SELF-EFFICACY BELIEFS, STEREOTYPE THREAT, AND THE LEARNING ENVIRONMENT AS INFLUENCES IN THE DECISION TO LEAVE A STEM MAJOR

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By
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CERTIFICATION OF APPROVAL

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Dr. Dawn Poole Professor of Education	Date
Dr. Anysia Mayer Associate Professor of Education	Date
Dr. Harold Stanislaw Professor of Psychology	Date

DEDICATION

To all of the DREAMers striving toward a better future through higher education. “You may say I’m a dreamer, but I’m not the only one…” (Lennon, 1971)

ACKNOWLEDGEMENTS

If I have seen further, it is by standing on [the] shoulders of giants.

-Sir Isaac Newton (1675)

Any academic work of substance rests not only on the work of others who came before, but requires the help and support of many others in the present to be completed. Such is the case here. Although this work bears my name as author, I am not the sole producer of it. Several individuals were instrumental in completing this project and I would like to express my gratitude for their help.

First and foremost is Dr. Dawn Poole, my dissertation chair. There is no doubt that without Dr. Poole's guidance in breaking the project down into manageable steps, it would not have been completed in a timely manner. I am deeply grateful for her help in getting this over the finish line by the deadline. Her patience and calm demeanor were welcome approaches whenever the project seemed overwhelming. During those times, she always had wise, practical suggestions for traversing any blocks in the road without losing sight of the path.

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ABSTRACT

The present mixed methods study looked at self-efficacy beliefs, stereotype threat, and the learning environment as influences in a student's decision to switch from a STEM major to a non-STEM major. The study was conducted in two phases, a quantitative phase followed by a qualitative phase. In the quantitative phase, STEM students (N = 195) at a 4-year university in the Central Valley of California were surveyed using the Self-Efficacy Scale, the Social Attitudes and Identities Scale, and the College Campus Environment Scale. The qualitative phase consisted of semi-structured interviews with male (n = 2) and female (n = 2) Hispanic students. Self-efficacy beliefs and the learning environment were not significant influences in decisions to switch from a STEM major. Stereotype threat was a significant influence in students' decision to change from a STEM major. However, students who switched reported less susceptibility to stereotype threat. Female students were more likely to switch from a STEM major than male students and Hispanic students were more likely to switch from a STEM major than White students. Understanding factors influencing a student's decision to switch from a STEM major could inform the design of better programs and strategies to increase the number of students attaining STEM degrees.

CHAPTER I

INTRODUCTION TO THE STUDY

In the United States, widespread national public interest in science and engineering was spawned by the Russian launch of the first space satellite Sputnik on October 4, 1957. In response, on July 29, 1958, the U.S. government signed the National Aeronautics and Space Act into law and by October of 1958 the National Aeronautics and Space Administration (NASA) had been established (Dick, 2008). Two of the eight objectives that NASA was originally charged with addressed the "preservation of the role of the United States as a leader in aeronautical and space science and technology…" and the "most effective utilization of the scientific and engineering resources of the United States…" (NASA Space Act, 2008, p. 5). Although the National Science Foundation had been created eight years earlier under President Truman (National Science Foundation, n.d.), the world-wide attention garnered by the launch of Sputnik during the Cold-War era provoked the United States to provide additional resources for educating students that could move the United States forward in what was now conceived as the space race. As a result, in 1958 under President Eisenhower, the U.S. government also established the National Defense Education Act (NDEA) to provide $1 billion in federal funding for higher education in the areas of science, mathematics, and foreign languages through low-cost student loans. The program was highly successful early on, with the number of college students growing from 3.6 million in 1960 to 7.5 million in 1970 (Jolly, 2009; U.S. Senate, n.d.).

In 1983, under President Reagan, the National Commission on Excellence in Education published its report on the state of U.S. education. The report, *A Nation at Risk: The Imperative for Educational Reform*, raised the alarm that the "average achievement of high school students on most standardized tests is now lower than 26 years ago when Sputnik was launched" (U.S. Department of Education, 1983, p. 11). The report also noted that the U.S. position in the world was no longer secure in its competition for international standing and global markets, reigniting Cold-War era fears that the United States was losing its position as a world leader, particularly in education. It was noted in the report that the new generation of Americans was scientifically and technologically illiterate in a world that was becoming increasingly sophisticated in these areas. Although the report resulted in increased public awareness of the state of education in the United States, government support of educational programs in the sciences and technology declined over the next few decades.

The Academic Competitiveness Council (ACC), established by the Deficit Reduction Act of 2005, is charged with reviewing federal educational programs focused on science, technology, engineering, and mathematics (STEM). In a 2007 report, the ACC found that in 2006 federal funding for STEM supported 105 programs that included 24 K-12 programs, 43 undergraduate programs, 27 graduate and post-graduate programs, as well as 11 informal education and outreach programs available at institutions or agencies such as the Smithsonian Institute and the Department of Defense. Federal funding for all STEM programs combined in 2006 was $3.12 billion, less than half of 1958 levels of NDEA funding when adjusted for inflation (Jolly, 2009). Of the $3.12 billion, 77% or $2.4 billion went to fund graduate or post-graduate work in STEM (U.S. Department of Education, 2007).

Academic achievement in science is also in decline among U.S. students. In a 2008 report to Congress, Kuenzi noted that only 18% of twelfth grade students were proficient in science in 2005 compared to 21% in 1996. In 2002, STEM degrees comprised only 16.8% of all the *first university degrees* (degrees that nominally take less than 5 years to complete) awarded in the United States, below the international average of 26.4% and just topping Brazil, the lowest producer at 15.5%. China and Japan were the top producers at 52.1% and 64.0%, respectively. However, in absolute numbers, the United States falls third (n = 219,175) to China (n = 484,704) and Japan (n = 351,299) for total STEM degrees awarded in 2002 (Kuenzi, 2008). A review of longitudinal data looking at trends in the STEM pipeline found that of all high school graduates, those who were the most prepared for STEM majors enrolled in STEM majors or completed a STEM major at a steady rate from 1972 to 1992, reaching a pinnacle of 28.7% for the 1992-1997 cohort, but then dropped off considerably to only 13.8% by the 2000-2005 cohort (Lowell, Salzman, Bernstein, & Henderson, 2009).

In 2009, President Obama rolled out his *Educate to Innovate* campaign to improve educational outcomes in the United States, particularly in the STEM fields.

The campaign proposed, over the next decade, to develop the educational resources necessary for students to acquire skills needed to succeed in STEM fields in order to ensure the United States has enough well-qualified individuals to remain competitive in the global economy, maintain national security, and drive innovation for future enterprise (Office of the Press Secretary, 2009). In response to the continued mediocre performance of U.S. students on international assessments (PISA, 2012), along with the current and projected shortage of qualified candidates to fill STEM positions (President's Council of Advisors on Science and Technology, 2012; Xue & Larson, 2015), President Obama's educational campaign aspired to roll out a set of initiatives aimed to increase federal investment, garner support from the private sector, increase the base of excellent teachers fluent in STEM subjects, and encourage a more diverse talent pool with a focus on underrepresented groups, including girls and women (Office of the Press Secretary, 2009).

In a 2016 report on science and engineering indicators, the National Science Foundation noted that although women generally outnumber men in undergraduate education, in 2013 men earned the majority of degrees conferred in physics (81%), engineering (81%), and the computer sciences (82%). Compared with the year 2000, the number of women attaining 2013 baccalaureate degrees in computer sciences dropped by 10% and by 5% in mathematics and statistics. Physics and engineering baccalaureate degrees awarded to women also dropped by 3% and 1%, respectively, from 2000 to 2013.

Caucasian students continue to achieve STEM educational outcomes in greater numbers than other ethnicities, even though the number of bachelor's degrees awarded to Caucasian students declined from 71% in 2000 to 62% in 2013. Between 2000 and 2013, the number of Hispanic students earning a STEM bachelor's degree increased from 7% to 11%. During the period between 2000 and 2011, Asian and Pacific Islanders earning bachelor's degrees in STEM majors increased from 9% to 10%, but dropped back to 9% by 2013. The number of African American and Native American or Alaska Native students earning bachelor's degrees in STEM was unchanged from 2000 to 2013, remaining at 9% and 1%, respectively.

Statement of the Problem

The aims of President Obama's educational campaign were optimistic in tone and broad in scope. However, the magnitude of the tasks the campaign outlines requires implementation strategies that can be applied effectively across a nation with a wide variety of social and cultural dimensions. Attracting a more diverse talent pool necessitates understanding the goals, motivations, and resources of those who would be receptive to pursuing a STEM career, but may not consider it a viable option. Different geographical areas may produce a set of factors that are unique to student populations in those areas. In this case, taking a one-size-fits-all approach may not be conducive to teasing out the critical factors that hinder underserved populations from taking on and completing a STEM major. Instead, it may be more productive to investigate whether different geographical areas exhibit unique factors affecting the decisions to declare and complete a STEM major.

As a geographical region, the Central Valley of California, stretching over 450 miles, is one of the largest agricultural producers in the world. As such, farmworkers make up a large proportion of the labor force in the more rural areas of the valley. Farmworkers in the valley are predominately Hispanic or Latino (92%), most of whom have less than a high school education (78%), and live in poverty (Rogers & Buttice, 2013). Consequently, many college students in the Central Valley are the first generation in their families to attend college, often with limited resources. In sharp contrast, Silicon Valley lies just to the west, at the intersection of the Central Valley and the San Francisco Bay area. In 2013, the Silicon Valley employed over 340,000 individuals in services or products related to innovation and information technology (Silicon Valley Index, 2013). A hub of technology and engineering, it is the home of many of the leaders in technological innovation, including Apple, Google, Facebook, Hewlett Packard, Lockheed, and Intel. The juxtaposition of the two valleys—one with an ethnically diverse underrepresented population and the other with access to STEM jobs—offers a prime setting for developing STEM talent in alignment with *Educate to Innovate* objectives.

In concert with the *Educate to Innovate* initiatives, educational institutions have been challenged to produce better outcomes with their resources. In 2011, Vice President Biden called for colleges to increase their graduation rates (U.S. Department of Education, 2011). Additionally, as U.S. students fall behind the achievements of international students, the national drive to remain competitive in producing a workforce that can lead the United States competently into an increasingly technologically advanced and complex future adds further pressure. Producing better outcomes with increasingly limited resources has led to an emphasis placed on students for timely degree completion. This often translates into students making hasty, ill-considered choices of a major. In the case of challenging STEM majors, such choices may be counterproductive. Ultimately, 40% of students entering college with a declared STEM major fail to persist to STEM degree completion (President's Council of Advisors on Science and Technology, 2012).

For various reasons, students often change majors after starting to pursue a college degree. This may be detrimental to the student's achievement of his or her educational goals (degree completion). The most salient consequence is coming up against financial aid limits before the student is able to complete all of the degree requirements to attain his or her degree. In most cases, the student may take on significant student debt without attaining a degree and consequently experience reduced employment prospects to resolve that debt. A less obvious impact involves the initial filling of spots in the major with a student who will not complete the program, potentially displacing a student who may be more likely to complete the degree. An even more remote impact is that the college rates of completion will be negatively impacted.

A survey conducted by Woosley and Jackson (2002) found that most students changed their major because the career options in the new major were more appealing, the courses were more interesting, there were more opportunities for jobs in the new field, or the faculty in the new major seemed more interested in the students. When asked about their previous major, students reported that they left because they did not like the potential jobs in the fields or that the coursework was not interesting. The majority of the students (64%) who changed majors did so after taking only one or two courses in the previous major. There is little research looking at factors leading to the decision by women and students of color to switch from a STEM major at a Hispanic Serving Institution (HSI) in the Central Valley of California. The purpose of this study was to determine how factors related to a student's self-efficacy, the learning environment, and stereotyping impacted the decision of diverse students at an HSI in California to change from a STEM major to a non-STEM major.

Research Questions and Hypotheses

The present research was guided by the following research question: How do self-efficacy beliefs, stereotype threat, and the learning environment influence the decisions of women and students of color to change from a STEM major to a non-STEM major? For the purposes of this research, switching from one STEM major to a different STEM major was not considered a notable change.

H_1: Students who change from a STEM major to a non-STEM major will perform differently on measures of self-efficacy, stereotyping, and satisfaction with the learning environment than those students who do not change from a STEM major to a non-STEM major.

H_2: Female students starting in a STEM major will be more likely to change to a non-STEM major than male students starting in a STEM major.

H_3: Students of color starting in a STEM major will be more likely to change to a non-STEM major than White students starting in a STEM major.

H_4: Self-efficacy, stereotyping, and the learning environment will contribute to decisions to change majors from the STEM majors.

Significance of the Study

If specific factors can be dependably identified, strategic early interventions may be implemented to slow or stop the attrition of talented diverse individuals from STEM professions. Ideally, interventions may be implemented that increase the diversity of students attaining STEM degrees. At the very least, interventions may be developed to mitigate the negative impact of changing majors on degree completion. Fostering a diverse pool of individuals who work in STEM fields is critical if the United States is to remain a world leader and innovator in science and technology. The U.S. population is becoming increasingly heterogeneous and the majority of the global population is not White and male.

Having a diverse body of STEM professionals has a number of advantages. Diverse individuals bring distinctly different perspectives and issues that may not be salient or of concern to White male STEM professionals. Individuals of diversity can offer mentorship to others who share similar characteristics and serve as inspiration for future diverse generations to believe that they can make important contributions to an increasingly global economy. Learning to work cooperatively with many different individuals is a necessity in today's collaborative work environment. Providing learning opportunities that include many different individuals enhances the future

STEM professional's ability to establish cooperative collaborations with others in the field. Additionally, diversity brings a richness of experience that allows for greater creativity, productivity, and success—all necessary ingredients for the innovation needed to carry the United States into a successful future as a global leader.

Theoretical Framework

In the 1950s, Erikson (1950, 1959, 1968) first proposed his eight stages of psychosocial development, which has since become a widely accepted model of human development. As a psychoanalyst, Erikson expanded on Freud's theory of early psychosexual development to include development across the entire human lifespan, as well as emphasizing the psychological, social, and cultural influences that impact the resolution of identity crisis for each stage of development. With an increased focus on lifetime development within the context of one's social and cultural influences, Erikson helped pave the way for humanism, which focused on the development of positive human potential, as a psychological approach that offered an alternative to behaviorism.

In education, three of Erikson's stages, as they are currently conceived, are of particular importance with regard to choice of major. Stage 4, *school age*, is comprised of individuals between 5 years to 12 years who must resolve either being industrious and competent or inferior in their abilities. Stage 5 occurs during the adolescent years between 12 and 18 when the individual either strengthens his or her ego identity or remains confused about his or her role in society. Stage 6, *young adulthood*, involves the much longer age span between 18 years to 40 years in which individuals either develop the ability to be intimate with others or—according to Erikson—fail to develop healthy social relationships, which results in isolation and loneliness. Arnett (2000) proposed an additional stage of human development, *emerging adulthood*, identified as the period between 18 years and 25 years and unique to industrialized cultures.

Arnett (2000) proposed that significant shifts in social roles and expectations have arisen as a result of industrialization, with marriage and family roles often being delayed subsequent to the social conveniences afforded by the modern lifestyle. The conveniences that come with greater economic development offer a degree of affluence that allows for less social pressure to quickly enter adulthood and consequently more flexibility in role exploration. It is important to note that the emerging adulthood stage is a social and cultural construct, not necessarily a universal one. It is not consistently found in non-industrialized countries. Alternatively, social class within postindustrial societies may also be an important distinction—with only middle and upper classes having this luxury, whereas those of lower socioeconomic status may have to take on familial and work responsibilities earlier, thereby missing out on critical opportunities to explore options that may move them up the socioeconomic ladder.

According to Arnett (2004), emerging adulthood may be characterized by five distinct features: (a) identity exploration, (b) instability, (c) self-focus, (d) feeling in-between, and (e) possibility. As emerging adults, individuals are often engaged in active exploration of potential serious love interests, possible future careers, and alternative worldviews. Inherently, this transition from adolescence to adulthood is marked by instability, not only due to separating from one's childhood circumstances (home, family), but also results from the process of trying out new things. Consequently, intense self-focus is the result as the individual does the work of sorting out his or her future options; as is the feeling of being in-between—no longer a child/adolescent, but not yet a full-fledged adult. In spite of this uncertainty, emerging adults can look forward to this as a time full of possibility and hope for a positive, productive future.

Arnett (1997) also found that internal characteristics most prominently identified by young people as significant markers of adulthood included *accepting responsibility for one's self* and *making independent decisions,* rather than external circumstances such as marriage, children, or a career—although being financially responsible was another, less prominently identified characteristic of adulthood. Therefore, from the perspective of an emerging adult, the work of moving into adulthood requires exploring possibilities, learning to accept responsibilities, and fostering an identity that allows one to confidently engage in autonomous decision-making.

Self-efficacy was initially conceptualized as an important informative psychological construct by the psychologist Albert Bandura in 1962 as part of his theory of social learning, although the set of behaviors he identified had been a part of successful human learning long before. By the 1990s, Bandura's research had greatly expanded an understanding of the self-efficacy concept and it became a cornerstone for his Social Cognitive Theory, which is widely accepted today. For Bandura, self-efficacy is the central mechanism driving the exercise of individual or personal agency. He stated that, “Self-efficacy beliefs function as an important set of proximal determinants of human motivation, affect, and action” (Bandura, 1989, p. 1175). These beliefs are critical to the attainment of personal goals, such as the successful pursuit of higher education. In the subsequent years, much research has been done to examine the role of self-efficacy in academic settings. Of particular interest for the present study is the role this type of confidence plays in fostering academic persistence at the college level, particularly for students who may not persist to degree completion as a result of their beliefs that they cannot be successful in doing so.

Self-efficacy is one of the three cognitive variables in Social Cognitive Career Theory (SCCT) as proposed by Lent, Brown, and Hackett (1994). In addition to self-efficacy, outcome expectations and goal mechanisms are critical for forming career interests, selecting academic and career choices, as well as persistence in pursuing one’s educational and occupational goals. Using Bandura’s Social Cognitive Theory as a base, SCCT looks at how contextual factors such as gender, social connection, culture, and unexpected life events interact dynamically to influence an individual’s career choices. In SCCT, career choice results from an individual’s beliefs about his or her ability in certain endeavors and the degree of success attained in pursuing those endeavors. Success in a particular area leads to greater self-efficacy and increased expectations for positive outcomes, which then leads to greater interest in pursuing goals in those areas. Lent et al. suggested that this is a lifelong process that begins in early childhood and continues into adulthood. The narrowing of one's focus in adulthood to a specific career choice results from beliefs, mitigated by contextual factors, about the probability of success in the chosen career. Intervening learning experiences continue to shape one's self-efficacy and outcome expectancies, and vocational interests. If the individual perceives potential barriers to success as few, then he or she will continue to pursue the chosen career goals. If perceived potential barriers loom large, then the motivation to continue to work toward the goal wanes.

Definitions

Full-time attendance is carrying a course load of 12 or more semester units.

Hispanic Serving Institution is an institution of higher education that has an enrollment of undergraduate full-time equivalent students that is comprised of at least 25 percent Hispanic students at the end of the award year immediately preceding the date of application with at least 50 percent of students receiving Title IV need-based financial assistance (U.S. Department of Education, 2011).

STEM majors are majors in the areas of: (a) biological and biomedical sciences, (b) computer and information sciences, (c) engineering and engineering technologies, (d) mathematics and statistics, and (e) physical sciences and science technologies, as defined by Kuenzi (2008).

Students of color are students whose ethnicity is not White or Caucasian.

Persisters are students who graduate or continue toward a degree in a declared STEM major after the first year of full time attendance at college.

Switchers are students who change their intended STEM major after the first year of full time attendance at college.

Summary

There is a national focus on increasing the number of qualified individuals to work in STEM fields. Colleges and universities have been charged with improving the graduation rates of STEM majors; however, less than half of students who declare a STEM major graduate with a STEM degree. Identifying the factors that contribute to a student's decision to switch from a STEM major to a non-STEM major may provide a better understanding of systemic and personal supports needed to help students persist in completing a STEM degree.

CHAPTER II

REVIEW OF THE LITERATURE

In what has become a landmark ethnographic study, Seymour and Hewitt (1997) looked at patterns of persistence in undergraduates initially pursuing a degree in a science, engineering, or mathematics (SEM) field ($N = 335$). Over a 3-year period from 1990 to 1993, they conducted surveys, interviews, and focus groups at seven 4-year institutions of higher education across the United States (U. S.). Of the seven institutions, three were private colleges or universities (all located in the west) and four were public universities (one in the Northeast, one in the Midwest, and two in Western states). All of the institutions were chosen for their focus on granting undergraduate SEM degrees. Additionally, they conducted follow-up focus groups with another set of students ($N = 125$) at six different universities to confirm the validity of their original findings. The purpose of the original study by Seymour and Hewitt was to determine the relative importance of the most salient factors, as expressed by SEM students, that led undergraduate SEM majors to switch into non-SEM majors.

Factors identified by the undergraduates were categorized by Seymour and Hewitt (1997) into five major areas of concern: (a) the choice of and preparation for the SEM major, (b) the learning experience within SEM majors, (c) time and money aspects, which included the consideration of SEM careers post-graduation and the lifestyle required while pursuing an SEM degree and after attaining one, (d) the different experiences of women and men in pursuing an SEM degree, and (e) the impact of race and ethnicity on pursuing an SEM degree. The Seymour and Hewitt study is decades old—26 years since the onset of the study and 23 years since its conclusion. One immediate concern is the relevance of the findings in today's educational context. Educators have had over 20 years to address the implications of the issues brought up by Seymour and Hewitt, yet many of the issues still persist. A detailed discussion of the original issues, along with current research findings, follows, beginning with the choice of and preparation for a major in what is now a field in science, technology, engineering, or mathematics (STEM), followed by the learning experience as it relates to STEM majors, gender differences in pursuing a STEM major, and finally the impact of race and ethnicity issues on persistence in a STEM major.

Choice and Preparation

Choosing a major in college may be one of the most important decisions a student will make as an undergraduate. Seymour and Hewitt (1997) found that there were specific reasons behind the choice to pursue a SEM major that might predispose a student to switch from a SEM major to a non-SEM major. For switchers, the decision to major in SEM was often driven by the influence of others (teachers or family members), altruistic desires (wanting to better the world), or being uninformed or misinformed about SEM majors, either through the belief that the SEM major was a logical extension of high school performance or a poor understanding of what the major entailed. Although these were issues that were also identified by persisters, the significant difference was that persisters experienced these issues within the context of an intrinsic interest in the chosen field, whereas switchers did not.

Without that intrinsic interest, switchers reported not having the wherewithal to continue in the initial SEM major when faced with challenges inherent in a difficult course of study. In a large-scale study (*N* = 7,970) of experiential factors that facilitate attainment of a STEM degree, Maltese, Melki, and Wiebke (2014) found that, at the college level, the most significant factor for persistence in a STEM major was an interest or passion for the chosen field. They surveyed faculty and students (*n* = 5,648) from a diverse sample of 2- and 4-year colleges and universities across the U.S. based on National Center for Educational Statistics data on degree completion. The resulting sample was stratified by census region, primary degree-granting status and whether institutional control was public or private. The schools were then ranked on STEM degree production, with a minimum requirement of 100 STEM degrees awarded in the years between 2008 and 2010. Schools were randomly selected for participation from the top and bottom ranks. Additionally, the authors surveyed STEM professionals (*n* = 2,322) who were no longer in the academic arena through a survey web-link placed on the main page of the *Scientific American* website for a two week period.

Maltese et al. (2014) compared the formative STEM experiences of STEM individuals and non-STEM individuals in the areas of influential individuals, type of precipitating events, and initial onset of interest across a developmental span that ranged from pre-kindergarten to post-college. Individuals were considered STEM

(46%) if they were in a STEM major as an undergraduate or graduate, had earned an undergraduate or graduate STEM degree, or were employed in a STEM field. All others were considered non-STEM (54%). In terms of diversity, 72% of the individuals in the sample were U. S. born, 62% were students, 51% were female, 77% were White, 8% were Asian, 7% were Hispanic, 4% were multiracial, and 3% were Black. Of the students, 63% were in bachelor's programs, 34% were in graduate programs, and 3% were in associate's or certificate programs.

In terms of influential factors, Maltese et al. (2014) noted that STEM individuals were more likely than non-STEM individuals to report innate interests as most influential, followed by parents or guardians, and teachers as the least likely influence. In the area of precipitating events or experiences, intrinsic and extrinsic factors separated STEM from non-STEM individuals. STEM individuals reported building or tinkering and innate interest as sources of inspiration, whereas non-STEM individuals reported events that depended on other individuals, such as class activities or field trips. Although becoming interested in STEM subjects prior to sixth grade seemed to be important in pursuing STEM careers, there were no significant differences between STEM individuals and non-STEM individuals in terms of the timing of initial interest in STEM. In terms of persistence, 43% of the non-STEM individuals had originally intended to pursue a STEM major, but chose a non-STEM major instead. As mentioned earlier, STEM individuals were significantly less likely to change majors than non-STEM individuals when the primary reason for selecting the major was based on personal interest in the field.

Another large-scale longitudinal study by Tracey and Robbins (2006) looked at the strength and clarity of a student's interest in a field as variables that may moderate the relationship between the congruence of a student's interest with his or her chosen major on GPA and persistence. Tracey and Robbins followed a diverse body of students (N = 80,574) over five years at 87 four-year colleges in four states, collecting data at three intervals—enrollment status after one year, two years, and five years (post-graduation). They used two-dimensional measures of Realistic, Investigative, Artistic, Social, Enterprising, and Conventional (RIASEC) scores categorized as People-Things and Data-Ideas to determine personal interest and choice of major congruence. Interest level was measured as a sum of RIASEC scores taken from the unisex edition of the ACT interest inventory. Clarity of interest was measured as vector length derived from the dimensional measures. ACT test scores and demographic data were gathered through college records. A four-stage hierarchical linear regression was used to analyze the relationships between the predictor variables of ACT score, congruence, interest level, and interest clarity and the academic outcomes of GPA and persistence to degree completion. Results indicated that the congruence measures predicted college GPA better than ACT scores across all three time points. They found that students who reported higher interest levels in their major were more likely to have a higher GPA than those who reported lower interest in the major. However, on the persistence measures, the congruence measures did not predict outcomes over ACT scores. Students with lower levels of interest were more likely to persist than those with higher levels of interest. Tracey and Robbins suggested that although GPA is related to persistence in that one must maintain an acceptable GPA to continue, other variables such as financial and social support may have more of an impact on persistence than the level of interest in a chosen major. Tracey and Robbins also found that clarity of interest was not a significant moderator of the relationship between the congruence of one's major and interest in that major with GPA or persistence. However, only students with a declared major were included in the study. Tracey and Robbins noted that they "lost many of the students" (p. 87) from an original sample of 533,204 because they were not in a declared major.

An earlier study by Tracey, Robbins, and Hofsess (2005) found that the clarity or crystallization of one's interest in a career path undergoes a period of uncertainty in the senior year of high school as a result of environmental pressures, but that clarity of interest increased as the individual matures. These findings support Arnett's (2000) proposal of the emerging adulthood stage of psychosocial development in which adolescents explore their identity. The transition to college during this developmental stage offers a setting with many opportunities to explore possibilities while engaging in pursuits that develop responsibility and critical thinking skills, ideally resulting in an individual identity that is marked by stability, confidence, and autonomy ready to move into a productive young adulthood. Although these may seem a fairly straightforward set of tasks, biology may be working against an easy developmental course for the emerging adult. Neuroscience research looking at biological correlates of behavior suggest that brain development in humans is not yet complete until at least 30 or 40 years of age (Sowell, Thompson, & Toga, 2004). Using magnetic resonance imaging (MRI) to examine adolescent brains, Giedd (2004) found that in normal human development the dorsolateral prefrontal cortex continued to show development into a person's 20s. This area is important for the abstract reasoning and cognitive flexibility necessary to strategize, prioritize, and evaluate the consequences of making a decision. As part of the frontal lobe, it is involved in the execution of higher cognitive functions such as working memory, as well as inhibiting impulses.

Decreases in grey matter—often noted in adolescence (Giedd, 2004; Sowell et al., 2004)—are normally accompanied by increases in white matter. White matter in the brain is indicative of the myelination of axons, a key factor in the speed of neuronal transmission. A study by Asato, Terwilliger, Woo, and Luna (2010) used diffusion tensor imaging to examine the brains of children, adolescents, and adults ($N = 114$). They found that increases in white matter continued well after adolescence in the corpus callosum (a large, thick bundle of nerve fibers which connects the two hemispheres of the brain) and in the areas of association between the prefrontal cortex and striatum, which are also important for top-down executive functioning. They also noted that these changes were more likely to occur earlier in females than in males, most likely due to hormonal influences. The significant restructuring of the brain that begins in adolescence and extends into early adulthood, particularly in regions correlated with higher-level cognitive functions, suggests that the emerging adulthood stage is a prime time for development of academic, social, and emotional ability.

However, it may also be a time of significant instability, particularly within the context of making decisions—such as choosing a major—that will determine the course of one's future. Maltese et al. (2014) found that 45% of individuals in their study did not discover an innate interest in STEM until *after* college.

In terms of preparation, inadequate high school preparation for a STEM major or conceptual difficulties with STEM material were not reported by participants in the Seymour and Hewitt (1997) study as major factors in the decision to change major. However, it was noted that the effects of inadequate high school preparation and difficulties with the conceptual material did have an impact on decisions to switch majors. The most commonly reported problems fell into two major areas: (a) lack of exposure to curricular content that was relevant or of sufficient depth, and (b) failure to acquire needed study skills and habits along with an attitude or work ethic that encourages persistence or resilience when faced with the increased challenges of a STEM major. The inadequacies of academic preparation are still a concern today. The most recent assessments in mathematics and reading from *The Nation's Report Card* (National Assessment of Educational Progress, 2015) found that the average mathematics score for any group of students was lower than 2013 scores, with only 33% of eighth grade students performing at or above proficiency.

In addition to the lack of academic preparation, the failure to acquire needed skills and a resilient attitude may have a critical impact on whether or not a student persists at a STEM major. Compared to easily quantifiable academic proficiency, these are often the soft skills required of students to succeed in their academic pursuits. Self-efficacy (SE) is an important component of developing and using any skill set. In an attempt to identify significant predictors of academic success, Chemers, Hu, and Garcia (2001) looked at the effects of optimism and SE on the personal adjustment and academic performance of first-year students ($N = 373$) at a 4-year California university. Students ($n = 256$) were surveyed and assessed at the beginning of their first academic year and again at the end of the same academic year. Of the students who completed both sets of assessments, 82% were female. Several self-report measures using Likert-scale responses were taken to assess the following: (a) academic SE, (b) general level of optimism, (c) challenge-threat perceptions, (d) self-perceptions of academic performance, (e) self-rating of academic performance, (f) self-perceptions of his or her academic evaluation, (g) the student's expectations for future academic performance, (h) level of stress experienced in the month prior to the assessment, (i) a survey of physical and mental health symptoms, and (j) an *adjustment* measure that looked at the student's satisfaction with his or her academic progress and intention to continue. High school grade point average (GPA) was used to control for varying degrees of academic ability prior to entering the university. Additionally, due to the overrepresentation of females in the final sample, correlational analyses were done to assess the impact of the gender variable on the outcome measures. Chemers et al. determined that gender was not a significant factor as the gender variable was weakly correlated with the other variables; therefore the sample was not divided on this variable for the final statistical analyses.

Structural equation modeling was used to test the model of predictors for academic success proposed by Chemers et al. (2001). SE was found to have a significant direct effect on whether students viewed the demands of academic work to be challenging or threatening. Those who had higher SE ratings were more likely to view such demands as challenging, but not threatening (standardized coefficient = .27, $p < .001$). Further analysis of this relationship using Pearson's correlation indicated that SE had more impact on how well the student thought he or she could cope with the demand ($r = .39$, $p < .001$) rather than the difficulty of the demand ($r = -.01$, *ns*). The direct effect of optimism on evaluations of challenge-threat situations was noted to be small, but significant (standardized coefficient = .16, $p < .001$). On the other hand, optimism may have had an indirect effect in this area as it had a moderate effect on SE that was significant (standardized coefficient = .31, $p < .001$). Overall, Chemers et al. found that students who self-rated higher in SE were more likely to persist at academic endeavors than those who were not as highly rated on SE. Additionally, optimistic students tended to be more efficacious.

Hsieh, Sullivan, and Guerra (2007) looked at the differences in SE and goal motivation in two groups of diverse college students ($N = 112$), those in good academic standing (GPA of 2.0 or above, $n = 52$) and those on academic probation (GPA below 2.0, $n = 60$). In this study, SE was defined as "students' beliefs about their capabilities to successfully complete a task" and goal orientation was defined as "students' reasons for approaching an academic task" (Hsieh et al., 2007, p. 456). One self-report measure of perceived SE was used and three different self-report measures were used to assess goal orientation in the areas of: *mastery goals, performance-approach goals,* and *performance-avoidance goals.* All responses were measured using a Likert-scale.

Pearson's correlation indicated a moderate and significant relationship between perceived SE and academic performance measured by the student's GPA ($r = .36$, $p < .001$). A hierarchical regression analysis confirmed the positive relationship between SE and GPA ($R^2 = .13$, $R^2_{adj} = .12$, $F[1, 94] = 14.15$, $p < .001$). Additional analyses done using an ANOVA to determine the effect of GPA on SE found that GPA had a significant effect on the students' perceived SE, $F(1, 99) = 17.92$, $p < .001$, $d = .85$. Cohen's *d* indicates that this is a large effect size. Students who were on academic probation had significantly lower ratings of SE than those who were in good standing academically. The results of the study by Hsieh et al. (2007) add additional evidence to the large body of research supporting SE as a strong predictor in the area of academic performance.

Using Bandura's Social Cognitive Theory as a framework, Baier (2014) looked at the impact of academic performance, SE, socioeconomic factors, employment status, participation in learning communities, and faculty mentoring relationships on the academic persistence of first-time college students during their first semester at college ($N = 319$). Baier defined SE beliefs as "the belief in one's capability to execute the courses of action required to manage prospective situations and to achieve goals" (p. 12). For her pretest posttest design, Baier used the 10-point Likert scale College Self-Efficacy Inventory in a web-based format to measure SE.

This measure was used to evaluate college SE as a predictor variable for college persistence and as a mediating variable for the relationship between high school GPA and college persistence. The dependent measure for persistence was the College Persistence Questionnaire, also assessed in a web-based format.

The results of Baier's (2014) study found that there was a significant and strong positive relationship between SE scores and a student's intent to persist at college ($r = .62$, $p = .01$) at the beginning of the first semester, as well as at the end of the first semester ($n = 172$, $r = .56$, $p = .01$). At the beginning of the semester, results from a linear multiple regression analysis using ACT scores, high school GPA, college SE, and mentorship as predictors for intent to persist ($R^2 = .46$, $F[4, 216] = 45.48$, $p < .001$) indicated that college SE ($\beta = .49$, $t = 8.67$, $p < .001$) was the most significant predictor of intent to persist at the beginning of the semester, followed by mentorship ($\beta = .30$, $t = 5.38$, $p < .001$), with ACT scores and high school GPA not contributing significantly to the model. College SE accounted for 18.9% of the variance and mentorship accounted for 7.2%, with high school GPA and ACT scores at 0.8% and 0.03%, respectively. At the end of the first semester, linear multiple regression analysis using first semester GPA, college SE, mentorship, and participation in learning communities as predictors for intent to persist ($R^2 = .41$, $F[4, 165] = 28.09$, $p < .001$) found that college SE ($\beta = .40$, $t = 5.86$, $p < .001$) and mentorship ($\beta = .35$, $t = 5.10$, $p < .05$) were significant predictors, but college GPA and participation in learning communities were not. College SE accounted for 12.4% of the variance, mentorship accounted for 9.4%, first semester college GPA accounted for 1.4%, and participation in learning communities only 0.5%. There was no significant effect of SE as a mediator for the relationship between high school GPA and intent to persist.

All of the aforementioned studies offer support for SE as an important factor in the persistence of college students to attain their educational goals. Locus of control (Rotter, 1954, 1975, 1990), the degree to which an individual believes he or she has control over events, also contributes to persistence and resilience. Dweck's 1986 study looking at adaptive versus maladaptive patterns of behavior as motivational factors in student outcomes led to her focus on a social-cognitive approach to learning motivation. As a result, she developed the idea of the fixed mindset and the growth mindset as important self-concepts related to academic and occupational success. In a fixed mindset, when faced with a poor grade on a test, a student may engage in avoidance behaviors or cheating on future tests because mistakes are seen as an inherent lack of ability. On the other hand, to a student with a growth mindset, a poor grade on a test is seen as an opportunity to improve his or her learning—an external event that was not an indicator of inherent poor ability.

Moser, Schroder, Heeter, Moran, and Lee (2011) found neurological correlates for Dweck's mindset theory by using an electroencephalograph to measure brain activity while students attempted a difficult stimulus-response task that generated many errors. Their results showed that those with a growth mindset demonstrated more adaptive responses on subsequent trials by attending to correcting their errors than those with a fixed mindset. Additional research has shown that growth mindsets can be developed and strengthened (Blackwell, Trzesniewski, & Dweck, 2007) through feedback that focuses on praise for engaging in the learning process (skill development) rather than outcome (correct answers) and well-placed constructive criticism. For emerging adults, an academic setting that fosters growth mindsets may help them navigate through the challenges they are facing in this stage of their lives, as well as developing stronger, more resilient self-concepts.

Walton and Cohen (2011) found that a brief social-cognitive intervention could significantly improve the outcomes of incoming freshman by offering them an alternative psychological framework similar to the approach proposed by Dweck to foster growth mindsets through developing an internal, rather than external, locus of control. The intervention consisted of second semester African-American students writing a statement about the difficulties that they experienced as incoming freshmen, the commonality of those experiences, and their transitory nature. They were then asked to endorse their message to new students via a video recording of their statement, which would be shown to incoming freshmen. The European-American control group went through the same process; however, they wrote a statement that was not related to social belongingness at college. This intervention allowed the students in the treatment group to frame difficulties at school as external to themselves and not due to any internal deficits. At the end of their four years, the treatment group was three times more likely to have a GPA in the top 25% of their class than those who had not received the treatment. It also reduced the number of those students who had GPAs in the bottom 25% of their class. There was no significant difference in academic performance in the control group. The achievement gap between the African-American students and European Americans was reduced by 79%. The study by Walton and Cohen, along with Dweck's decades of research, suggests that developing soft skills may be an effective course along with the development of academic skills.

The Learning Experience

Seymour and Hewitt (1997) found that participants reported that poor teaching was the third most common reason for switching from a SEM major to a non-SEM major. In all, 90% of switchers and 74% of persisters raised concerns about the teaching ability of SEM faculty. The primary reason for switching was a lack or loss of interest in the SEM discipline, followed by the greater appeal of a non-SEM major, which was seen as more interesting or better in terms of quality of education. In both instances, poor teaching may be a significant contributor to loss of interest or perceptions of educational quality. Additional factors impacting the learning experience included: the perception of an unnecessary "hardness" in SEM majors, the long-standing "weed-out" tradition, the fostering of a competitive culture, and an unsupportive culture within the department.

Traditional lecturing continues to be the standard method of teaching in STEM courses at most colleges and universities (Kulturel-Konak, D'Allegro, & Dickinson, 2011) in spite of evidence that it may not be the most effective method of teaching. Freeman et al. (2014) conducted a meta-analysis of 225 published and unpublished (to control for publication bias) studies to compare the effectiveness of teaching methods using traditional lectures with those using active learning. They looked at studies from 1998 to 2010 that compared undergraduate student performance in STEM courses using traditional lectures or active learning. Freeman et al. found that students who experienced traditional lecture courses were 1.5 times more likely to fail exams and other forms of assessment than students who had experienced active learning approaches in their courses. The overall mean effect size for student performance was a weighted standardized mean difference of 0.47, ($Z = 9.781$, $p < .001$). The average failure rate in courses was 55% higher using traditional lecturing (33.8%) compared to active learning courses (21.8%).

Additionally, the preferred learning style of women may differ significantly from the learning style of men. Kulturel-Konak et al. (2011) compared male and female (STEM and non-STEM majors) preferences for how learning content is delivered and approaches to learning new content. Participants were male (45%) and female (55%) first and second year college students at Penn State Berks during the spring and fall of 2010 who completed an on-line survey of learning styles. Of the male participants, 67% were enrolled in a STEM major, whereas 44% of the female participants were enrolled in a STEM major.

Results from the Kulturel-Konak et al. (2011) study indicated that STEM majors tended to prefer hands-on presentation of material, whereas non-STEM majors preferred presentation of material that required creative thinking. Males preferred concrete presentation of material, whereas females preferred presentation of material that was more abstract and required creative thinking. In the context of learning new information, males preferred doing research followed by learning content by testing out implications, whereas females preferred learning content by testing out implications followed by research. The preference of females was also the order of preferred content delivery for non-STEM majors. Interestingly, 99% of males reported that success in STEM was more difficult depending on one's gender compared to 95% of females—although it was not reported specifically which gender the participants believed experiences more difficulty.

Gender Issues

Men and women differed slightly in their reasons for switching or persisting in a STEM major in the Seymour and Hewitt (1997) study. Seymour and Hewitt noted that overall, men and women shared the most common reason for switching—the loss of interest in the field. Beyond that men were noted to be more focused on future careers and women tended to want a more personally satisfying life post-graduation. Men were more likely to report financial issues as a factor in switching than women. Seymour and Hewitt noted that women experienced greater challenges than their male counterparts as a result of minority status, gender prejudice, overt sexism, psychological alienation, and an environment that fosters competition over collaboration in the learning process. Women have traditionally been underrepresented in the STEM majors and this continues to be the case across the nation (President's Council of Advisors on Science and Technology, 2012). Increasing the number of successful women in STEM careers was a primary focus of President Obama's *Educate to Innovate* initiative (The White House, n.d.). Although it is a complex issue, research suggests that making small changes to the environment of the classroom may make STEM majors more desirable to women.

Cheryan, Plaut, Davies, and Steele (2009) looked at how environmental cues affect the interest level of women in the computer sciences. The study took place in the designated Computer Science building on a college campus. Participants ($N = 39$) were taken individually into one of two rooms—decorated with pretested objects identified as stereotypical of computer scientists or decorated with objects that were similar but not stereotypical of computer scientists—and were directed to disregard the décor as they were sharing the building with another group. The participants were then left alone in the room for 1 minute to give them time to peruse the room. The participants were then asked to complete a questionnaire about their current attitude toward computer science (CS), rate their level of interest in CS, as well as their level of confidence in their computer abilities, and indicate whether they would be interested in learning computer programming. They were also asked to report their mood. After completing the questionnaire the participant was taken into the lobby and asked to recall details about the room and report on their impressions of the "geekiness" of the room. The results of a 2 x 2 ANOVA (Gender x Environment) found no main effect for gender or environment on interest in CS. However, there was a significant interaction between gender and environment, $F(1, 35) = 6.91$, $p < .05$, $\eta_p^2 = .17$. Women reported less interest in CS than men when left in the stereotypical environment, but when left in the non-stereotypical environment, women's reported level of interest in CS did not differ significantly from men's reported level of interest in CS.

In considering the lifestyle that one would have with a career in STEM, many female participants reported that the STEM lifestyle was too all-consuming, personally unrewarding, and that STEM professionals were cold and narrowly focused. Seymour and Hewitt noted that these conclusions were often driven by stereotypical perceptions of what life would be like working in a STEM career and the type of person who is successful in a STEM career. A study by Cheryan, Siy, Vichayapai, Drury, and Kim (2011) found that women believed they would be more successful in CS when they interacted with a non-stereotypical role model, regardless of gender, than when they interacted with a role model who fit current stereotypes for CS majors. Female students (N = 85) who were not currently CS majors were randomly assigned to interact with one of four confederates posing as participants. Each pair was given a task that involved asking questions designed to get to know the partner. The 2 x 2 between-subjects design looked at the gender of the role model (male/female) and the stereotypical qualities of the role model (CS major/non-CS major). Confederates representing CS majors wore clothing that had been identified as commonly worn by CS majors in an earlier study. These confederates also answered questions on the task about their hobbies, favorite movies, magazines, and TV shows with answers that had been pretested as common for CS majors.

Once the interview task had been completed, participants were separated from the confederate and asked to complete a questionnaire about their partner's responses during the task. The questionnaire also asked the participants to rate how well they would do majoring in CS and how successful they might be in CS. Potential moderator variables were addressed with questions asking about how similar the participants thought they were to the partner, how well they got along during the task, and several questions assessing gender-based threat. A 2 x 2 ANOVA indicated a main effect for stereotypicality on success beliefs, $F(1, 55) = 8.31$, $p < .01$, $\eta_p^2 = .13$. There was no main effect of role model gender and there were no interaction effects. Women reported lower success beliefs in CS after interacting with stereotypical role models than non-stereotypical role models. In the baseline condition (used to compare success belief scores), women's success scores were similar to scores in the non-stereotypical role model condition. These results indicate that the current trend of increasing traditional STEM role models for women may be counterproductive.

Race and Ethnicity Issues

Seymour and Hewitt (1997) reported that at the time of their study only 36% of the students of color entering engineering majors attained that degree, compared with 68% of White students. Some progress has been made in the decades since the Seymour and Hewitt study. According to the 2015 STEM Index, the number of Black students attaining STEM bachelor's degrees increased by 60% over what it was in 2000 and the index for Black students attaining graduate degrees in STEM was higher than all other races combined (Cook, Mason, Morse, & Neuhauser, 2015). Even so, the problem is far from being solved. Although students of color reported many of the same reasons for switching as White students, there were some areas of disparity. When compared with White switchers, students of color who switched were more likely to report having made an inappropriate choice in choosing a SEM major, struggling with conceptual difficulties in SEM subjects, and inadequate preparation in high school for the SEM major. They were less likely to cite poor teaching by SEM faculty or loss of interest in the SEM field as reasons for switching.

Perhaps one of the most striking points raised by Seymour and Hewitt (1997) in regard to issues of race and ethnicity is the tendency to assume that issues for students of color are the same across all ethnicities and races when they are not. Issues identified by Seymour and Hewitt as being unique to students of color were placed into four categories: differences in ethnic cultural values and socialization; internalization of stereotypes; ethnic isolation and perceptions of racism; and inadequate program support. Seymour and Hewitt noted that White SEM faculty and White SEM students seemed oblivious to the challenges faced by students of color in these areas. One common experience of any stereotyped group that perpetuates inequities in social and educational contexts is *stereotype threat*. Stereotype threat is a psychological threat that can occur in social contexts where an individual may unintentionally behave in ways that would confirm (personally or to others) an established negative stereotype (Steele & Aronson, 1995). Although it is a complex phenomenon, at the most basic level the anxiety generated by stereotype threat may cause underperformance on a test or even an avoidance of any situations that may pose such a threat.

Beasley and Fischer (2012) looked at stereotype threat as a possible explanation for the attrition of minority groups from STEM majors. Drawing their sample in the fall of 1999 from the National Longitudinal Survey of Freshman, Beasley and Fischer surveyed White (*n* = 998), Asian (*n* = 959), Hispanic (*n* = 916), and Black (*n* = 1,051) first-time freshman from 28 colleges. Participants were surveyed again in the spring of each of the subsequent four years, with a focus on whether or not the student had stayed in his or her intended STEM major. Beasley and Fischer found that Asian men were most likely to declare a STEM major (29%) and least likely to leave a STEM major (14%), whereas Black men were least likely to declare a STEM major (22%) and most likely to leave a STEM major (47%). In general, women were less likely to declare a STEM major. Of the women, Black and Asian women declared STEM majors at an equal rate (18%), followed by White women (17%), and Hispanic women (14%). However, of those women, 44% of the Hispanic women would leave the STEM major, followed by 41% of the Black women, and 39% of the White women. Asian women were least likely to leave a STEM major (34%).

In the third year survey, Beasley and Fischer (2012) assessed stereotype threat by including a:

> group based performance anxiety measure, which [was] derived from a series of questions from the third wave about race and/or gender self-consciousness and the extent to which students [felt] that their individual performance reflects upon their group. Items include[d] student's agreement on three

> statements: “if I excel academically it reflects positively on my group,” “if I do poorly academically it reflects negatively on my group,” and “if I don’t do well people will look down on others like me.” (pp. 435-436)

To control for the potential impact of general performance anxiety unrelated to *group-based performance anxiety*, Beasley and Fischer included two additional questions that asked if (from the perspective of the professor or fellow students) the student was doing poorly it would reflect negatively on the student individually, rather than his or her group.

Results of a one-way ANOVA indicated that race had a significant effect on *group-based performance anxiety*, with Black men and Black women reporting the most anxiety. Hispanic men and Hispanic women had significantly lower anxiety scores than Black men and women. Asian men and Asian women reported similar levels of anxiety, which were lower than the anxiety scores of Hispanic men and women, but higher than those of White men and women. White men and White women reported the lowest levels of anxiety, with White women reporting the lowest levels of *group-based performance anxiety*. Using logistic regression, Beasley and Fischer (2012) found that stereotype threat was a significant factor in decisions to leave STEM majors for White women, Hispanic women, Black women, and Black men. Additionally, they found that White males in STEM majors also experienced low-levels of stereotype threat with similar results—leaving the STEM major, whereas Hispanic men experiencing stereotype threat did not leave their STEM majors. Beasley and Fischer propose that this finding may result from White male perceptions of becoming a minority in the face of Asian male dominance in STEM fields.

Gonzales, Blanton, and Williams (2002) looked at the risk of stereotype threat based on gender and ethnicity stereotypes in Latina women. White (n = 60) and Latino/a (n = 60) undergraduates were asked by a White male to complete a difficult test measuring mathematical and spatial ability. The Latino category included students who were of Mexican, Cuban, Puerto Rican, Central American, or South American descent; all had self-identified as Latino/a. Each ethnic group had an equal number of males (n = 30) and females (n = 30). In the stereotype threat for Latinas condition, participants in the *diagnostic* condition were told that the test was a good indicator of their "actual abilities and limitations," whereas participants in the *non-diagnostic* condition heard no mention about ability. Each group had 12 minutes to complete the test. Latinos and Latinas in the diagnostic condition performed more poorly on the test than those in the non-diagnostic condition, $F(1, 111) = 60.93$, $p < .001$, partial $\varepsilon^2 = 0.35$. Women showed a similar pattern with lower test performance when the test was described as diagnostic of ability, $F(1, 111) = 13.24$, $p < .001$, partial $\varepsilon^2 = 0.10$. White males showed no difference in performance between the diagnostic and non-diagnostic conditions, $F(1, 111) < 1.00$, *ns*, partial $\varepsilon^2 \leq 0.01$.

Walton and Cohen (2007) looked at how belonging uncertainty affected the motivation and potential of stereotypically stigmatized students and non-stigmatized students using three different experimental conditions. The *stigmatized* group consisted of Black students (n = 36) and the *non-stigmatized* group consisted of

White students (*n* = 34) who were asked to generate a list of friends who would fit in well with the CS department. Black students were divided into three groups: those asked to generate a list of eight friends that would fit in well with the CS department, those asked to generate a list of two such friends, and those who were not asked to generate any list of such friends. White students were divided into two similar groups with one group generating a list of eight friends and the other generating a list of two friends. All of the students then completed a motivational outcomes measure designed to assess: the student's personal beliefs about fitting in and succeeding in the field of CS, the type of academic advice to a same-race peer interested regarding CS, activation of race-related cognitions, level of self-doubt, stereotype activation, and self-perceived stereotype threat.

In general, generating a list of eight friends was rated as more difficult by Black students and White students than generating a list of two friends. Results indicated a significant Race x Condition interaction, $F(1, 52) = 4.16$, $p = .046$. Black students reported a lower sense of belongingness after generating a list of eight friends than after generating a list of two friends, $t(52) = 2.07$, $p = .043$, $d = .85$. The *no list* condition did not differ significantly from the *list two friends* condition. White students did not differ in their sense of belongingness. A significant Race x Condition interaction was also found for the global assessment of potential relative to peers, $F(1, 53) = 9.18$, $p = .004$. Black students in the *list eight friends* condition estimated their potential in the 31^{st} percentile, those in the *list two friends* condition estimated their potential in the 58^{th} percentile, and those in the *no list* condition gave estimates of potential in the 51st percentile. Again, White students did not differ in their estimates of potential.

When asked to advise a same-race peer, Black students asked to list eight friends discouraged the peer from pursuing CS more often than those asked to list two friends. White students did not differ between conditions. Although there was no significant interaction effect, there was a main effect of condition for the activation of race-related cognitions $F(1, 65) = 6.03$, $p = .017$, with Black students in the *list eight friends* condition displaying higher race activation than those in the *list two friends* condition, $t(65) = 2.21$, $p = .031$. White students did not differ significantly between conditions. There were no significant effects for the remaining measures of self-doubt, stereotype activation, and self-perceived stereotype threat. The findings of Walton and Cohen (2007) suggest that even in the absence of fear of experiencing stereotyping or racial bias, belonging uncertainty may contribute to a pervasive underlying belief that "people in my group do not belong" (p. 87). This, in turn, could lead to increased social isolation for students of color in the academic setting, particularly when attempting a STEM major.

Summary

In the decades since Seymour and Hewitt (1997) first announced their findings, much research has been generated on the issues identified by the students in the original Seymour and Hewitt study as factors influencing their decision to leave a STEM major. Unfortunately, many of the issues continue to be of concern, particularly for women and students of color. Expanding the understanding of these issues may highlight areas of systemic change that can be implemented to provide a more welcoming and supportive academic environment for students who aspire to become STEM professionals.

CHAPTER III

METHODOLOGY

The present study looked at how self-efficacy beliefs, stereotype threat, and the learning environment may contribute to undergraduate women and students of color choosing to switch from an intended STEM major to a non-STEM major at an Hispanic Serving Institution (HSI) in California. The present study used an explanatory, sequential mixed-methods design that was undertaken in two phases (Creswell, 2014). The first phase was quantitative, followed by a second qualitative phase. This type of design is appropriate to identify quantifiable factors that impact students' decisions to switch majors, which can then be used to inform the collection of qualitative data that can provide a deeper understanding of how and why students come to those decisions (Creswell, 2014; Maxwell, 2013). For each phase, the sampling procedures used in the study are described below, along with the measures and methods that were used for data collection, and the processes used to analyze the data. Approval from the California State University, Stanislaus Institutional Review Board was obtained before any of these data collection methods were implemented.

Phase One

Sample and Participant Selection

The target population was full-time students who entered a 4-year designated HSI university as first-time students or first-time transfers with a declared STEM major. The university is a medium-sized, public university located in a city of 71,245 in the geographic center of California (U. S. Census Bureau, 2014). As of fall 2016, the university served 9,762 students, enrolling 1,389 first-time freshman and 1,078 first-time transfers (Office of Institutional Research, n.d.). The same source indicated the university has a 6-year graduation rate of 57.4%, conferring 2,142 undergraduate degrees during the 2015-16 school year. It has a freshman retention rate of 85.1%. The university has an average class size of 27 with a student-to-faculty ratio of 21 to 1. It has four colleges on the campus: Arts, Humanities, and Social Sciences; Business Administration; Education, Kinesiology, and Social Work; and Science. In the fall of 2016, the university received 2,229 applications to the College of Science, along with 1,014 applications noting a pre-nursing interest, but an undeclared major. Of the 2,229 applications with a declared STEM major, 1,754 were admitted and 415 enrolled. In 2016, the College of Science had 2,227 full-time undergraduate students enrolled in 14 programs.

The university serves a diverse population of students. In the fall of 2016, the university had 8,620 full-time and part-time undergraduates with 65% female and 35% male students (Office of Institutional Research, n.d.). Of these, 53% were Hispanic, 23% were White, 11% were Asian/Pacific Islanders, 9% identified as Other, 2% were Black, less than 1% identified as American Indian, and 1% identified as Nonresident Alien. The College of Science had 2,745 enrolled students in 2016 with 66% female and 34% male (Office of Institutional Research, n.d.). Of these students, 50% were Hispanic, 23% White, 14% Asian/Pacific Islander, 9% identified as Other, 2% Black, 1% Nonresident Alien, and less than 1% American Indian. The

College of Science is comprised of 14 degree programs: (a) biological sciences, (b) chemistry, (c) child development, (d) cognitive studies, (e) computer science, (f) ecology and sustainability, (g) geology, (h) mathematics, (i) nursing for licensure, (j) nursing RN to BSN, (k) physical sciences, (l) physics, (m) pre-nursing, and (n) psychology. See Appendix A for the demographic characteristics of each program (Office of Institutional Research, n.d.).

Of these 14 programs, nine are considered STEM programs with majors as defined by the Kuenzi (2008) report to Congress: (a) biological and biomedical sciences, (b) computer and information sciences, (c) engineering and engineering technologies, (d) mathematics and statistics, and (e) physical sciences and science technologies. Programs in the College of Science that were excluded from this study based on this report include: child development, nursing for licensure, nursing RN to BSN, pre-nursing, and psychology. The program in ecology and sustainability was not included as it is a graduate program. Under current university guidelines, the cognitive studies program is not considered a traditional STEM major, so it was also excluded from the current study. In summary, seven programs from the College of Science were used to identify students as STEM majors for the present study: (a) biological sciences, (b) chemistry, (c) computer science, (d) geology, (e) mathematics, (f) physical sciences, and (g) physics.

The university has two grant-funded programs offering support for low-income and first generation Hispanic students majoring in STEM programs, Warriors on the Way to STEM (WOW 2 STEM) and the Central Valley Math and Science

Alliance (CVMSA). The WOW 2 STEM is a joint effort between the university and two local community colleges designed to facilitate the successful transfer of STEM students from a 2-year college to a 4-year university through mentoring, educational planning, workshops, and special presentations. This collaborative program includes a transfer guarantee that offers priority admission and a fee waiver to apply. The CVMSA promotes engagement and persistence by facilitating access to resources for STEM majors. This support program offers personal and professional one-on-one mentor relationships with faculty, regular workshops in academic excellence, opportunities to become an undergraduate research associate, along with all-expenses paid attendance at scientific conferences to present research. It also offers a dedicated group-study space with walk-in peer tutoring available.

The sampling method was convenient in its intent to select eligible students. The Office of Institutional Research at the university was contacted for a list of potential participants. Potential participants were students who were admitted during the years from 2010 through 2014, enrolled full-time either as a first-time freshman or transfer, with a declared major in one of the targeted College of Science programs at the time of their admission to the university.

Instruments

General Self-Efficacy Scale (GSE). The General Self-Efficacy Scale (Schwarzer & Jerusalem, 1995) is a 10-item scale that has been in use for over two decades to assess adaptation after life changes. Designed for use with general adult populations it assesses the construct of perceived general self-efficacy, including goal setting, effort investment, persistence when faced with barriers, and recovery from setbacks. Responses to each item are measured using a 4-point rating scale with 1 = *Not at all true*, 2 = *Hardly true*, 3 = *Moderately true*, and 4 = *Exactly true*. It takes about 4 minutes to complete. Summing the responses result in scores ranging from 10 to 40, with higher scores indicating greater self-efficacy.

Scholz, Dona, Sud, and Schwarzer (2002) looked at the validity and reliability of the GSE in 25 countries (*N* = 19,120). Reliability testing resulted in Cronbach's alpha values ranging from .75 to .91, with an overall α of .86. Unidimensionality of the scale was assessed using confirmatory factor analysis resulting in coefficients of .98 for the goodness of fit, .97 for the adjusted goodness of fit, .97 for the normed fit index, .03 for the root mean residuals, and .05 for the root mean square error of approximation. See Appendix B for a list of items included in the scale.

Social Identities and Attitudes Scale (SIAS). The Social Identities and Attitudes Scale (Picho & Brown, 2011) is a 30-item scale that assesses stereotype threat susceptibility along six dimensions: (a) math identification, (b) ethnic identification, (c) gender identification, (d) gender stigma consciousness, (e) ethnic stigma consciousness, and (f) negative affect. Responses to each item are measured on a 7-point Likert scale ranging from 1 = *strongly disagree* to 7 = *strongly agree*. Scores range from 30 to 210, with higher scores indicating greater susceptibility to stereotype threat. It takes about 5 minutes to complete. See Appendix C for a list of items included in the scale.

In testing the reliability and validity of the SIAS, Picho and Brown (2011) reported that content validity was established through 10 validators, five experts in the fields of stereotypes, gender educational psychology, and math and five graduate students in educational psychology. The items retained for use in the scale had a content validity index of 0.8 and above (Picho & Brown, 2011). Confirmatory factor analysis ($N = 200$) yielded a model with a $\chi^2(387) = 672.5$, $p < .001$, comparative fit index of .93, Tucker Lewis index of .93, and a root mean square error of approximation of .06, with high factor loadings for math identification (.81-.91), ethnic identification (.73-.91), gender identification (.62-.81), gender stigma consciousness (.73-.83), ethnic stigma consciousness (.63-.83), and negative affect (.63-.96). Reliability estimates for each of the six indices resulted in the following alpha levels: math identification ($\alpha = .95$), ethnic identification ($\alpha = .89$), gender identification ($\alpha = .81$), gender stigma consciousness ($\alpha = .88$), ethnic stigma consciousness ($\alpha = .85$), and negative affect ($\alpha = .93$).

College Campus Environment Scale (CCES). The College Campus Environment Scale (Fish, Gefen, Kaczetow, Winograd, & Futtersak-Goldberg, 2016) assesses the college environment in six areas that measure positive experiences valued by students: (a) academic and career expectations, (b) athletic opportunities and participation, (c) health, (d) role models and mentors, (e) safety, and (f) social and extracurricular activities. It consists of 43 items that address the aforementioned domains. Responses are recorded on a 4-point rating scale ranging from 1 = *Not at all important*, 2 = *Somewhat important*, 3 = *Important*, and 4 = *Very important*. It takes about 10 minutes to complete. Responses are summed with higher scores indicating greater positive endorsement of the importance of the college campus environment. Total scores range from 43 to 172. Items contained in the scale are listed in Appendix D.

Fish et al. (2016) tested the reliability and validity of the CCES. The scale had an overall Cronbach's alpha value of .95, with the following subscale values: (a) *Academic and career expectations* (α = .82), (b) *Social and extracurricular activities* (α = .73), (c) *Athletics* (α = .86), (d) *Health* (α = .82), (e) *Role models and mentors* (α = .85), and (f) *Safety* (α = .69). Content validity was established in consultation with experts in higher education and educational psychology, as well as review by a small sample of undergraduate students. Confirmatory factor analysis (N = 524) resulted in six subscales, with significant inter-correlations between all of the subscales except *Safety* and *Role models and mentors*. Fish et al. (2016) reported that the root mean square error of approximation had a value of .47 and the standardized root mean squared residual had a value of .06.

Demographic information. A single survey was constructed using the GSE, SIAS, and CCES, along with questions about age, gender, ethnicity, status as a first-generation student, annual household income, grade point average, participation in STEM support programs, the student's current major, and if applicable, his or her former major. See Appendix E for a list of additional questions included in the survey.

Method

A request to participate in the present study was sent by e-mail to the student's university and alternative e-mail accounts in October of the Fall 2016 semester with the following request:

> Hello,
>
> Congratulations! You have been selected to participate in a survey about how students decide on a college major. You were selected because you are a current or former student of California State University, Stanislaus in Turlock, CA. If you decide to participate, you will be entered into a drawing for one of three $50 Amazon Gift Cards.
>
> If you receive more than one e-mail invitation to this survey, please only reply to one of the invitations. Thank you!

Two reminders were sent out after the initial request to those students who had not yet responded. The first reminder was sent one week after the initial invitation with the following request:

> Hello,
>
> This is a reminder that you have been invited to win one of three $50 Amazon Gift Cards by participating in a survey about how a student decides on a college major. If you have not yet completed the survey, please consider doing so now in order to be entered into the drawing.

A second reminder was sent out after another week had passed to any remaining students who had not yet responded. It included the following request:

Hello,

Recently you were sent a survey about your experiences at CSU Stanislaus. If you have not yet done so, would you please take a moment to give us your valuable input? If you started the survey, but haven't yet finished it, doing so now will provide us with information that may help other students in choosing a college major.

Thank you for your time and don't forget to enter into the drawing for one of three Amazon gift cards worth $50 each.

The Amazon gift cards were offered as an incentive to increase participation in the study (Nulty, 2008; Van Selm & Jankowski, 2006). Students were offered potential compensation for participating in the study through the opportunity to be entered in a drawing to win one of three $50 Amazon gift cards by having their contact information recorded external to the survey.

Students who were recruited to the study were asked to provide informed consent to participate (see Appendix F). They were assured of their anonymity, the confidential nature of their responses, and of the importance of their responses (Nulty, 2008; Van Selm & Jankowski, 2006). Those who agreed to participate in the study were asked to complete the survey using *Qualtrics* software v. 9-2016 (*Qualtrics,* Provo, UT). The survey took approximately 20 minutes to complete and was available to participants for three weeks after the initial invitation. Surveys had one-time only access and were limited to only those who were invited to participate (Van Selm & Jankowski, 2006). Fall enrollment for the years 2010 through 2012 averaged

300 freshmen students per year who were enrolled in targeted College of Sciences programs (Office of Institutional Research, n.d.). Considering this average for the years 2010 through 2014 provided a potential pool of 1,500 participants. Bartlett, Kotrlik, and Higgins (2001) suggested that for a population size of 1,500 the minimum response rate for surveys with categorical data is 15%. A review of survey research by Nulty (2008) found that online surveys generated response rates from 20% to 47%. Based on these findings, a response rate of 15% to 20%, or about 230 to 300 students, based on average admission data, was desirable. The Office of Institutional Research provided 2951 university and alternate e-mails for 1,602 students. University and alternate e-mail addresses were used to send out the request for participants. After three weeks, 407 students had started the survey with 319 noted as completed in *Qualtrics*. In the present study, the number of students who had started the survey represents a return rate of 25%. Completed surveys represent a return rate of 20%.

Those students who indicated they had changed their major were asked whether they would be willing to participate in a follow-up interview at the beginning of the Spring 2017 semester. If they agreed, they were provided with a hyperlink to a form external to *Qualtrics* in order to maintain the confidentiality of their responses. In order to recruit participants for Phase 2 of the study, the external form asked for the student's contact information.

Data Analysis Procedures

All quantitative analyses were done using *SPSS*, Version 24.0 (IBM, 2012). An alpha level of .05 was used for all inferential statistical analyses. Of the 319 completed surveys, 124 surveys had missing responses in one or more of the SES, SIAS, and CCES measures, leaving 195 surveys with complete data for each of those measures. Additionally, only four students reported their ethnicity as Black and none of those had changed from their STEM major. One student reported *Other* for gender and had changed from a STEM major (biology) to a non-STEM major (economics). Consequently, these students were omitted from the inferential data analyses using the SES, SIAS, and the CCES because no comparisons could be made between switchers and persisters in those categories, leaving a total of 190 students in the sample. However, mean scores with standard deviations for the SES, SIAS, and CCES are reported for the Black ethnic category and the Other gender category in the following chapter.

Descriptive statistics were used to identify the demographic characteristics of the sample and summarize response rates for the survey. Raw scores for each item in the SES, SIAS, and CCES measures were used to conduct individual item analyses to identify items from the survey that may have impacted different demographic groups. These results were used to inform the construction of interview questions to be used in Phase 2 of the study. Raw scores for the SES, SIAS, and CCES were also summed to get a total score for each of those scales. None of the items in these scales required reverse-scaling. Independent *t*-tests were used to determine if there were significant differences between switchers and persisters in terms of age or GPA.

H_1: Students who change from a STEM major to a non-STEM major will perform differently on measures of self-efficacy, stereotyping, and satisfaction with the learning environment than those students who do not change from a STEM major to a non-STEM major. A 2 x 2 x 4 (switcher or persister; male or female; and White Hispanic, Asian, or Black ethnicities) factorial ANOVA was used to examine the differences on the SES, SIAS, and the CCES. Tukey's HSD was used for post hoc analyses to determine significant differences for the ethnicity variable.

H_2: Female students starting in a STEM major will be more likely to change to a non-STEM major than male students starting in a STEM major. Binomial logistic regression was used to predict whether or not a student would switch from a STEM major based on gender. A cross-tabulation table was used to interpret the results.

H_3: Students of color starting in a STEM major will be more likely to change to a non-STEM major than White students starting in a STEM major. Binomial logistic regression was used to predict whether or not students of color would be more likely switch from a STEM major than White students. A cross-tabulation table was used to interpret the results.

H_4: Self-efficacy, stereotyping, and the learning environment will contribute to decisions to change from a STEM major. Binomial logistic regression was used to predict whether or not a student would switch from a STEM major based on SES scores, SIAS scores, CCES scores.

Phase Two

Sample and Participant Selection

The sampling method was purposive in its intent to select participants. Eligible students were female and male students of color who indicated on the survey they had changed majors and were willing to participate in an interview. Participants were offered compensation for their participation in the interviews. For participating in the interview, each student was offered a $5 Starbucks card. Responses to this offer were limited, with only 10 students responding. Of these, only one followed through with the interview. In an effort to recruit more interviewees, an additional *Qualtrics* survey was sent out to the 171 students who had provided additional contact information through his or her e-mail address. This second *Qualtrics* survey had the following introduction:

> Hello,
>
> Last semester you participated in a research study and were asked to provide your contact information for an Amazon gift card drawing. All of the prizes have been awarded for that drawing and we thank you for your participation in that portion of our research.

> During the second phase of our research, we need an additional eight (8) students who would be willing to participate in individual interviews asking about your experiences in a STEM major. The interviews will be about 1/2 hour in length and you will receive a $20 Starbucks card for your participation.
>
> If you are interested in being considered for this part of the research, please answer the following questions and provide a phone number or email address where you can be contacted.
>
> Thank you very much for your time,
>
> June Newman
>
> Doctoral candidate
>
> California State University, Stanislaus

The survey was short, only asking: (a) if the student had changed his or her major from a STEM major to a non-STEM major, (b) his or her gender, (c) his or her ethnicity, and (d) current e-mail or phone contact information. The following e-mail request was sent out with this survey at the beginning of the Spring 2017 semester along with an increased incentive of a $20 Starbucks card for each participant:

> Congratulations! You have been selected as a potential participant in an interview about your experiences in a STEM major. Each person who participates in the interviews will get a $20 Starbucks gift card. Please take this very short survey to determine your eligibility. Thank you for your time!

A few days later a follow-up reminder was sent to 130 of the students who had not yet responded with the following request: “Hello, Just a friendly reminder to complete this very brief survey for a chance to get a $20 Starbucks card.” Another follow-up was sent a week later to the remaining 91 students who had not yet started the survey with this request:

> Hello,
>
> Just a quick reminder that you could get a $20 Starbucks gift card for participating in the interview phase of this research. Please finish this very brief survey to see if you qualify. Thank you so much for your time.

In total, 61 students responded to the request for interviews. Of those, only three had changed their major. One did not provide any contact information and another, when contacted, stated that he had not actually changed from a STEM major, but had added a nursing minor to his biology major. This recruitment attempt resulted in one additional interviewee. Two additional interviewees were recruited through snowball sampling, bringing the total number of interviews to four.

Method

Semi-structured face-to-face interviews were used to collect the qualitative data for this phase of the study. Construction of open-ended interview questions were informed by the data collected in Phase 1 of the study. Proposed interview questions were reviewed by two experts in the field of education and adjusted based on the feedback provided. Interviews were conducted on campus during February of 2017. Before beginning the interview, each student was apprised of what the interview process would involve, how the data would be analyzed and used, that they would be provided with a summarized version of the interview for review, and that any inaccuracies he or she identified would be corrected for the final version. The student was asked to sign an informed consent that included acknowledgment and permission to record the interview (see Appendix G). Each interview was 30 to 45 minutes in length. A semi-structured conversational style was used to gather information about how student experiences as an undergraduate in his or her STEM major impacted the decision to change to a non-STEM major. Audio recordings and field notes were taken during each of these sessions.

Data Analysis Procedures

A collective case study approach was used to analyze the data. Yin (2014) notes that this approach is appropriate for qualitative research that aims to explain the how or why of a particular phenomenon where the behavior of the individuals cannot be manipulated, contextual conditions are relevant to the phenomenon being studied, and the boundaries are not clear between the context and the phenomenon. The unit of analysis is the decision-making process (Baxter & Jack, 2008). Pattern-matching and cross-case synthesis was used to analyze the data from multiple interviewees (Yin, 2014). Each interview was recorded and transcribed verbatim. Transcribed data were then coded and analyzed using *Dedoose* software (SocioCultural Research Consultants, Los Angeles, CA). Initial analysis of these data was done using a combination of codes predetermined by the Phase 1 data and emerging codes to identify relevant themes, concepts, and categories. Reiterative coding was used to review the data to confirm that interviewee responses were accurately represented by the chosen themes, concepts, and categories. Additionally, any relationships between individual cases and patterns in the identified themes, concepts, and categories were reviewed during these phases of coding and used to synthesize the data. Memos were used to comment on themes, concepts, and categories that arose during the analysis, as well as preliminary interpretations of patterns found in the data. Member checking is an important component of the qualitative research process (Creswell, 2014). As a safeguard to strengthen validity, participants were asked to review the final version of their interview for accuracy and intended meaning. Qualitative data results were documented and organized in a confidential case study database (Yin, 2014).

Summary

The present study used quantitative and qualitative data to examine how self-efficacy beliefs, stereotype threat, and learning environment may interact to contribute to undergraduate students choosing to switch from their intended STEM major to a non-STEM major. The results of all data analyses are reported in Chapter IV.

CHAPTER IV

RESULTS

The purpose of this study was to examine the role of self-efficacy beliefs, stereotype-threat susceptibility, and the learning environment in undergraduate students' decision to change from a STEM major to a non-STEM major. This chapter presents the results of the quantitative analyses of data collected during Phase 1 followed by the qualitative analyses of data collected during Phase 2. The sections are ordered as follows: (a) demographic characteristics of the participants in Phase 1, (b) results of the 2 x 2 x4 factorial ANOVA, (c) results of the logistic regression, (d) results of the item-analyses for the development of interview questions, (e) demographic characteristics of the participants in Phase 2, (f) summaries of four interviews conducted, and (g) results from the *Dedoose* coding analyses.

Phase One: Quantitative Analysis

Participant Demographics

Participants were 195 students who were admitted during the years from 2010 through 2014 and enrolled full-time (at least 12 units per semester) either as a first-time freshman or transfer. The sample included male (n = 79) and female (n = 115), students from diverse ethnic backgrounds, categorized by the university as Hispanic (n = 77), White (n = 58), Black (n = 4), Asian (n = 25), or other (n = 31). There was one student who identified as *Other* in gender and ethnicity. The age range of the students was 48 years, with a minimum of 20 years and a maximum of 68 years. The mean age was 24.18 years, with a standard deviation of 5.28. Ninety students reported having changed from a STEM major, whereas 105 reported that they had not changed from their STEM major. The sample was evenly divided between first-generation college students (n = 97) and those who were not the first in their family to attend college (n = 97), one student did not answer that question. Ten students reported that they had participated in the WOW 2 STEM program, whereas 185 students reported that they had not participated in this program. Participation in the CVMSA program was slightly higher with 34 students reporting they had participated in the CVMSA program, whereas 160 reported not participating in this program. Participant demographics for annual household income are outlined in Table 1 and Table 2 below.

Table 1

Number of Students in Each Income Category Based on Gender, First-generation Status, and Status of STEM Major

	Gender		First-generation		Status of major	
	Male	Female	Yes	No	Switched	Persisted
Annual household income	*n*	*n*	*n*	*n*	*n*	*n*
Less than $20,000	34	31	31	34	29	36
$21,000 to $40,000	14	29	25	18	18	25
$41,000 to $60,000	12	12	12	12	8	16
$61,000 to $80,000	4	13	11	6	11	6
$81,000 to $100,000	4	1	3	2	4	1
More than $100,000	5	21	8	17	11	15
Total	73	107	90	89	81	99
Missing	6	8	7	8	9	6

Table 2

Number of Students in Each Income Category Based on Ethnicity

	Ethnicity					
	Hispanic	White	Black	Asian	Other	Total
Annual household income	*n*	*n*	*n*	*n*	*n*	*n*
Less than $20,000	20	21	1	9	14	65
$21,000 to $40,000	18	10	1	10	4	43
$41,000 to $60,000	13	5	1	1	4	24
$61,000 to $80,000	9	5	1	2	0	17
$81,000 to $100,000	3	2	0	0	0	5
More than $100,000	9	8	0	2	7	26
Total	72	51	4	24	29	180
Missing	5	7	0	1	2	15

Results of independent *t*-tests indicated that there were no significant differences in age between switchers (M = 23.68, SD = 4.70) and persisters (M = 24.61, SD = 5.71), $t(193) = -1.23$, $p = .22$, equal variances were assumed. There were also no differences in GPA between switchers (M = 3.13, SD = 0.39) and persisters (M = 3.23, SD = 0.48), $t(193) = -1.48$, $p = .14$, equal variances were assumed.

Descriptive Statistics for the Measures

Raw scores for each item on the SES, SIAS, and CCES measures were summed to get a total score for each scale. Descriptive statistics for the total SES, SIAS, and CCES scores are listed in Table 3 below.

Table 3

Descriptive Statistics for Scores on the Self-Efficacy Scale, Social Identities and Attitudes Scale, and College Campus Environment Scale

Scale	Maximum possible	Range	Minimum	Maximum	*M*	*SD*
SES	40	21	19	40	32.47	4.03
SIAS	210	133	65	198	130.63	25.30
CCES	172	128	44	172	120.62	24.94

Mean scores and standard deviations were also computed for each item in the SES, SIAS, and CCES for the item analysis, noted in Table 4, Table 5, and Table 6, respectively. On the SES, a single item, "If someone opposes me, I can find the means and ways to get what I want," stood out as it generated the lowest score (see Table 4). On the SIAS, the importance of being good at math generated the highest score, although concerns about personal math skills in the context of testing generated relatively low scores (see Table 5 below). On the CCES, students reported that safety and health concerns were the most important features of the campus environment (see Table 6 below).

Hypothesis Testing

H_1: Students who change from a STEM major to a non-STEM major will perform differently on measures of self-efficacy, stereotyping, and satisfaction with the learning environment than those students who do not change from a STEM major to a non-STEM major. The results of a 2 x 2 x 4 (change of major, gender, and ethnicity) factorial ANOVA indicated that there were no significant interaction effects for any of the measures (SES, SIAS, and CCES). There were no significant main effects of changing majors, gender, or ethnicity on the SES. There was a significant main effect of changing majors on the SIAS, but no significant main effects for gender or ethnicity. For the CCES, there were significant main effects for gender and ethnicity, but not changing majors. Levene's test of equality of error variances was not significant for the SES, $F(15, 174) = 0.78$, $p = .70$; the SIAS, $F(15, 174) = 1.38$, $p = .16$; or the CCES, $F(15, 174) = 1.33$, $p = .19$. See Table 7 below for mean scores and standard deviations for each factorial level. Table 8 follows with the results of each factorial ANOVA.

As noted above, the results of the factorial ANOVA indicated that there was a main effect of changing from a STEM major to a non-STEM major on the SIAS measure with switchers ($M = 125.55$, $SD = 26.33$) reporting significantly lower stereotype susceptibility than persisters ($M = 134.51$, $SD = 23.84$). For the CCES there was a main effect of gender with females ($M = 124.98$, $SD = 20.72$) indicating significantly more positive endorsement of the importance of the college campus environment than males ($M = 114.10$, $SD = 29.49$). Post hoc analysis using Tukey's HSD indicated that there was a significant difference ($M_{diff} = -20.01$, $SE = 5.82$, $p = .004$) between the endorsement of White students and Asian students, with Asian students ($M = 134.60$, $SD = 20.85$) reporting a more positive endorsement of the importance of the college campus environment than White students ($M = 114.59$, $SD = 24.66$). There were no other significant differences. See Table 9 for a full reporting of overall means and standard deviations.

Table 4

Means and Standard Deviations for Each Item of the Self-Efficacy Scale

Item	*N*	*M*	*SD*
I can solve most problems if I invest the necessary effort.	195	3.59	0.57
I can always manage to solve difficult problems if I try hard enough.	195	3.37	0.58
If I am in trouble, I can usually think of a solution.	195	3.34	0.58
It is easy for me to stick to my aims and accomplish my goals.	195	3.28	0.65
I can usually handle whatever comes my way.	195	3.28	0.62
I am confident that I could deal efficiently with unexpected events.	195	3.25	0.69
Thanks to my resourcefulness, I know how to handle unforeseen situations.	195	3.19	0.73
When I am confronted with a problem, I can usually find several solutions.	195	3.19	0.63
I can remain calm when facing difficulties because I can rely on my coping abilities.	195	3.18	0.74
If someone opposes me, I can find the means and ways to get what I want.	195	2.78	0.67

Table 5

Means and Standard Deviations for Each Item of the Social Identities and Attitudes Scale

Item	*N*	*M*	*SD*
Being good at math will be useful to me in the future.	195	5.71	1.47
I value my ethnic background.	195	5.57	1.52
I value math.	195	5.57	1.52
My math abilities are important to my academic success.	195	5.50	1.57
Doing well in math is critical to my future success.	195	5.36	1.58
Math is important to me.	195	5.31	1.57
I am connected to my ethnic heritage.	195	4.79	1.89
My ethnicity is an important reflection of who I am.	195	4.77	1.75
Members of the opposite sex interpret my behavior based on my gender.	195	4.67	1.60
My gender affects how people treat me.	195	4.49	1.73
My gender affects how people act toward me.	195	4.48	1.78
My gender contributes to my self-confidence.	195	4.34	1.75
My identity is strongly tied to my gender.	195	4.21	1.74
My gender influences how I feel about myself.	195	4.15	1.88
My gender is central to defining who I am.	195	4.11	1.77
I experience doubt about my math abilities.	195	4.11	1.82
My gender influences how teachers interpret my behavior.	195	4.11	1.66
People from other ethnic groups interpret my behavior based on my ethnicity.	195	4.10	1.64
Most people judge me on the basis of my gender.	195	3.91	1.73
Most people judge me on the basis of my ethnicity.	195	3.90	1.83
My ethnicity affects how my peers interact with me.	195	3.86	1.68
I feel like I am letting myself down when doing difficult math on a test.	195	3.63	1.91
I start to lose confidence in my abilities when doing difficult ma on a test.	195	3.59	1.90
My ethnicity affects how I interact with people of other ethnicities.	195	3.53	1.85
My ethnicity influences how teachers interact with me.	195	3.44	1.69
I feel like a failure when doing difficult math on a test.	195	3.04	1.85
I feel hopeless when doing difficult math on a test.	195	3.00	1.89
I feel like giving up when doing difficult math on a test.	195	2.85	1.87

Table 6

Means and Standard Deviations for Each Item of the College Campus Environment Scale

Item	*N*	*M*	*SD*
I feel safe on campus.	195	3.61	0.64
There are campus safety measures to protect students.	195	3.60	0.68
Filing a harassment or discrimination complaint is confidential.	195	3.48	0.80
I feel safe from student-related violence.	195	3.44	0.78
There are campus policies and procedures that protect students from harassment and discrimination.	195	3.44	0.82
A student health center facility that is conducive to privacy.	195	3.41	0.82
There are clear and visible procedures for reporting crimes.	195	3.36	0.78
A student health center with convenient hours.	195	3.31	0.83
I feel safe when using the athletic facilities.	195	3.29	0.84
A mental health center where it is easy to get an appointment with a staff member.	195	3.25	0.91
My daily decisions are not determined by concerns for safety.	195	3.23	0.94
Seeking mental health services is not stigmatized on campus.	195	3.23	0.94
A student health center that is easily accessible.	195	3.19	0.89
A student health center that provides treatment options and referrals.	195	3.16	0.89
A student health center where it is easy to get an appointment with a staff member.	195	3.13	0.96
A mental health center that provides information on maintaining mental health.	195	3.10	0.92
I feel I won’t be put at risk because of my gender.	195	3.09	1.05
Social events are welcoming to all students.	195	3.04	0.96
A mental health center that has an accessible crisis hotline.	195	3.01	1.03
I feel safe from social pressures of drug and alcohol use.	195	3.01	1.07
I feel I won't be put at risk because of my ethnic background.	195	3.00	1.10
Athletic facilities have convenient hours.	195	2.94	0.97
A student health center that provides information on maintaining physical health.	195	2.93	1.00
I have the opportunity to work with faculty members on campus committees, organizations or projects (outside of class).	195	2.92	0.95
Athletic facilities are easily accessible.	195	2.87	0.95
There are a variety of athletic facilities such as a gym, pool, court, track, etc.	195	2.85	0.98
A student health center that is close to where I live.	195	2.75	1.06
There are opportunities to attend meetings of campus clubs, committees, and organizations.	195	2.75	1.01
There are organizations or student government groups.	195	2.66	1.07
There are a variety of social activities on campus.	195	2.63	0.98
Athletic facilities are close to where I live.	195	2.46	1.09
There are a variety of sports teams.	195	2.43	1.08
I am able to explore non-traditional career goals for my ethnic background.	195	2.38	1.10
I am able to explore non-traditional fields of study and academic opportunities for my ethnic background.	195	2.28	1.08
I am able to explore non-traditional fields of study and academic opportunities for my gender.	195	2.28	1.08
There are many faculty members of my gender.	195	2.07	1.05
There are strong role models from my ethnic background.	195	1.99	1.06
There are many administrators of my gender.	195	1.95	1.05
There are many faculty members from my ethnic background.	195	1.93	1.03
There are fraternities and sororities.	195	1.81	1.04
A mentor is from the same ethnic background as I am.	195	1.79	0.99
There are parties on campus.	195	1.74	0.99

Table 7

Mean Scores and Standard Deviations for Each Factorial Level Based on STEM Major Status

		SES		SIAS		CCES	
Variable Level	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Switched	89	31.79	4.28	125.55	26.33	121.02	24.97
Male	30	31.70	4.57	118.10	25.60	113.23	28.76
Hispanic	15	32.13	5.22	113.13	25.07	113.13	34.11
White	7	30.43	3.60	115.14	19.18	99.86	15.52
Asian	5	33.20	4.66	122.00	23.44	128.20	26.23
Other	3	30.00	3.61	143.33	41.10	120.00	22.34
Female	59	31.83	4.17	129.34	26.09	124.98	22.02
Hispanic	37	31.03	4.16	130.81	28.76	123.00	23.04
White	11	33.82	2.99	129.18	15.24	123.18	18.82
Asian	6	30.83	5.42	134.33	13.56	139.50	21.82
Other	5	34.60	2.97	112.80	34.86	126.20	20.27
Total	89	31.79	4.28	125.55	26.33	121.02	24.97
Hispanic	52	32.50	4.47	125.71	28.67	120.15	26.73
White	18	32.50	3.57	123.72	17.78	114.11	20.74
Asian	11	31.91	4.99	128.73	18.79	134.36	23.41
Other	8	32.88	3.80	124.25	37.77	123.88	19.69
Other							
Other	1	27.00	-	116.00	-	111.00	-
Persisted	101	33.20	3.70	134.51	23.84	120.18	25.43
Male	47	33.32	3.35	130.85	26.67	114.66	30.24
Hispanic	12	32.17	2.33	130.00	20.74	112.50	28.82
White	19	34.32	3.61	127.21	28.74	105.11	30.70
Asian	8	31.88	3.00	149.38	17.49	139.38	19.65
Other	8	34.13	3.83	122.25	32.46	115.88	30.66
Black	2	31.50	4.95	139.00	24.04	111.00	8.49
Female	54	33.09	4.02	137.70	20.80	124.98	19.39
Hispanic	13	31.62	4.17	136.77	21.15	128.62	13.60
White	21	33.95	3.35	139.67	17.47	123.57	18.66
Asian	6	32.50	5.21	151.17	17.43	128.67	19.29
Other	14	33.43	4.27	129.86	24.65	122.14	25.53
Black	2	29.50	0.71	159.00	2.83	139.00	4.24
Total	101	33.20	3.70	134.51	23.84	120.18	25.43
Hispanic	25	31.88	3.36	133.52	20.80	120.88	23.25
White	40	34.13	3.44	133.75	24.03	114.80	26.48
Asian	14	32.14	3.92	150.14	16.81	134.79	19.53
Other	22	33.68	4.04	127.09	27.23	119.86	26.95
Black	4	30.50	3.11	149.00	18.13	125.00	17.07

Note: Although the ethnic category of *Black* and the gender category of *Other* were not included for analysis in the factorial ANOVA and not included in the totals above, the group means and standard deviation are included here for comparison.

Table 8

Results of ANOVAs for the Self-Efficacy Scale, Social Identities and Attitudes Scale, and College Campus Environment Scale

Variables	*df*	*F*	*p*	η_p^2
Self-Efficacy Scale	174			
Change of major	1	2.03	.16	.012
Gender	1	0.40	.53	.002
Ethnicity	3	1.37	.26	.023
Change x Gender	1	0.98	.33	.006
Change x Ethnicity	3	0.53	.66	.009
Gender x Ethnicity	3	1.29	.28	.022
Change x Gender x Ethnicity	3	1.73	.16	.029
Social Identities & Attitudes Scale	174			
Change of major	1	6.17	.01*	.034
Gender	1	1.50	.22	.009
Ethnicity	3	1.54	.21	.026
Change x Gender	1	0.19	.66	.001
Change x Ethnicity	3	0.93	.43	.016
Gender x Ethnicity	3	1.49	.22	.025
Change x Gender x Ethnicity	3	1.46	.23	.025
College Campus Environment Scale	174			
Change of major	1	0.01	.94	.000
Gender	1	5.58	.02*	.031
Ethnicity	3	4.03	.01*	.065
Change x Gender	1	0.36	.55	.002
Change x Ethnicity	3	0.12	.95	.002
Gender x Ethnicity	3	1.11	.35	.019
Change x Gender x Ethnicity	3	0.51	.68	.009

$*p < .05$

Table 9
Overall Mean Scores and Standard Deviations for Gender and Ethnicity

		SES		SIAS		CCES	
Variable	*n*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Male	77	32.69	3.92	125.88	26.83	114.10	29.49
Hispanic	27	32.15	4.12	120.63	24.36	112.85	31.27
White	26	33.27	3.95	123.96	26.70	103.69	27.24
Asian	13	32.38	3.59	138.85	23.53	135.08	22.06
Other	11	33.00	4.07	128.00	34.24	117.00	27.59
Female	113	32.43	4.13	133.34	23.98	124.98	20.72
Hispanic	50	31.18	4.13	132.36	26.91	124.46	21.02
White	32	33.91	3.19	136.06	17.25	123.44	18.41
Asian	12	31.67	5.14	142.75	17.29	134.08	20.43
Other	19	33.74	3.93	125.37	27.72	123.21	23.78
Total	190	32.54	4.04	130.32	25.37	120.57	25.15
Hispanic	77	31.52	4.13	128.25	26.49	120.39	25.50
White	58	33.62	3.53	130.64	22.61	114.59	24.66
Asian	25	32.04	4.33	140.72	20.44	134.60	20.85
Other	30	33.47	3.93	126.33	29.72	120.93	24.95

For Hypotheses 2 through 4, a binomial logistic regression analysis was conducted to predict the likelihood of a student changing from a STEM major to a non-STEM major using the SES, SIAS, CCES, gender, ethnicity, first-generation status, and annual household income as predictors (see Table 10). A test of the model was statistically significant, $\chi^2(14, N = 190) = 44.81$, $p < .001$. Nagelkerke's R^2 was .30, indicating a weak to moderate relationship between the predictor variables and the group membership variable (switch or persist). The SIAS, gender, and ethnicity were significant predictors, whereas the SES, CCES, first-generation status, and annual household income were not significant predictors.

H_2: Female students starting in a STEM major will be more likely to change to a non-STEM major than male students starting in a STEM major. Results from the binomial logistic regression model indicated that female students were significantly more likely to switch from a STEM major than male students (β = 0.80, *SE* = 0.39, *p* = .04, Exp(B) = 2.22). Female students were 2.22 times more likely to switch their major than male students.

H_3: Students of color starting in a STEM major will be more likely to change to a non-STEM major than White students starting in a STEM major. Results from the binomial logistic regression model indicated that Hispanic students were significantly more likely to switch from a STEM major than White students (β = 1.64, *SE* = 0.49, *p* = .001, Exp(B) = 5.17). Hispanic students were 5.17 times more likely to switch their major than White students.

H_4: Self-efficacy, stereotyping, and the learning environment will contribute to decisions to change from a STEM major. The binomial logistic regression model indicated that the SIAS was a significant predictor of whether or not a student would switch from a STEM major (β = -0.02, *SE* = 0.01, *p* = .01, Exp(B) = 0.98). As SIAS scores increased, the likelihood of switching majors slightly decreased, Exp(B) = 0.98). SES scores and CCES scores were not significant predictors of whether or not a student would switch from a STEM major.

Table 10
Logistic Regression Model Predicting the Likelihood of Changing From a STEM Major

	β	*SE*	*p*	Exp(B)
SES	-0.09	0.05	.07	0.92
SIAS	-0.02	0.01	.01*	0.98
CCES	0.01	0.01	.30	1.01
Gender (Male)	0.80	0.39	.04*	2.22
Ethnicity (White)				
Hispanic	1.64	0.49	.001*	5.17
Asian	1.04	0.61	.09	2.83
Other	-0.04	0.59	.94	0.96
First-generation (No)	0.08	0.37	.83	1.08
Annual household income				
(Less than $20,000)				
$21,000 to $40,000	-0.59	0.47	.21	0.56
$41,000 to $60,000	-0.99	0.58	.09	0.37
$61,000 to $80,000	0.44	0.70	.53	1.55
$81,000 to $100,000	1.85	1.34	.17	6.34
More than $100,000	-0.54	0.57	.35	0.59

$^*p = .05$

Phase Two: Qualitative Analysis

Participants

Participants were four Hispanic students, two males and two females. One female student had graduated in Spring 2016 with an undergraduate degree in psychology. All of the others were continuing students with majors in psychology.

Interviews

Each interview was recorded and transcribed verbatim. Pseudonyms were used for each of the interviewees to ensure their confidentiality. A summary of each interview follows.

Interview one. Rosa was a first-generation female student who self-identified as Latina. She was in her junior year at the university. She enjoyed her college experience and felt that she was "actually learning something" as she found her earlier academic experiences "pretty boring." She initially enrolled with a major in biology, with plans to become a medical doctor, specializing in oncology or pediatrics. She had wanted to be a doctor since she was young and really enjoyed biology; however, she did not enjoy the program at *this* university. Early in her time here, she took an introductory psychology course that she really enjoyed. Rosa stated that she had been interested in the brain since grade school and that this class "solidified" her interest. She then realized that she enjoyed psychology, particularly neuroscience, much more than the classes she had taken as part of her biology major, so she switched to a major in psychology. She had taken several cognitive psychology classes, along with physiological and abnormal psychology in preparation for graduate work in neuropsychology, which she felt was still in alignment with her plans to become a doctor, but now with a focus on neuropsychology. She may even like to teach in the future, so that she can help students and give back.

Rosa found that in the biology department, she had to be more self-directed and self-sufficient in a way that made her feel disconnected. She valued connection with her professors and gained valuable personal insights and direction when they shared their personal experiences as professionals in the field. She noted that her professors in the biology department were not as open in that regard as her psychology professors. She found her biology professors distant and disconnected to her as a student, often unavailable and when available, unapproachable and often intimidating. She stated that interactions with her professors in the biology department usually consisted of directions such as, "Okay, take Bio 1050 and now Bio 1150 and don't fall behind." She felt that her professors in the psychology department were not only more accessible, but more engaged when she was interacting with them. She also noted that she felt comfortable enough to "share some of [her] point of views on some things [she] was trying to figure out on [her] own." Although class sizes were similar in both departments, she found that her psychology professors were more interactive.

She looked forward to having more research classes in psychology because she loved doing science in the laboratory. She acknowledged that math skills were important for STEM majors and noted that she did not have a strong interest in math, but felt that her math skills were good and not part of the reason she chose to change from the STEM major. She also noted that she was currently taking some classes to fulfill the pre-med requirements, and that more biology classes may be in her future. She knew that biology and the medical field were connected, but she viewed them "as kind of separated." She felt strongly that the biology department at the university was not for her, and that even if she had experienced more connection there, she probably still would have changed because she “finds [neuropsychology] a tad bit more interesting.” She still held on to the idea that a medical degree was an active goal of hers, but did not feel that she “needs a biology degree to get there.”

Interview two. Sofia was a first-generation female student who self-identified as Hispanic. She had just graduated from the university with a degree in psychology and a minor in Gender Studies. She enjoyed her time as a student and planned on returning to get her Master’s degree in Counselor Education. She started out with a major in biology, but had some medical issues that resulted in her changing from the STEM major. Early in her freshman year, she had to take several weeks off during the semester to have gall bladder surgery. As a result of the time off from school, she fell behind in her schoolwork. She initially approached her biology professor about making up the work, but he would not allow her to do so. Having missed so much time, it was difficult for her to pick up on the work when she regained her health and returned to class. This was a critical class for her major and she feared not being able to complete her education according to her timeline. She found herself at a loss for an immediate answer to her dilemma, so she scrambled to come up with an alternate plan in order to graduate on time.

In high school, she wanted to be a marine biologist and planned to go to her “dream college, Humboldt.” Family circumstances kept her from going to Humboldt and she attended the local university instead, with a plan to eventually transfer to the college of her dreams. Even though her illness had derailed her plans for a biology degree, Sofia stated that she was not really happy with the biology program before that—that in fact, this turn of events was the final straw for her. She reported that she had been having a hard time in the major because "things were moving too fast or [she] wasn't prepared" well enough in high school for the biology courses in college and she "was having a hard time keeping up with everything." She acknowledged that math was an important part of the biology major and recognized that, in addition to her dislike for math, her math skills were not that strong. She was not looking forward to the advanced math classes she was going to have to take as part of the major. Faced with the inevitability of leaving the biology major, she began considering other options for her college major. During this time, a friend reminded her that she had enjoyed the psychology class they had taken together in high school and this strongly influenced her decision to major in psychology.

When asked to compare her experiences in the biology department with her experiences in the psychology department, Sofia relayed that she did not feel well supported in the biology department. She noted that she had experienced anger and rudeness from her professors, condescension, evasion in answering questions, superciliousness, and often made to feel small when approaching the faculty with questions about the material. However, in the psychology department, she felt the pace was better suited to her, the professors were easier to talk to, more accessible during office hours, and more willing to help her if she had questions about the material. She stated that over 100 students attended her first introductory psychology class, yet the professor made it very enjoyable and interesting—even to students who were not psychology majors. Overall, Sofia was happy that she changed majors. She reported that her family was also very supportive during her time at college and that they supported the choices she made. She initially had concerns that they might be disappointed with her change in majors, but was relieved when they encouraged her to do what was important to her. They felt that she knew best because they had not gone to college themselves. She noted that they are "just happy [she] went to college!"

Interview three. Oscar was a first-generation male student who self-identified as Hispanic. He was in his senior year at the university, majoring in psychology with a minor in biology. He knew early on that he would go to college. He was inspired by a cousin who successfully went to college ahead of him, as well as his family who wanted him to go to college so he could do "something better than just the normal." He had an uncle in Mexico who was a successful chemical engineer and a well-respected member of his family, so he initially enrolled as a chemical engineering major at UC Santa Barbara. It was a "predominantly Caucasian university" and 5 hours away from his parents' home. This move was "a big culture shock" for him and he subsequently did not feel that he had a strong support system at that university. He felt that if he had joined a fraternity early on, the trajectory of his academic path would have been very different and it would have been a much more positive experience for him. He also felt that better preparation in high school would have made him more successful as a college student.

After 2 years at UC Santa Barbara, Oscar returned to his parents' home and began again at the local community college with the intention of majoring in biology, because he had begun to lose interest in chemistry as he moved into upper-level classes. At the community college he had the opportunity to take a psychology class and this first class transformed a mild interest into a stronger desire to pursue this area of study. He attributed this to the professor, who was “very inspirational” and “full of spirit.” Oscar enjoyed her interactive approach to teaching and he saw some connections between psychology and biology. She also provided some mentoring in that she encouraged him to follow up with certain psychology professors once he got to the university—professors who would be supportive and also help him find his way to graduate school.

Although this professor was integral to his decision to switch to psychology, he admitted that he had already become dissatisfied with chemistry, particularly the rigidness and narrowness of the discipline, as well as his view that it only offered limited possibilities in terms of theoretical viewpoints and potential careers. He stated that his loss of interest “was probably a lack of passion—like [he] didn’t really find it super enjoyable.” Conversely, he felt that biology and psychology offered more opportunity, with “a little bit more free-flowing” ideas and interpretations—the ability to take different perspectives. He acknowledged the importance of math in the STEM majors and felt that his math skills were up to par, as he received higher grades in his math classes than his chemistry classes. His fondness for math had its limits though—he admitted that he only “liked math to a certain point.”

Oscar’s parents were initially upset at his decision to change his major because he was already 2 years into college and now he would be starting over.

However, once he explained that he did not have a "passion" for engineering or chemistry and that it was not worth doing if he ended up doing something he did not enjoy, they supported his decision. Once he moved back home, he was able to develop his focus and moved forward with his new academic plans—to do well at the community college and transfer to a 4-year university. The local university had appeal because it was close to his parents' home and he would not have to pay rent while attending school. He also liked the smaller classes and the easy accessibility of the professors. Once back in his family home environment, Oscar spent his time studying and working with minimal distractions.

He credited the fraternity with helping him further develop the maturity and focus to become a better, more effective student. Prior to joining the fraternity, he did not have strong study skills or the discipline that was required to be successful at the 4-year university. He felt that his high school classes did not prepare him well for the responsibility he needed as a college student, particularly within the less-structured college environment. He also found high school classes fairly easy and admitted that he did not have to apply himself, yet he still did well, so he had not developed the study skills he needed in college. Consequently, he felt that he had two unproductive years at UC Santa Barbara and had he been more productive, he may have persisted in getting his STEM degree there. The group of men in the fraternity at his current college had been a strong social support system for him and together they brought their GPAs up from the lowest in the organization to the highest level. He noted that "seeing a group of men succeeding in college and doing good acts, like community service, stuff like that, it definitely would have been…life-changing, like a lot earlier."

Interview four. Nico was a first-generation male student who self-identified as Spanish. He was in his 6th year at the university. He worked three different jobs and attended school full-time. He noted he will be graduating at the end of the current semester and planned to go on to graduate school. He enjoyed going to college, although at one point he did not think that he would go to college. Although his family was very supportive of him going to college, they had not been able to give him any practical advice or guidance due to their own lack of experience with the system. He continuously challenged himself, consistently setting academic goals throughout his education, starting with elementary school. He was an ESL student who experienced difficulty under some of his teachers because of his language skills, but also found inspiration through others. He believed that if he could make it through elementary school successfully, then he would be able to successfully complete high school. If he accomplished that, then he believed he would be able to complete college, as well—in spite of being told by one of his elementary school teachers that he would not go to college. College was an important goal for him as his parents came here to provide a better future for their children.

He started as a freshman at the university with a major in biology and the desire to become a doctor. Nico originally chose the biology major because he enjoyed science in high school and particularly liked doing experiments. He also enjoyed chemistry and considered a minor in that subject as well. The inspiration to become a doctor came later, at the suggestion of his parents. He spent his first semester taking general education classes and held off taking classes for the biology major until later. The following semester he took a general biology class which he found to be very different from his high school biology class. He noted that the professor's teaching style was very different, the material was much more detailed, and there was very little in the way of explanation or discussion of the material. Even so, he persisted in the major, thinking he needed to improve his study habits. He began this process by reaching out to other students and forming a study group. In addition to helping him master the material, the study group also gave him a sense of connection, so he did not feel that he was going it alone. He also made use of the tutoring center at the university and the study materials of students who had previously taken the course.

Nico also felt that the professors in the biology department were not as readily available as his high school teachers had been and that he would have to take the initiative to contact them for help. Additionally, he stated that meeting with the professor was limited in its usefulness because he kept referring Nico back to the syllabus as the answer to all of his questions. Nico was left with the impression that learning in college was going to be harder than he thought. He stated that he knew whether a professor would be hard to deal with on the first day of class in the way he or she presented the syllabus—whether they took the time to explain the details of the syllabus or if they just "rush through the syllabus and call it a day." The latter approach led him to believe that the professor was too busy to be bothered with the students.

Nico persisted at his biology major until the end of his junior year. At the time, his GPA was much lower than what he came in with and that summer he was feeling things were unnecessarily hard. He felt that he was capable of doing better than this and was searching for a better understanding of why he was feeling that way. He had previously taken a few child development classes with the intention of minoring in child development, as well as the chemistry minor and the biology major. The intersection of child development with psychology led him to change his major because he found psychology more interesting than biology. He felt this was in alignment with his goal of being a doctor because he intended to work with children and he did not "need to be a bio major to be a doctor." At the beginning of his senior year, he dropped all of his biology classes and declared a major in psychology. Nico felt that math skills were important in the STEM majors and reported that he was quite good at math in high school. He loved math, it was one of his favorite subjects, and he was good at it, so he felt that his math skills did not have any impact on his decision to change from the STEM major.

After changing his major to psychology, Nico was able to raise his GPA. He ascribed this change to the differences in the professors of the psychology department, along with his greater interest in psychology and child development courses. He noted that the psychology professors had more "passion," along with more time to devote to their students, and were more willing to share their own college experiences in order to help their students learn better. Nico participated in the Faculty Mentor Program (FMP) while in the biology major and noted that the professors in this program were helpful to him. He noted that the difference between the FMP professors and the professors in the psychology department was the degree they appeared to enjoy helping the students. He felt that this friendly interest and desire to help was readily apparent to students, as was the ridiculing tone of some of the biology professors. In one example, he noted that a biology professor had remarked to a student in front of the class, "How could [you] miss a simple, easy question when everything was in lecture." He contrasted this with how the professors in the psychology department handled wrong answers—by initially agreeing and then modifying the answer so the student gets the correct information.

After some initial concerns, Nico's parents were supportive of his decision to change his major, even though it would lengthen the time he would be in college. He admitted being somewhat disappointed in this himself, initially viewing it as a personal shortcoming until he found that most college students take five years to finish college. He made the point that it was his life and it was more important for him to do what he found interesting in life than adhere to someone else's expectations for his life. In summing up, he thought it would help future students to be more aware of the difficulty of a STEM degree.

Thematic Patterns

A priori codes were used that matched patterns established in earlier research or cross-matched with data from the quantitative analysis of the present study (Yin, 2014). Emergent codes were added as indicated by patterns in the data. It is interesting to note that all of the students chose psychology as their new, non-STEM, major. The following themes and sub-themes emerged from the raw data as it was analyzed.

Personal factors. This category included interpersonal aspects, dynamics, and prospects that were identified as important by the student. One personal factor that was unique to Sofia was the impact that her gall-bladder surgery had on her continuing in the STEM major. She noted that having the surgery mid-semester, along with several weeks of recovery, and the inflexibility of her professor to make-up the work put her so far behind that she felt like she "wasn't going to make it…to graduate on time." Additional sub-themes are discussed below.

Psychological alienation. Two of the students, Rosa and Nico, reported that having an interpersonal connection with their professors was very important to them. They stated that this type of connection allowed them to experience their professors as personal mentors or successful social models to be emulated. They felt that when the professors shared their own personal experiences as a student, it helped the students guide their own educational journeys. They felt that this connection was available to them in their new psychology majors and that this was a strong draw to the non-STEM major. All of the students expressed a degree of psychological alienation during their time in the STEM program, which they attributed to the perceived inaccessibility or unapproachability of the STEM professors. However, Oscar attributed this distance to the large number of students in the STEM major and his own inexperience with ways to effectively connect with his professors, rather than the personal characteristics of the professors.

Inappropriate choice of a STEM major. Seymour and Hewitt (1997) found that students chose their STEM major based on either the influence of family, altruistic desire, or the belief that college was a logical extension of high school performance without being sufficiently prepared for the depth required in college. Every student interviewed had chosen his or her STEM major for one of these reasons, rather than an intrinsic interest that might have sustained them through their pursuit of a STEM major. Rosa voiced some intrinsic interest that had been present since childhood, but expressed that she eventually found neuropsychology suited her interests better than her original biology major. Her original choice of biology as a major was also driven by her strong desire to become a doctor, not just any doctor, but an oncologist or pediatrician—choices that may have been driven by an altruistic ambition.

Nico and Oscar noted that they had chosen their STEM majors because their families had certain expectations for their sons, Nico as a doctor and Oscar as a chemical engineer following in the footsteps of his notable uncle. Sofia seems to have been the most idealistic and least internally driven to pursue her STEM major. She originally chose an unrealistic marine biology major—unrealistic because she is fearful of being in the ocean, which she eventually abandoned when she could not attend her "dream school." Indeed, attending the dream school seemed to be more of a priority than the major itself. Enrolling in the STEM major at this university seemed to be the end result of increasingly limited options rather than purposeful choice. When faced with the potential loss of her biology major, she admits that she was having enough difficulty with the STEM major that the surgery was just the final push she needed to leave the major. Once she was faced with choosing a new major, she was at a loss to come up with a new major until her high school friend suggested psychology—which she then pursued.

Appeal of the non-STEM field. All of the students found the psychology major to be much more appealing than their previous STEM majors. They all came to the psychology major as a result of taking a single class in psychology, either in high school as in Sofia's case, or as part of their general education requirements. Their experiences in these classes stood in stark contrast to their learning experiences in the STEM major. They noted that their psychology professors were much more approachable and willing to help them. For some of them, this first psychology professor inspired and encouraged them in ways they had not experienced before. This may have enabled them to feel successful at a time when they may not have been experiencing much success in their STEM classes, which may have emphasized the appeal of the non-STEM major.

Future prospects. Future considerations were an important part of all of the students' decisions to change majors. Oscar and Nico particularly noted the importance of intrinsic interest and "passion" as critical factors when considering their future work. When challenged by their families about their change in majors, both of them emphasized that it was important to them to have an interest in what they were doing for their future career, otherwise it was not worth doing. This intrinsic interest was a vital feature of the "imagined" future for all of the students. As mentioned above, intrinsic interest was also important for Rosa in her choice of psychology over biology. She noted that she had a strong interest in biology, but her interest in neuropsychology was stronger. Sofia was also driven to find something of interest to pursue for her new major; she just needed her friend to remind her of her interest.

The STEM experience. This thematic category included factors that students reported about their academic experiences while in their STEM programs. This included how academically supported students felt from the department and faculty, as well as how these academic factors impacted the student's satisfaction with the program and continued interest in pursuing the STEM degree.

Unsupportive culture. All of the students reported feeling unsupported in their academic pursuits while in the STEM major. They reported that they were often given cursory guidance about academic requirements and were expected to be able to manifest outcomes on their own. According to the students, any attempts to garner more information or help were met with either indifference or discourtesy. The overall feeling reported by the students was one of not caring whether or not students were successful—that they were expected to survive on their own.

Perception of poor teaching. Faculty in the STEM major were described by the students in a particularly unfavorable light. They were noted to be ridiculing, intimidating, condescending, evasive about the material, and generally too busy to be bothered. STEM professors were noted to be publicly angry and rude toward the students and based on their own experiences or their observations of how other students in their classes were treated, they concluded this behavior was the norm. Students often felt small or unimportant when approaching the faculty with questions. These types of experiences led Rosa to state that *this* biology department was why she was no longer pursuing a degree in that department—implying that a different biology department may have enabled her to persist in her STEM degree.

Dissatisfaction with the STEM program. Given the unanimous reports of an unsupportive culture and poor experiences with faculty it is not surprising that students complained of dissatisfaction with the program. Even so, it is an important consideration in that students did not report becoming dissatisfied and then looking elsewhere. Instead, they fortuitously experienced introductory classes from a different major they found more satisfying, which then made their dissatisfaction with the STEM major more apparent, driving them toward the more satisfying program. It is also not uncommon to become dissatisfied with an unsuitable or untenable situation, as in Nico's case. The resulting discomfort may then lead to looking for a more satisfying or face-saving alternative.

Lack or loss of interest in the STEM major. The loss of interest was often cited as an underlying factor in the decision to change from the STEM major to psychology. It was often mentioned as an afterthought, something that was subsequent to another, stronger reason for changing. However, this reason gains more strength when considered alongside the students' emphasis on "passion" or strong intrinsic interest as the important reason for choosing the non-STEM major.

Readiness for the STEM. This theme involved the preparation, skills, and mindset that the student brought to the task of getting a higher education. The students reported that all of these factors indirectly impacted their decisions to change from their STEM major. These factors were not given as the main reason for, or the direct cause of, the change, but rather an acknowledgement that being better prepared may have helped them be more successful in achieving a STEM degree.

Inadequate preparation. Admittedly, the students found that their high school experiences had not prepared them well enough for the rigors of college. This lack of preparation generally fell into two categories, the difficulties of the STEM coursework and a lack of "soft skills." Both are outlined in more detail below.

Perceived hardness of the STEM major. Students often reported that the STEM coursework was much more difficult than what they had experienced in high school, and more difficult than they had expected. They expressed surprise that they had not been better prepared and felt that they had been done a disservice by their high schools—that they had been misled by their earlier success in STEM subjects there. Some expressed surprise that they were not doing as well in college because the work had been so easy for them before—that good grades had come easily and now they were much more difficult to attain.

Soft skills. These skills are the indirect skills that are needed to succeed in anything, not just getting an education. Having these skills is often referred to as being mature or grown up, taking responsibility for personal and professional outcomes, or just “getting the job done.” They include things like getting up on time, adhering to a schedule, navigating a “system” to access resources, setting long-term goals, allocating time to work towards long-term goals, following through on the steps to achieve established goals, and the delay of short-term gratification in favor of long-term outcomes. Oscar reported struggling quite a bit with these, although statements made by some of the others implied a struggle with these skills as well. Oscar noted that the highly-structured environment in high school left him struggling with the perceived freedom of college and the responsibility of adhering to a class schedule that he created. Nico and Oscar both noted that they had to “learn how to learn.” Already in college, they were surprised that they had to spend time learning how to study effectively in order to be successful there. Sofia admitted to being overwhelmed and underprepared when she first got to college. Rosa seems to be the only student not impacted by this factor. Although she admitted that elementary school and high school were not difficult, she reported that she finally felt she was being academically challenged at a level that she enjoyed.

Summary

The quantitative portion of the study found significant differences between switchers and persisters on the SIAS, between genders on the CCES, and between Asians and White students on the CCES. It also indicated that female students and Hispanic students were significantly more likely switch from a STEM major to a non-STEM major than other students. The qualitative portion of the study found that students interviewed for the present study endorsed many of the same themes that had been identified by students over two decades ago. A discussion of the results follows in Chapter V, along with implications of the results, limitations of the study, suggestions for future research, and concluding remarks.

CHAPTER V

DISCUSSION

The present mixed methods study looked at factors influencing the decisions of undergraduates to change from a STEM major to a non-STEM major at a Hispanic serving 4-year university in the Central Valley of California. Data were collected in two phases, a quantitative phase and a qualitative phase. Phase 1 consisted of a survey with invitations distributed through e-mail to a qualified selection of students who had attended the university from 2010 through 2014. Analyzed variables included the status of the student's major; scores on the SES, SIAS, and CCES; gender; ethnicity; first-generation status; and annual income. Phase 2 involved semi-structured interviews with four students of color who had changed from a STEM major to a non-STEM major. Prominent themes that emerged were related to personal factors, academic experiences in the STEM program, and the student's readiness for the challenges of a STEM major.

Summary of Results

The present research was guided by the following research question: How do self-efficacy beliefs, stereotype threat, and the learning environment influence the decisions of women and students of color to change from a STEM major to a non-STEM major? It generated four hypotheses that are discussed below.

H_1: Students who change from a STEM major to a non-STEM major will perform differently on measures of self-efficacy, stereotyping, and satisfaction

with the learning environment than those students who do not change from a STEM major to a non-STEM major

This hypothesis was selectively supported. There were no significant differences between switchers and persisters on the SES. However, there were significant differences between switchers and persisters on the SIAS, with switchers scoring lower overall than persisters. Lower scores on the SIAS indicate less susceptibility to stereotype threat. There were no significant differences between switchers and persisters on the CCES.

H_2: Female students starting in a STEM major will be more likely to change to a non-STEM major than male students starting in a STEM major

This hypothesis was supported. There was a significant difference between male and female students who started in a STEM major. Female students were 2.22 times more likely to switch from their STEM major to a non-STEM major than male students in a STEM major.

H_3: Students of color starting in a STEM major will be more likely to change to a non-STEM major than White students starting in a STEM major

This hypothesis was supported. There was a significant difference between Hispanic students who started in a STEM major and White students who started in a STEM major. Hispanic students were 5.17 times more likely to switch from their STEM major to a non-STEM major than White students in a STEM major. There were no significant differences between other students of color who started in a STEM major and White students who started in a STEM major.

H_4: Self-efficacy, stereotyping, and the learning environment will contribute to decisions to change from a STEM major

This hypothesis was also selectively supported. SES scores and CCES scores were not significant predictors of whether or not a student would switch from a STEM major. However, the SIAS was a significant predictor of whether or not a student would switch from a STEM major. Higher scores on the SIAS indicate greater susceptibility to stereotype threat. Results from the present study indicated that the likelihood of switching majors slightly decreased as SIAS scores increased, indicating that switchers were less susceptible to stereotype threat than persisters. Although not related to a specific hypothesis, female students scored significantly higher on the CCES than male students and Asian students scored significantly higher on the CCES than White students.

Discussion

As noted above, the results of the present study suggested that there are some significant differences between switchers and persisters. Although Hypothesis 1 and Hypothesis 4 were not supported uniformly, Hypothesis 2 and Hypothesis 3 were supported, suggesting that women and students of color, most notably Hispanic students, were more likely to switch from a STEM major than White male students in STEM majors. These results support the findings of the Seymour and Hewitt (1997) study conducted over a quarter of a century ago. A priori codes for the qualitative analysis were based on these earlier findings and the students interviewed for the present study substantiated many of the themes noted by Seymour and Hewitt.

Choice and Preparation

As noted in earlier chapters, students often choose their STEM majors either based on the influence or opinions of others such as family and friends, altruistic desires, or a misunderstanding about what the STEM major entails. Seymour and Hewitt (1997) noted that although switchers and persisters may make their choice of major as a result of the aforementioned reasons, having an intrinsic interest often made the difference between students who switched and those who persisted. The students interviewed for the present study reported that having a strong interest in the field that would be the basis for their future career was an important consideration in choosing the new non-STEM major. The choice to switch majors was made because they found they no longer had an interest in pursuing the STEM major. This supports the findings of Maltese et al. (2014) that innate interest was the primary reason that STEM professionals had persisted in their degree. However, it should be noted the students in the present study did not consider strong intrinsic interest as an important consideration when choosing their STEM major—this only became important after spending some time in the college environment and then making the choice for their new major based on this interest.

Deciding about a major never happens in a vacuum—families, friends, and idealism often drive decisions when people are not yet sure of their own convictions. Tracey et al. (2005) found that students undergo a period of uncertainty beginning in the senior year of high school when deeper interests begin to coalesce and crystalize. When facing uncertainty, it is common to look to others for help in making important decisions. In the past, students may have felt beholden to choices made based on the direction of others, particularly family members, and under pressure to quickly enter the workforce. However, Arnett (2000) suggested that the modern lifestyle in post-industrial societies allows for social and economic factors that are more generous today than in the past, affording many young people the luxury of changing their minds, of indulging the exploration of different potential career trajectories while in college. Each of the students interviewed noted that their families were supportive of the change in major after initially expressing dismay at the student's plan to change majors. For family members, attaining the goal of a college education was the most salient factor, even if it took longer or the degree no longer aligned with what the family had originally hoped for.

Arnett (2004) suggested that the developmental stage of emerging adulthood is a time of exploration and learning to make independent decisions about what is important to the individual and accepting the responsibility for those decisions. For many individuals, this stage of development usually coincides with college attendance. Attending college is rife with new experiences and opportunities for exploring novel ideas while gaining knowledge. For Rosa, Oscar, and Nico the desire to change majors was driven by experiencing courses outside of the STEM major that captivated their interest, opening new avenues potentially leading to a different future. Sofia also explored different possibilities to come up with a new major, but her choice was made under the pressure to "graduate on time." Feeling compelled to make a decision quickly; she fell back on the next best thing, her earlier interest in psychology.

Nico and Oscar stressed the importance of intrinsic interest to their families as they discussed the change from the STEM major and the extra time it would add to their college years. For them, the change in major represented a decision that freed them from the family's imposed choice of major and career to their own choice—a choice they made independently, based on their intrinsic interest, and they were willing to take responsibility for the decision. Indeed, all of the students took responsibility for consequences of making the change in majors. Nico, Oscar, and Rosa cited greater interest as an important determinant for the change, agreeing that it was "worth it" to be doing something of interest to them. Sofia also felt, in hindsight, that she ended up with a degree that served her interests better than the biology degree would have, particularly as she looks forward to entering a graduate program focused on clinical work.

In addition to being influenced by family to pursue a STEM degree, Oscar and Nico may have been inadequately informed or misinformed about what a STEM major would entail. As in the Seymour and Hewitt (1997) study, inadequate preparation or misinformation were never cited by the students in the present study as direct factors in the choice to change from the STEM major. However, with the exception of Rosa, they all noted that they were negatively impacted by this lack of preparation. Oscar seemed surprised at how much more different college was than high school, noting that he was not prepared for the rigor of college coursework. He noted that the course material was much more difficult than in high school and he struggled with the soft skills needed to apply himself academically. Nico believed that college, and the STEM major, was a logical next step and that college success would come as easily as the academic success he experienced in high school. Sofia reported that she had to move through the STEM material more quickly than was comfortable for her and she often felt ill-prepared to do the work, even if she had not taken the time off for her surgery.

When faced with these types of challenges, Chemers et al. (2001) found that SE was an important factor in a student's ability to persist in academic endeavors, suggesting that weak SE beliefs may have contributed to the lack of persistence in students from the present study. Results from Hsieh et al. (2007) and Baier (2014) also suggested that switchers report lower levels of SE. The results of the present study indicated that there were no significant differences in SE between switchers and persisters. Chemers et al. found that SE distinguished a student's perception of academic difficulties, with those having high levels of SE interpreting difficulties as challenging, rather than threatening. Students interviewed for the present study did not indicate they changed majors because they believed they would not be successful. Aside from the intrinsic interest, they instead cited factors external to themselves as key elements of their decision to change from the STEM major. The focus on external factors rather than internal characteristics as causal factors supports Dweck's (1986) social-cognitive approach to learning whereby setbacks are seen as opportunities for improvement, rather than indicators of a lack of ability.

Walton and Cohen (2011) also found that external rather than internal attributions for setbacks allowed students to persist at their academic endeavors. It may be that most of the students interviewed for the present study were operating from a growth mindset rather than a fixed mindset. Rosa seems to have had the strongest predisposition to using a growth mindset as she appeared very confident in her abilities as a student, relishing the more challenging coursework in college, and situating her difficulties in the STEM major as a problem within the biology department at *this* college. Nico may be the one exception as he reached a critical point after his junior year, seriously questioning that "something must be wrong with [him]," and doubting his ability to be successful. Even so he did exhibit a growth mindset early on when he initially faced difficulty in his STEM classes by reaching out to other students to form study groups, working with a tutor, and participating in the FMP.

The Learning Experience

In the Seymour and Hewitt (1997) study, poor teaching was the third most common reason for switching out of a STEM major, just behind the appeal of the non-STEM major as more interesting or of better quality. The students interviewed for the current study also seemed to have much stronger convictions about the quality of instruction in their non-STEM majors than in their initial STEM majors. As noted earlier, they often stressed that the non-STEM major had greater interest for them than the initial STEM major. This lack or loss of interest for the STEM major was the primary factor given by students from the Seymour and Hewitt study as the reason for changing to a non-STEM major. All of the students interviewed for the present study reported that the appeal of the non-STEM major was derived from differences in the way the material was presented by the professors.

All of the students interviewed for the current study reported negative interactions with STEM faculty, particularly when compared to faculty in their non-STEM major. Professors in the STEM majors were noted to be distant and inaccessible to the students, which was often perceived as a lack of concern or care about the academic success of the students. For Rosa and Nico, having a strong interpersonal connection with faculty was an important factor in making the change to a non-STEM major. Additional adjustments were made by the students to accommodate this change. Rosa originally chose her STEM major for altruistic reasons, which shifted once she encountered the distant professors in the biology department. Rosa transferred the altruistic desires that drove her initial choice for a STEM major as a route to being an oncologist or pediatrician to perhaps teaching neuropsychology to future students so that she can give back. Oscar, Nico, and Rosa extended the length of time they would be in college when they changed majors.

In general, students reported that professors in the biology department presented traditional lectures that did not elaborate details of the material in ways that the students could understand. When professors were approached for clarification, students were expected to know and understand the material or they were directed to check the syllabus. Alternatively, professors in the psychology department were noted to be more interactive in their presentation of the class materials. All of the students found the interactive approach more conducive to mastering the material and keeping their interest. This supports the findings of the Freeman et al. (2014) meta-analysis indicating that students in classes using traditional methods were more likely to fail than those in classes using active learning. Nico and Oscar both admitted that their GPAs dropped while in the STEM major, but they managed to bring them back up once they transferred to the non-STEM major.

Kulturel-Konak et al. (2011) found that males and females preferred different teaching styles, with males preferring concrete presentation of material and females preferring a more abstract, creative approach. Reports from the students interviewed did not support the findings of Kulturel-Konak et al. as males and females both preferred the more interactive approach of the psychology professors. Oscar specifically noted that the appeal of psychology over chemistry was the flexibility in accepting creative solutions and approaches to the material. He found chemistry to be "too narrow" in its approach and application. Nico noted that psychology professors were much more supportive than the biology professors when correcting students who gave a wrong answer during class. He stated that in his psychology classes, professors would acknowledge the wrong answer and then "make modifications to better your answer to make it fit what they want you to know." This is in keeping with the Blackwell et al. (2007) study that found well-placed constructive criticism and feedback focused on praise for engaging in the learning process rather than correct answers developed stronger, more resilient students.

Sofia, Oscar, and Nico indicated that the STEM program was harder than they expected and they were not well prepared for it, as noted earlier. They all felt that they might have been able to succeed in the program with more support from the professors and the department. Although she did not find the program hard, Rosa noted that she was expected to find her own way in the biology department with no guidance and the others echoed this view that the STEM program offered little to no support for the students. Perhaps it is not surprising that the students found psychology professors more engaging and supportive. As a field, psychology is the study of human behavior, including learning and motivation, so most psychology professors should be well-versed in the factors and techniques that foster and enhance learning. Even so, there may be psychology professors who could be perceived in ways that are similar to the way the students viewed their STEM professors; however, none of the students interviewed for this study reported such behavior from their psychology professors. Professors in the STEM subjects may not be the cold, condescending, and uncaring individuals they were perceived to be. Just as doctors are not often trained in bedside manner, professors in the STEM subjects, while experts in their specific field, may not have had much training in how to *teach* effectively. They may have had little knowledge of research from education or social science about how best to facilitate learning. Alternatively, this behavior on the part of the STEM professors may have been part of a “weed-out” process that the students were not overtly aware of, but nevertheless may have influenced decisions to leave the major.

Gender Issues

Although both sexes reported loss of interest in the STEM field as the reason for switching, Seymour and Hewitt (1997) found slight differences between the experiences of men and women in the STEM majors that also impacted their decision to change. Women were noted to be more affected by their status as a minority in a traditionally male dominated setting, along with prejudice toward their gender and overt sexism. When combined with the competitive-not collaborative environment, many women reported a sense of psychological alienation. The women interviewed for this study did not report experiencing any of these situations. However, the women reported experiences that the men did not report having.

Rosa reported that her biology professors were distant and disconnected, often unavailable or unapproachable, and intimidating. Sofia relayed that she felt unsupported in the biology department. She had experienced anger and rudeness from her professors who were condescending, evasive in answering questions, and supercilious. She indicated that she was often made to feel small when approaching the faculty with questions about the material. However, in the psychology department, she felt the pace was better suited to her, the professors were easier to talk to, more accessible during office hours, and more willing to help her if she had questions about the material. Neither Oscar nor Nico reported experiencing such treatment from their STEM professors, although they did note that STEM professors often did not have time to meet with students. However, Nico did report observing other students treated in a disrespectful and belittling manner—a manner he noted as "not fair."

In addition to these experiences, Cheryan et al. (2009) found that women were more sensitive than men to stereotypical environmental cues and that these cues influenced how interested they were in CS. As previously noted, in the present study women scored significantly higher than men on the CCES, indicating they were more likely to place importance on features of the campus environment than men. This offers some limited support for the findings of Cheryan et al. as the CCES does not focus specifically on the campus environment of STEM programs. Additionally, Asian students scored significantly higher on the CCES than White students. Overall, safety concerns and the ability to follow-up any concerns without retribution were the primary features of the campus environment identified as important, followed by physical and mental health concerns. The least important features of the campus environment were having administrators, faculty members, and mentors of the same gender or ethnicity. Cheryan et al. (2011) found that having STEM role models of the same gender was counterproductive in promoting beliefs in female participants that they could be successful in CS. The results of the present study support the findings of the 2011 Cheryan et al. study and suggest that interacting with role models of the same gender or ethnicity may not be a critical factor for students to feel successful or supported in the academic environment.

Race and Ethnicity Issues

At the time of the Seymour and Hewitt (1997) study, almost twice as many White students attained engineering degrees than students of color. Although the number of students of color in STEM is increasing, White students are still overrepresented in STEM programs. Cook et al. (2015) reported that Black students had made the most gains in attaining STEM degrees, increasing by 60% since 2000. The results of the present study suggest that Black students are continuing to persist in attaining STEM degrees. As mentioned before, Black students were not included in the inferential data analysis because none of the Black students participating in the study had switched out of their STEM major. The persistence of these Black students is notable. From the viewpoint of educators, such persistence is desirable. In spite of the lack of a comparison group of Black switchers, the SIAS scores of these students may allow limited speculation on the impact of stereotype threat on Black students. Overall, Black students had SIAS scores close to the SIAS scores of Asian students, who reported the most susceptibility to stereotype threat. Black men had SIAS scores slightly lower than Asian men, who also reported the most susceptibility to stereotype threat. Black females reported experiencing the most susceptibility to stereotype threat with the highest scores on the SIAS. They also had the lowest scores on the SES. The only lower score on the SES was the one student who identified with an ethnicity and gender of *Other*. This student also had a relatively low score on the SIAS and had switched from a STEM major. Hispanic male switchers had the lowest SIAS scores, with White male switchers scoring slightly higher. There was a significant difference between switchers and persisters on the SIAS, with switchers reporting significantly less susceptibility to stereotype threat than persisters.

These findings run counter to much of the literature on stereotype threat (Beasley & Fischer, 2012; Gonzales et al., 2002; Steele & Aronson, 1995). In spite of high SIAS scores, Black students persisted in their STEM major. Beasley and Fischer found that Black men were most likely to leave a STEM major. The results of the present study did not support those findings. However, Beasley and Fischer also found that Black men and Black women experienced the highest amount of stereotype threat. The current study suggests support for those findings. Although the Black students in the present study scored relatively high on the SIAS, they did not approach the ceiling score of 210. It may be that Black students who switch would score even higher on the SIAS than the Black persisters in the current study. Interestingly, the student with the most susceptibility to stereotype threat was a White male persister majoring in biology who had the highest SIAS score (198). This may offer some support to the suggestion of Beasley and Fischer that White males may feel threatened as their ethnicity begins to move into minority status.

Beasley and Fischer (2012) also found that stereotype threat was a significant predictor for Black men and Black women leaving a STEM major. Despite the perceived stereotype threat, Black students in the STEM majors at this institution continued in the major. Perhaps these Black students had a strong intrinsic interest in the STEM major that provided motivation to persist despite how others may view their performance in the STEM major. Socially and culturally, Black individuals have had to endure a long history of oppression and opposition. It may be that these experiences result in greater personal resilience. Additionally, Black students may have had to overcome social pressure from their Black peers to preserve important ethnic values that may not always align with academic goals. Alternatively, there were Black fraternities and sororities on the campus that may have offered support for Black students in STEM majors in ways that were similar to those reported by Oscar.

Gonzales et al. (2002) also found a significant effect of stereotype threat on a difficult cognitive test with Latino/a participants scoring significantly lower than White participants. The results of the present study do not support these findings. Switchers scored lower on the SIAS than students who persisted in the STEM major. Overall, Hispanic students had lower SIAS scores than Whites, Asians, and Blacks. All of the students interviewed for the current study were Hispanic who attended an HSI college. During the interviews they did not express any negative experiences around their ethnicity, nor did they appear uncomfortable talking about their ethnicity. The only exception was Rosa, who was born in Mexico and appeared uncomfortable when asked about her ethnicity. It should be noted that Rosa's interview was conducted shortly after the election of a president who had promised to tighten restrictions on Mexican immigration.

Implications of the Study

The present study contributes to and extends the current knowledge base about factors that may impact a student's intention to attain a STEM major. Based on the findings, there are a number of broader implications. As students move through the educational ladder, elementary and high school educators should encourage students to make decisions about a college major based on intrinsic interest rather than external factors. STEM majors should be promoted in ways that generate excitement and interest, without oversimplification of what it takes to attain a STEM degree. Additionally, it may be beneficial to present students with a broader scope of potential careers that can be had with a STEM major.

Developing stronger bridges between high school and college could make for a smoother, more familiar transition. Connecting incoming freshmen with a STEM mentor at the junior or senior level could help the incoming student successfully navigate the academic course he or she has chosen. This pairing could be an effective supplement to the new student orientation, which may present a wealth of information at a time when students are experiencing information overload due to the novelty of the setting. Retention of information presented at the orientation is likely to be limited and having a peer-mentor can provide relevant information at times when it would be most appropriate and helpful. Offering more secondary support for students, such as tutoring services, career-counseling, or brief educational seminars offering instruction in study skills or effective time-management strategies may help students succeed academically. Often these supports are already in place, but need to be more salient and user-friendly for students.

Teaching soft skills along with academic subjects and gradually lessening the external supports for students to increase their independence as they move toward attending college could help students prepare for the greater self-reliance needed to succeed in college. Educating high school students about wide-ranging careers available in STEM majors, perhaps even implementing a "Walk in My Shoes" program to allow students to interact with a professional in their field of interest to gain first-hand experience with the day-to-day expectations could help students make a more informed choice of major.

At the college level, administrators could support faculty with professional development in areas that may increase collaboration with students in the learning process. STEM professors may be unaware or unaccepting of sound, research-based principles in learning, motivation, and engagement. This could be addressed by encouraging cross-discipline collaboration and non-competitive interaction with faculty in other departments to share ideas and successful strategies to increase student engagement. Above all, emphasizing a focus on students as the most important element in higher education could help faculty present a more "user-friendly" interface with the students they serve. After all, without students there would be no need for professors.

On a much larger scale, professional opportunities in STEM for women and people of color remain limited. Many of these positions involve working in a setting that may be restrictive or even hostile for men of color and all women. Perceptions of limited career opportunities offer fewer incentives to pursue and persist at a challenging academic path. Advocacy and outreach to improve public perception of STEM, along with cultivating workplace settings that embrace human diversity as an important factor in generating creativity and innovation are important tools in promoting change. Maintaining a leading edge in a world that is increasingly sophisticated in technology and globally interconnected requires diverse perspectives and talents.

Limitations and Recommendations

As with most studies, the present study would have benefited from a larger, more representative sample size, particularly for the qualitative phase. Interviews from the present study only offer the perspectives of individuals from one ethnic group, all of whom chose to switch from a STEM major to a major in psychology. It would have been more informative to interview students of other ethnicities. Interviewing students who had changed to other non-STEM majors, as well as including students who persisted as a comparison for switchers would also be more informative. It would also have been more informative to have a group of Black switchers to compare with Black persisters. Unfortunately, without a comparison group in the current study any speculation is one-sided and, therefore, cannot offer a full picture of factors affecting this group of students. As an additional source of data, interviewing professors would offer a more well-rounded picture of the variables at play. The current study offers a small snapshot of student experiences in the STEM majors. A longer, longitudinal study would provide a richer, more detailed picture of how students come to switch from or persist in a STEM major, ideally beginning in high school.

The CCES assesses the campus environment in general without exploring academic supports that may be of importance to students. Using a scale that measures more of the learning environment may provide more relevant information. Specifically assessing the availability, salience, and accessibility of services and supports that facilitate academic activity such as library hours; laboratory conditions; the ease and speed of internet access; the availability of computers and software; and secondary supports such as tutors, information technology staff, and librarians may be more relevant to decisions about persisting at a major. Moreover, the impact of classroom size, the availability of classes, as well as the availability and quality of direct contact with professors and teaching assistants may also influence a student's decision to change from a STEM major.

Women and individuals of color continue to be underrepresented in the STEM fields. As indicated by the results of this study, women and Hispanic students are more at-risk for leaving a STEM major than males and White students. Additional research is needed to further explore factors that impact students who aspire to STEM majors and careers, but do not attain those visions. Increasing the understanding of factors influencing a student's decision to switch from a STEM major could inform the design of better programs and strategies that may increase the number of students attaining STEM degrees.

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APPENDICES

APPENDIX A

DEMOGRAPHIC CHARACTERISTICS FOR COLLEGE OF SCIENCES

Percentage of Undergraduate Students by Program as of Fall 2016

		Gender		Ethnicity				Age	
Degree Program	*n*	Male	Female	White	Hispanic	Asian	Black	≤ 24	≥ 25
Biological Sciences	735	33%	67%	22%	42%	21%	2%	82%	18%
Chemistry	121	51%	49%	26%	40%	14%	2%	70%	30%
Child development	224	3%	97%	24%	54%	8%	3%	78%	22%
Cognitive studies	16	25%	75%	38%	38%	13%	-	38%	63%
Computer science	289	82%	18%	22%	41%	20%	2%	79%	21%
Ecology & sustainability	-	-	-	-	-	-	-	-	-
Geology	31	74%	26%	58%	35%	-	3%	32%	68%
Mathematics	127	54%	46%	35%	41%	9%	1%	76%	24%
Nursing (licensure)	170	22%	78%	29%	32%	25%	2%	79%	21%
Nursing RN to BSN	36	17%	83%	17%	39%	28%	-	8%	92%
Physical sciences	2	50%	50%	50%	50%	-	-	50%	50%
Physics	36	86%	14%	17%	42%	11%	6%	86%	14%
Pre-nursing	260	13%	87%	16%	51%	20%	2%	99%	1%
Psychology	951	22%	78%	19%	59%	8%	3%	79%	21%
Undeclared Biology	24	33%	67%	38%	29%	8%	-	63%	38%
Undeclared Nursing	246	13%	87%	16%	52%	14%	2%	94%	6%

Note. Percentages may total more than 100 due to rounding. (Office of Institutional Research, n.d.)

APPENDIX B

GENERAL SELF-EFFICACY SCALE

Please rate how well the following statements describe you. In answering each question, use a range from 1 to 4 where 1 stands for **not at all true,** 2 stands for **hardly true,** 3 stands for **moderately true,** and 4 stands for **exactly true.** Please make only one response choice per question.

1. I can always manage to solve difficult problems if I try hard enough.
2. If someone opposes me, I can find the means and ways to get what I want.
3. It is easy for me to stick to my aims and accomplish my goals.
4. I am confident that I could deal efficiently with unexpected events.
5. Thanks to my resourcefulness, I know how to handle unforeseen situations.
6. I can solve most problems if I invest the necessary effort.
7. I can remain calm when facing difficulties because I can rely on my coping abilities.
8. When I am confronted with a problem, I can usually find several solutions.
9. If I am in trouble, I can usually think of a solution.
10. I can usually handle whatever comes my way.

APPENDIX C

SOCIAL IDENTITIES AND ATTITUDES SCALE

Please rate how strongly you agree or disagree with the following statements. In answering each question, use a range from 1 to 7 where 1 stands for **strongly disagree** and 7 stands for **strongly agree.**

1. My gender influences how I feel about myself.
2. Math is important to me.
3. My gender contributes to my self-confidence.
4. My gender influences how teachers interpret my behavior.
5. I value my ethnic background.
6. Most people judge me on the basis of my ethnicity.
7. My gender is central to defining who I am.
8. Being good at math will be useful to me in the future.
9. Most people judge me on the basis of my gender.
10. My identity is strongly tied to my gender.
11. I feel a strong attachment to my ethnicity.
12. My gender affects how people treat me.
13. My ethnicity is an important reflection of who I am.
14. I am connected to my ethnic heritage.
15. My gender affects how people act toward me.
16. My math abilities are important to my academic success.

17. My ethnicity affects how my peers interact with me.

18. Doing well in math matters to me.

19. Members of the opposite sex interpret my behavior based on my gender.

20. My ethnicity influences how teachers interact with me,

21. I value math.

22. My ethnicity affects how I interact with people of other ethnicities.

23. Doing well in math is critical to my future success.

24. People from other ethnic groups interpret my behavior based on my ethnicity.

When doing difficult math problems on a test I…

25. Experience doubt about my math abilities.

26. Feel like I am letting myself down.

27. Start to lose confidence in my abilities.

28. Feel like a failure.

29. Feel hopeless.

30. Feel like giving up.

APPENDIX D

COLLEGE CAMPUS ENVIRONMENT SCALE

Instructions: We are interested to know how highly you value the college campus characteristics described below. The following questions are designed to help understand how important these specific college campus characteristics are to you. Please rate each item as to how important it is to your perception of an ideal college environment using the scale provided.

1 = *Not at all important*, 2 = *Somewhat important*, 3 = *Important*, and 4 = *Very important*.

1. A student health center that is close to where I live.
2. A student health center where it is easy to get an appointment with a staff member.
3. A mental health center that has an accessible crisis hotline.
4. A student health center facility that is conducive to privacy.
5. There are a variety of athletic facilities such as a gym, pool, court, track, etc.
6. There are a variety of social activities on campus.
7. A student health center that provides information on maintaining physical health.
8. A mental health center where it is easy to get an appointment with a staff member.
9. There are many administrators from my ethnic background.
10. Filing a harassment or discrimination complaint is confidential.
11. There are campus safety measures to protect students.
12. Athletic facilities are easily accessible.
13. Athletic facilities have convenient hours.
14. I feel safe when using the athletic facilities.
15. There are a variety of sports teams.
16. Athletic facilities are close to where I live.
17. There are clear and visible procedures for reporting crimes.
18. There are organizations or student government groups.
19. There are campus policies and procedures that protect students from harassment and discrimination.
20. A mentor is from the same ethnic background as I am.
21. There are many administrators of my gender.
22. I am able to explore non-traditional fields of study and academic opportunities for my ethnic background.

23. There are strong role models from my ethnic background.
24. I am able to explore non-traditional fields of study and academic opportunities for my gender.
25. A student health center that provides treatment options and referrals.
26. There are opportunities to attend meetings of campus clubs, committees, and organizations.
27. I have the opportunity to work with faculty members on campus committees, organizations or projects (outside of class).
28. I feel safe from student-related violence.
29. A mental health center that provides information on maintaining mental health.
30. I feel safe on campus.
31. My daily decisions are not determined by concerns for safety.
32. I feel I won’t be put at risk because of my gender.
33. I feel I won't be put at risk because of my ethnic background.
34. Seeking mental health services is not stigmatized on campus.
35. There are many faculty members of my gender.
36. I feel safe from social pressures of drug and alcohol use.
37. There are many faculty members from my ethnic background.
38. A student health center that is easily accessible.
39. A student health center with convenient hours.
40. I am able to explore non-traditional career goals for my ethnic background.
41. There are parties on campus.
42. There are fraternities and sororities.
43. Social events are welcoming to all students.

APPENDIX E

DEMOGRAPHIC QUESTIONS

1. What is your age?
2. What is your gender?
3. Choose the ethnicity you primarily identify with (Hispanic, Asian, Black, White, or Other)
4. What major were you in when you started at CSU Stanislaus?
5. What major are you in now?
6. Have you participated in the WOW 2 STEM?
7. Have you participated in the Central Valley Math and Science Alliance program?
8. For the purposes of this research only, may we access your information on file with the university?

If not then:

1. Are you the first person in your family to attend college?
2. What is your current Grade Point Average?
3. What is your annual household income?

   Less than $20,000

   21,000 to 40,000

   41,000 to 60,000

   61,000 to 80,000

   81,000 to 100,000

   More than 100,000

APPENDIX F

INFORMED CONSENT FOR PHASE ONE

Dear Participant:

You are being asked to participate in a research project that is being done to fulfill requirements for a Doctoral degree in Educational Leadership at CSU Stanislaus. We hope to learn about factors that may affect a student's decision to change his or her academic major. If you decide to volunteer, you will be asked to complete an on-line survey that will take about 15 minutes to complete. It will include questions about your college experiences and some personal information. Your responses will be kept completely anonymous.

There are no known risks to you for your participation in this study.

It is possible that you will not benefit directly by participating in this study. The information collected will be protected from all inappropriate disclosure under the law. All data will be kept in a secure location. Only the researcher and her advisor will have access to the data. No personally identifiable information will be kept with the data.

There is no cost to you beyond the time and effort required to complete the procedures described above. If you agree to participate, you will be entered into a drawing for 1 of 3 $50 Amazon gift cards. Your participation is voluntary. Refusal to participate in this study will involve no penalty or loss of benefits. You may withdraw at any time without penalty or loss of benefits.

If you agree to participate, please indicate this decision by checking the box below. If you have any questions about this research project please contact me, **June Newman**, at **jnewman@csustan.edu** or my faculty sponsor, **Dr. Dawn Poole** at **dpoole@csustan.edu**. If you have any questions regarding your rights and participation as a research subject, please contact the IRB Administrator by phone (209) 667-3493 or email IRBAdmin@csustan.edu.

Sincerely,
June Newman
Doctoral Candidate

If you do **NOT** want to participate in the study, please click on the **I do NOT agree to participate** button below.

By clicking on the **I agree to participate** button below, you agree to the following:

I have read and understand the information provided above. I consent to take part in this study. I am at least 18 years old.

___I agree to participate   ___I do not agree to participate

APPENDIX G

INFORMED CONSENT FOR PHASE TWO

Dear Participant:

You are being asked to participate in a research project that is being done to fulfill requirements for a Doctoral degree in Educational Leadership at CSU Stanislaus. We hope to learn about factors that may affect a student's decision to change his or her academic major. If you decide to volunteer, you will be asked to participate in an interview that will take about a half and hour to complete. It will include questions about your college experiences and some personal information. Your responses will be kept completely confidential.

There are no known risks to you for your participation in this study.

It is possible that you will not benefit directly by participating in this study. The information collected will be protected from all inappropriate disclosure under the law. All data will be kept in a secure location. Only the researchers and their direct supervisors will have access to the data. No personally identifiable information will be kept with the data.

There is no cost to you beyond the time and effort required to complete the procedures described above. If you agree to participate, you will given a $20 Starbucks gift card. Your participation is voluntary. Refusal to participate in this study will involve no penalty or loss of benefits. You may withdraw at any time without penalty or loss of benefits.

If you agree to participate, please indicate this decision by signing below. If you have any questions about this research project please contact me, **June Newman**, at **jnewman@csustan.edu** or my faculty sponsor, **Dr. Dawn Poole** at **dpoole@csustan.edu**. If you have any questions regarding your rights and participation as a research subject, please contact the IRB Administrator by phone (209) 667-3493 or email IRBAdmin@csustan.edu.

Sincerely,
June Newman
Doctoral Candidate

I have read and understand the information provided above. All of my questions, if any, have been answered to my satisfaction. I consent to take part in this study. I have been given a copy of this form.

Signature ______________________________________ Date ____________________

Name (printed) ____

In addition to agreeing to participate, I also consent to having the interview audiotape-recorded.

Signature ______________________________________ Date ____________________

Name (printed) ____