Jossey-Bass.

Merriam, S. B. (1998). Qualitative research and case study applications in education (2nd ed.). San Francisco: Jossey-Bass.

Miles, M. B., & Huberman, A. M. (1994). Qualitative data analysis (2nd ed.). Beverly Hills, CA: Sage.

Morrow, S. L., Gore, P. A., & Campbell, B. W. (1996). The application of a sociocognitive framework to the career development of lesbian and women and gay men. Journal of Vocational Behavior, 48, 136-148.

Multon, K. D., Heppner, M. J., & Lapan, R. T. (1995). An empirical derivation of career decision subtypes in a high school sample. Journal of Vocational Behavior, 47, 76-92.

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

Nauta, M. M., Epperson, D. L., & Kahn, J. H. (1998). A multiple-groups analysis of predictors of higher level career aspirations among women in mathematics, science, and engineering majors. Journal of Counseling Psychology, 45, 483-496.

Nevill, D. D., & Schlecker, D. I. (1988). The relation of self-efficacy and assertiveness to willingness to engage in traditional nontraditional career activities. Psychology of Women Quarterly, 12, 91-98.

Niles, S. G., Erford, B. T., Hunt, B., & Watts, R. H. (1997). Decision-Making styles and career development of college students. Journal of College Student Development, 38, 479-488.

Niles, S. G., & Sowa, C. J. (1992). Mapping the nomological network of career self-efficacy. Career Development Quarterly, 41, 13-21.

O'Brien, V., Martinez-Pons, M., & Kopala, M. (1999). Mathematics self-efficacy, ethnic identity, gender, and career interests related to mathematics and science. Journal of Educational Research, 92, 231-235.

Osipow, S. H., & Gati, I. (1998). Construct and concurrent validity of the career decision-making difficulties questionnaire. Journal of Career Assessment, 6, 347-364.

Osipow, S. H., & Temple, R. D.(1996). Development and use of the task-specific occupational self-efficacy scale. Journal of Career Assessment, 4, 445-456.

Osipow, S. H., Temple, R. D., & Rooney, R. A. (1993). The short form of the Task-Specific Occupational Self-Efficacy Scale. Journal of Career Assessment, 1, 13-20.

Pajares, F. (1996). Self-efficacy beliefs in academic settings. Review of Educational Research, 66, 543-578.

Pajares, F. (1997). Current directions in self-efficacy research. In M. Maehr & P. R. Pintrich (Eds.), Advances in motivation and achievement. (Volume 10, pp.1-49). Greenwich, CT: JAI Press.

Pajares, F., & Valiante, G. (in press). Gender differences in writing motivation and achievement of middle school students: A function of gender orientation? Contemporary Educational Psychology.

Parsons, E., & Betz, N. E. (1998). Test-retest reliability and validity studies of the Skills Confidence Inventory. Journal of Career Assessment, 6, 1-12.

Patton, M. Q. (1980). Qualitative evaluation methods. Newbury Park, CA: Sage.

Patton, M. Q. (1990). Qualitative evaluation and research methods. Newbury Park, CA: Sage.

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

Post-Kammer, P., & Smith, P. L. (1985). Sex differences in career self-efficacy, consideration, and interest of eighth and ninth graders. Journal of Counseling Psychology, 32, 551-559.

Post-Kammer, P., & Smith, P. L. (1986). Sex differences in math and science career self-efficacy among disadvantaged students. Journal of Vocational Behavior, 29, 89-101.

Read, B. K. (1994). Motivation factors in technological college women's selection of nontraditional careers. Journal of Career Development, 20, 239-258.

Reekie, F. A. (1995). Strategic action plan with clients who have learning disabilities. Journal of Employment and Counseling, 32, 164-180.

Richie, B. S., Fassinger, R. E., Prosser, J., & Robinson, S. (1997). Persistence, connection, and passion: A qualitative study of the career development of highly achieving African American-Black and White women. Journal of Counseling Psychology, 44, 133-148.

Robbins, S. B. (1985). Validity estimates for the Career Decision-Making Self-Efficacy Scale. Measurement and Evaluation in Counseling and Development, 18, 64-71.

Rooney, R. A., & Osipow, S. H. (1992). Task-Specific Occupational Self-Efficacy Scale: The development and validation of a prototype. Journal of Vocational Behavior, 40, 14-32.

Schaefers, K. G., Epperson, D. L., & Nauta, M. M. (1997). Women's career development: Can theoretically derived variables predict persistence in engineering majors? Journal of Counseling Psychology, 44, 173-183.

Scheye, P. A., & Gilroy, F. D. (1994). College women's career self-efficacy and educational environments. Career Development Quarterly, 42, 244-251.

Schunk, D. H. (1984). Enhancing self-efficacy and achievement through rewards and goals: Motivational and informational effects. Journal of Educational Research, 78, 29-34.

Schunk, D. H. (1995). Self-efficacy and education and instruction. In J. E. Maddux (Ed.), Self-efficacy, adaptation, and adjustment: Theory, research, and application (pp. 281-303). New York: Plenum Press.

Schunk, D. H. (1991). Self-efficacy and academic motivation. Educational Psychologist, 26, 207-231.

Schunk, D. H., & Pajares, F. (in press). Gender and ethnic differences in self-efficacy. In A. Wigfield, & J. Eccles (Eds.), Development of achievement motivation. San Diego: Academic Press.

Schunk, D. H., & Swartz, C. W. (1993). Goals and progress feedback: Effects on self-efficacy and writing achievement. Contemporary Educational Psychology, 18, 337-354.

Sells, L. W. (1980). The mathematical filter and the education of women and minorities. In L. H. Fox, L. Brodey, & D. Tobin (Eds.), Women and the mathematical mystique (pp. 65-75). Baltimore: Johns Hopkins University.

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

Solberg, V. S., Good, G. E., & Fisher, A. R. (1995). Career decision-making and career search activities: Relative effects of career search self-efficacy and human agency. Journal of Counseling Psychology, 42, 448-455.

Solberg, V. S., Good, G. E., & Nord, D. (1994). Career search self-efficacy: Ripe for applications and intervention programming. Journal of Career Development, 21, 63-72.

Speight, J. D., Rosethal, K. S., Jones, B. J., & Gastenveld, P. M. (1995). Medcamp's effect on junior high school students' medical career self-efficacy. Career Development Quarterly, 43, 285-295.

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

Stickel, S. A., & Bonnett, R. A. (1991). Gender differences in career self-efficacy: Combining a career with home and family. Journal of College Student Development, 32, 297-301.

Sullivan, K. R., & Mahalik, J. R. (2000). Increasing career self-efficacy for women: Evaluating a group intervention. Journal of Counseling and Development, 78, 54-62.

Swanson, J. L., & Woitke, M. B. (1997). Theory into practice in career assessment for women: Assessment and interventions regarding perceived barriers. Journal of Career Assessment, 5, 443-462.

Taylor, K. M., & Betz, N. E. (1983). Applications of self-efficacy theory to the understanding and treatment of career indecision. Journal of Vocational Behavior, 22, 63-81.

Taylor, K. M., & Popma, J. (1990). An examination of the relationship among career decision-making self-efficacy, career salience, locus of control, and vocational indecision. Journal of Vocational Behavior, 37, 17-31.

Temple, R. D., & Osipow, S. H. (1994). The relationship between task-specific self-efficacy egalitarianism and career indecision for females. Journal of Career Assessment, 2, 82-90.

Tschannen-Moran, M., Hoy, A.W., & Hoy, W. K. (1998). Teacher efficacy: Its meaning and measure. Review of Educational Research, 68, 202-248.

Vondracek, F. W., & Skorikov, V. B. (1997). Leisure, school, and work activity preferences and their role in vocational identity development. Career Development Quarterly, 45, 322-331.

Wheeler, K. (1983). Comparisons of self-efficacy and expectancy models of occupational preferences for college males and females. Journal of Occupational Psychology, 56, 73-78.

Williams, T. W., & Betz, N. E. (1994). The relationship among occupational and task-specific measures of career self-efficacy. Journal of Career Assessment, 4, 341-351.

Woolfolk, A. E., Rosoff, B., & Hoy, W. K. (1990). Teachers sense of efficacy and their beliefs about managing students. Teaching and Teacher Education, 6, 137-148.

Yin, R. K. (1994). Case study research: Design and methods (2nd ed.). Newbury Park, CA: Sage.

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

APPENDIX A
BACKGROUND OF PARTICIPANTS

Name	Age	Educational Background	Occupation
Abe	61	BS Chemistry MS Chemistry Ph.D. Chemistry	Semi-retired Chemistry Professor, Dean of Sciences
Chris	24	BS Physics Minor in Mathematics	Software Designer and Programmer
Gary	38	BA Mathematics	Computer Consultant
Gene	38	BS Biochemistry Ph.D. Organic chemistry	Natural Products Synthetic Chemistry Professor
Jake	34	BS Computer Science	Software Designer
Jeff	32	BS Industrial Engineering BS Electrical Engineering	Applications Engineer
Jim	38	BS Physics Ph.D. Physics	Physics Professor
Matt	48	BS Chemistry Ph.D. Biochemistry	Chemistry Professor
Steve	48	BS Mathematics MS Mathematics Ph.D. Mathematics	Mathematics and Computer Science Professor
William	64	BS Physics Ph.D. Physics	Physics Professor

APPENDIX B
INTERVIEW PROTOCOL

Background information—Age, Schools Attended, Family, Previous occupations and how many years at current occupation?

Could you please describe your current occupation?

What experiences contributed to your decision to pursue your occupation?

How were you influenced by others?

What did people say to you as you were pursuing mathematics (science or technology)? (Family/Teachers/Peers/ and Culture) What sort of sociocultural messages did you get?

How would you describe your feelings and beliefs about mathematics (science or technology) as you were pursuing it?

How did pursuing mathematics (science, technology) make you feel?

What are your beliefs about what you do, or the area for which you were preparing yourself to have a career?

What are your emotional responses about your area of interest?

Tell me one memorable story that would really help me understand how you came to do what you do.

Why do you think that so few women pursue mathematical-related careers?

What could be or should be done to alter that?

Considering your academic and career history, if you could have done anything differently, what would that be?

APPENDIX C
INTERVIEW PROTOCOL CONTENT MATRIX

	Past	Present	Future
Behavior/Experience	Questions 2-7	Question 2	
Opinion/Value	Questions 2-9	Question 8	Question 8
Feeling	Question 6	Question 8	
Knowledge	Question 1	Questions 2&8	
Sensory	Questions 6&7	Question 6	
Demographic/Background	Question 1	Questions 1&2	

Adopted from Patton (1990), Matrix of Question Options.

APPENDIX D
LIST OF CODES

Question 1	DEM	Demographic Information
	SCH	Schools Attended
	CAR-PST	Past Occupations
	FAM-CAR	Family's Occupations
Question 2	CAR-PRE	Participants Current Occupation
Question 3	PST-PERF	Participant's Mastery Experiences/ Past Performances
Question 4	VIC	Vicarious Experiences, Influenced by others
	VIC-PAR	Influence by Parent/s
	VIC-PEER	Influence by Peer group or Friend/s
	VIC-TEACH	Influence by Teachers
	VIC-SIB	Influence by Siblings
Question 5	VERB-FAM	Verbal Persuasions by Family Members
	VERB-TEACH	Verbal Persuasions by Teachers
	VERB-PEER	Verbal Persuasions by Peer Group or Friends
	VERB-SOC	Verbal Persuasions from Socio-cultural sources
Question 6	BE-CONT	Beliefs about the Content area of their field
	PI	Physical Indexes
Question 7	MEM-EP	A Memorable Incident/Episode
Question 8	BE-WOM	Beliefs about Women in Math-related areas
	BE-STRAT	Beliefs about interventions/Strategies for change
Question 9	CHA	What the participant would have done differently/Change