Personality, Interests, Self-Efficacy, and Anxiety of Female STEM Majors: A Description, Comparison, and Prediction of Female STEM Majors

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Personality, Interests, Self-Efficacy, and Anxiety of Female STEM Majors: A Description, Comparison, and Prediction of Female STEM Majors

by

Jennifer Lee McKinney

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The Undersigned Faculty Committee Approves the

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Personality, Interests, Self-Efficacy, and Anxiety of Female STEM Majors: A

Description, Comparison, and Prediction of Female STEM Majors

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Approval Date
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This work is dedicated to my mother, Sandra McKinney, my biggest supporter, best friend, and the strongest woman I know.

Last, thank you, God, for Your grace to become a doctor of mathematics education.
Abstract

Personality, Interests, Self-Efficacy, and Anxiety of Female STEM Majors: A Description, Comparison, and Prediction of Female STEM Majors

By

Jennifer McKinney

Gender disparities in specific science, engineering, technology, and mathematics (STEM) degrees are apparent in the United States’ higher education reports (e.g., National Science Committee on Science and Engineering Indicators, 2014). There is a lack of understanding female STEM majors’ selection that can be addressed by personality, STEM interest (INT), STEM self-efficacy (SE), and mathematics anxiety (MA), and understanding the relationship between those factors. The purpose of the study was to describe, compare, and predict female STEM majors based on personal factors (i.e., INT, SE, MA, and personality) through the following strands: (a) to examine the association of female STEM majors’ personality and INT, SE, and MA, (b) to compare the personality traits between females non-STEM and STEM majors, and (c) to predict the likelihood of a female majoring in a STEM field based on her INT, SE, and MA. This research survey data was collected from 128 female undergraduate students, including STEM (n = 62) and non-STEM majors (n = 63). Instruments include the Big Five Inventory (John, Donahue, & Kentle, 1991; John, Naumann, & Soto, 2008), STEM items on the Basic Interest Markers (Liao, Armstrong, & Rounds, 2008), and Nauta’s (1997) adaptation of Lent, Brown, and Larkin’s (1986) Self-Efficacy for Academic Milestones Scale. Results revealed neuroticism was positively related to MA, and conscientiousness and agreeableness were negatively related to MA. SE predicted INT, MA, and majoring in STEM. Finally, the study found STEM majors were more open than non-STEM majors. This research has implications for
identifying female STEM majors who may have MA, decreasing those students’ MA, and recruiting females who would be open to a STEM career.

**Key Words:** female STEM majors, personality, self-efficacy, interests, math anxiety
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Chapter One: Introduction

General Problem

Gender disparities in specific science, engineering, technology, and mathematics (STEM) degrees are apparent in United States’ higher education reports (e.g., Gonzales, Allum, & Sowell, 2013; National Science Committee on Science and Engineering Indicators, 2014; Snyder & Dillow, 2015). Broadly, gender differences in college education are not apparent. Between 2002 and 2012, Snyder and Dillow (2015) reported enrollment in degree-granting institutions increased by 24%, and the increases in enrollment by gender were approximately the same: 25% for males and 24% for females. Since the late 1990s, the National Science Committee on Science and Engineering Indicators (NSCSEI; 2014) has reported females have earned about half of all science and engineering bachelor’s degrees. However, this trend is not the same for all science and engineering degrees. The NSCSEI found males earned the majority of engineering, computer sciences, and physics bachelor’s degrees. Between 2000 and 2011, the NSCSEI also found the percentage of science and engineering bachelor’s degrees awarded to females in computer science, mathematics, physics, and engineering declined. The disproportionality of females and males persists at the graduate level.

Gonzales et al. (2013) found the rate of females earning degrees in particular STEM fields was not proportional to the rate of males earning the same degrees. They stated the number of mathematics and computer science master’s degrees awarded from 2001–2002 to 2011–2012 increased by 2.3% for females and 3.9% for males. The percentage of change of females in other science-related graduate degree programs was also disproportionate. The NSCSEI (2014) stated that from 2000 to 2011, females enrolled at disproportionately low rates in engineering, computer science, and physical sciences graduate degrees.
This underrepresentation of females in particular majors and degree programs affects the number of females qualified for specific jobs and thus has consequences for the representation of females in the workforce. Females are underrepresented in specific science and engineering occupations (e.g., 13% of engineering employees and 25% of mathematics and statistics employees; NSCSEI, 2014). In the global science and engineering labor market, the NSCEI stated that since the mid-1990s, China and South Korea have experienced the most growth in the number of researchers, workers involved in the innovation and development of new inventions, information, and practices. Although the United States has undergone steady growth in the number of science and engineering researchers, the NSCSEI declared that the United States has had a slower growth rate than China and South Korea have had. A slower growth rate has economic consequences.

The American Association of University Women (2013) highlighted the US labor market’s concern about the current outsourcing of science-related work due to the lack of science inquiry and shortage of scientists in the United States. The underrepresentation of females in science disciplines creates major economic consequences. Rosser (2012) suggested a better representation of females in the fields may bring about new ideas that would improve quality of life. Drawing more females into particular STEM fields would increase the United States’ independence from other nations, and the increase of female scientists and mathematicians would bring different perspectives to their fields.

**Anecdote.** In high school, I decided to pursue a career in mathematics because I was more interested in mathematics than in English or elective classes. Part of my decision was based on my preference for working with numbers instead of people. Although I worked well with
others, I preferred to be less sociable or gregarious. Other personal aspects that helped with mathematics were my attention to detail and persistence when performing mathematics.

As an undergraduate mathematics major, I realized the gender disparity in the field. In my mathematics classes, as the level of the courses progressed, the number of females dramatically decreased. In one class, I was one of three females out of approximately 35 students. All my upper-level mathematics course teachers were male. I accepted the male dominance of the field and adapted to the setting. I noticed I had more in common with my male mathematics classmates than with females in my education and elective classes. I also noticed the females in my upper-level mathematics courses had different interests and social interactions and agendas than other females on campus had.

My experiences directly relate to the subject of my research, which provides a great deal of insight or bias. These experiences led me to investigate what factors contribute to females’ choice of STEM college majors. The purpose of this research was to address personal factors (i.e., personality, interest, beliefs, and anxiety) that affect females’ STEM major selection.

**Theoretical Contributions**

Several theories and models; including the five-factor model (McCrae & Costa, 1996), Holland’s theory (Holland, 1966), and the social cognitive career theory (Lent, Brown & Hackett, 1994); describe the factors and reasons for academic or vocational intentions. These models and theories consist of specific factors that affect major educational and vocational decisions, such as personality (Holland, 1966; John, Naumann, & Soto, 2008), interests (Costa, McCrae, & Holland, 1984), and self-efficacy (Lent et al., 1994).

**Five-Factor Model.** In the Five-Factor Model of Personality (FFM), basic tendencies are inferred capacities expressed through characteristic adaptations (McCrae & Costa, 1996).
McCrae and Costa’s (1996) characteristic adaptations are existing indicators of basic tendencies, such as social skills, attitudes, beliefs, preferences, vocational interests, and interpersonal adaptations. John et al. (2008) stated that characteristic adaptations have implications for academic settings (e.g., low levels of conscientiousness predict students’ problems with organization and attention). Their research focused particularly on personality dimensions that influence life outcomes, including college classes and jobs.

McCrae and Costa (1990) defined traits as “dimensions of individual differences in tendencies to show consistent patterns of thoughts, feelings, and actions” (p. 23). They described elements of individual differences as ways people can be classified by the degree to which they exhibit a characteristic trait. Traits are on a spectrum; a person can vary from the characteristic trait to the antonym of that trait. Trait adjectives are often used synonymously with other adjectives. McCrae and Costa clarified that although traits are tendencies, they are not habits, states, or moods. Traits are more consistent than states and moods are because those are temporary and can change with the environment or situation. McCrae and Costa also elucidated that traits must exist over time and through different conditions. Traits are expressed. The more of a trait someone possesses, the more likely he or she is to express it, and the more likely others are to observe it (McCrae & Costa, 1990). Traits are part of a larger personality framework.

The Big Five (Saucier & Goldberg, 1996) is a model of personality attributes and is often used interchangeably with the FFM (McCrae & Costa, 1996). The FFM consists of traits in the factors of openness, conscientiousness, extraversion, agreeableness, and emotional stability. Emotional stability is often used as the antonym of neuroticism. Factors are statistically independent clusters of broad traits (Barenbaum & Winter, 2008). Personality psychologists use the acronym OCEAN to suggest the breadth of the factors (John et al., 2008). John and et al.
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(2008) described the five factors: O represents factors such as openness and originality; C signifies conscientiousness, control, and goal-oriented behavior; E describes extraversion, energy, assertiveness, and positive emotionality; A factors include agreeableness, altruism, and tender-mindedness; and N factors are neuroticism, nervousness, and emotional instability. This study adopted this model to seek understanding of female STEM majors’ characteristic adaptations and the connections to their basic tendencies (i.e., females’ personalities in relation to interests, preferences, beliefs, and attitudes).

**Holland’s Theory.** Realistic, intellectual, artistic, social, enterprising, and conventional types describe a theoretical kind of person (Holland, 1966). Theoretical types have a specific set of unifying characteristics. Holland (1966) described these specific qualities, ideas, and behaviors as “adaptive behaviors …, psychological needs and motives, self-concepts, life history, vocational and educational goals, preferred occupational roles, aptitudes, and intelligence” (p. 16). A person may resemble some types more than others. Holland’s personality type is the theoretical model with which the person most identifies. Each theoretical type is described by characteristics. Characteristics of these types, along with self-concept and preferred activities, lend themselves to specific occupations. Holland described intellectual types as preferring vocations such as physicist, scientific researcher, aeronautical engineer, mathematician, scientific authority, and biologist. Holland’s realistic types prefer vocations such as electrical technician, machinist, and tool designer. Research supports the connections of Holland’s types of vocational interest to specific professional vocations. Defruyt and Mervielde (1996) found engineers scored higher on realistic interests than on social science, and science majors had investigative type characteristics. Many intellectual and realistic vocations are STEM vocations.
Costa et al. (1984) claimed personality dispositions are consistently connected to vocational interests. McCrae and Costa (1990) echoed that claim by stressing individuals gravitate toward occupations that permit them to express their personality. Holland’s (1966) hypothesis was that occupational choice is an expression that reflects one’s knowledge, ability, motivation, and personality. The foundation of Holland’s theory (HT) of vocational choice was “the choice of a vocation is an expression of personality” (Holland, 1966, p. 2). The theory closely connects personality, interest, self-concepts, and motives with vocation. The present study adopted this model to seek understanding of how females’ personality, interests, and motivation (i.e., avoidance motivation) relate to their selection of a college major.

**Social Cognitive Theory.** Bandura (1986) defined social cognitive theory (SCT) as a particular view of human functioning “explained in terms of a model of triadic reciprocity in which behavior, cognitive and other personal factors, and environmental events all operate as interacting determinants of each other” (p. 18). The premises of SCT is self-efficacy (e.g., self-efficacy beliefs, self-efficacy expectation, perceived self-efficacy, and academic self-efficacy). Bandura claimed self-efficacy beliefs are critical mediators of behavior (i.e., avoidance vs. approach behavior, performance quality of behaviors in the specific area, and persistence in adversity). Self-efficacy expectations are a person’s belief in his or her ability to successfully perform a task or behavior (Whiston, 1993). Whiston found these beliefs determine the action or inaction of, effort toward, and persistence in the behavior under adversity. Bandura defined perceived self-efficacy as people’s “judgements of their capabilities to organize and execute courses of action required to attain designated types of performances” (p. 391) and stated, “Perceived self-efficacy is concerned not with the skills one has but with judgements of what one can do with whatever skills one possesses” (p. 391). The distinction between self-efficacy and
self-concept is the former deals “primarily with cognitive perceived capabilities of the self”
(Bong & Clark, 1999 p. 141), and the latter includes “cognitive and affective responses toward
the self and is heavily influenced by social comparison” (Bong & Clark, 1999, p. 139).

Social cognitive career theory (SCCT) is a model of factors affecting career choices. Lent
et al. (1994) expanded on Bandura’s (1986) SCT to join vocational interest, career decisions,
persistence, and performance task (Lapan, Shaughnesy, & Boggs, 1996). Self-efficacy, interest,
and personality are simultaneous characteristics that enable people’s choices of majors (Larson et
al., 2010). Lent et al.’s propositions of SCCT of careers included: (a) efficacy is strongly related
to interests; (b) the achievement to interest relationship is mediated by efficacy expectations; (c)
efficacy beliefs affect the manifestation of goals and beliefs at the beginning and end of college;
and (d) vocational interests, prior goals, and beliefs predict college major choice. This study
adopted this model to seek understanding of how female STEM majors’ self-efficacy beliefs are
related to interest and how both self-efficacy and interest are related to college major selection.

Many of these theories complement each other’s connection between factors of
personality, interest, self-efficacy beliefs, and avoidance motivation (i.e., anxiety). The FFM and
HT relate personality to major life choices such as vocation. HT and the FFM connect
personality to interests and self-efficacy constructs (i.e., beliefs and self-concepts). HT connects
personality—Holland Types—to motives. SCCT links efficacy to interest, and SCT links
efficacy to avoidance behavior. SCCT relates interest and efficacy to choices such as college
major. Therefore, these three models were blended to gain an entire perspective of how
personality, interests, self-efficacy, and anxiety relate to one another and to college major
selection. With the blended model as shown in Figure A1, the purpose of this study was to
increase understanding of the theories and models presented (i.e., FFM, HT, SCT, and SCCT) in
relation to female STEM majors’ personalities, interests, self-efficacy beliefs, and avoidance motivation (i.e., mathematics anxiety).

**Research Questions**

The research questions this study sought to address were:

1. To what extent are female STEM majors’ STEM interest, STEM self-efficacy, and mathematics anxiety associated with personality traits? Specifically, to what extent is extraversion and openness correlated to STEM interest? To what degree are neuroticism, conscientiousness, and openness correlated to STEM self-efficacy? To what extent is neuroticism correlated to mathematics anxiety?

2. To what degree are female STEM majors’ STEM interest and mathematics anxiety mediated by STEM self-efficacy?

3. To what extent do STEM career interests, STEM self-efficacy, and mathematics anxiety predict majoring in STEM? and

4. To what extent do each of the Big Five traits (Saucier & Goldberg, 1996) describe female STEM majors compared to female non-STEM majors?

**Definition of Key Terms**

**Personality.** Personality is a large framework but is defined in terms of broad traits. McCrae and Costa (1990) defined traits as individual differences of predispositions that result in consistent behavior. John et al. (2008) put traits as five broad factors: openness, conscientiousness, extraversion, agreeableness, and neuroticism.

**Mathematics anxiety.** Plake and Parker (1982) situated mathematics anxiety between two contexts: learning mathematics and evaluation in mathematics. Learning mathematics anxiety related to the process of learning or studying mathematics, for instance, being in a
mathematics classroom or using formulas and tables. They defined mathematics evaluation
anxiety as related to assessment (e.g., being given a mathematics assessment to take or one that
has been graded).

**STEM self-efficacy.** In relation to Bandura’s (1986) definition of perceived self-efficacy,
STEM self-efficacy is an adapted definition: one’s belief in his or her capabilities to execute a
plan of action required to perform well in a science-, technology-, engineering-, or mathematics-
based major. Nauta’s (1997) factor analysis defined four constructs of STEM self-efficacy: (a)
completing a mathematics, science, or engineering degree; (b) excelling in a mathematics,
science, or engineering field; (c) completing specific mathematics, science, or engineering
classes; and (d) completing mathematics, science, or engineering graduate school.

**STEM interests.** STEM interests are defined to be investigative or intellectual and
realistic interests. Holland (1966) stated realistic types’ preferred activities or interests involved
“motor skills, things, realism, [and] structure” (p. 20). Intellectuals’ interests involved scientific
projects, algebra, physics, trigonometry, and other activities that allow for expression of
analytical orientation. Similarly, STEM career interests are defined to be investigative or
intellectual and realistic career interests. Intellectual types prefer vocations such as physicist,
scientific researcher, aeronautical engineer, mathematician, scientific authority, and biologist
(Holland, 1966). Additionally, realistic types prefer vocations such as electrical technician,
machinist, and tool designer (Holland, 1966).

**Chapter Two: Literature Review**

This review of literature centered on factors that positively and negatively influence
females in their STEM college major selection. The review focused on content of empirical
research with statistically significant findings for females’ choices for or against a STEM major.
Knowledge gained from findings in this review guided the argument of which factors influence this phenomenon. Literature reviewed progressed through relationships of factors, including personality and STEM major; interest and personality; interest, self-efficacy, and STEM major; self-efficacy’s relationship with interest and mathematics anxiety; and mathematics anxiety and STEM major. Some findings overlapped, and these connections were emphasized. From these different perspectives of research, a conceptual framework was constructed, and specific correlations among related factors were further reviewed. A synopsis of recent findings was presented in Ceci, Williams, and Barnett’s (2009) meta-analysis of female’s underrepresentation in STEM fields; these findings guided the review.

Ceci, et al.’s (2009) meta-analysis examined empirical research on the underrepresentation of females in STEM fields and developed a casual model to explain influential factors of females in STEM fields. Ceci et al.’s casual model pointed to interests, attitudes and beliefs, motivation, and activities as major reasons for the underrepresentation of females in STEM professions. However, this model did not specifically account for personality and self-efficacy affecting interests, beliefs, motivation, and preference of activities. Nor did the model account for the interaction between interests, attitudes and beliefs, motivation, and activities. A relatively small amount of recent research reported or focused on the roles personality, interests, beliefs, and motivation of female STEM majors and STEM professionals play (e.g., Bieri Buschor, Berweger, Keck Frei, & Kappler, 2014; Chen & Simpson, 2015; Eccles, 2007; Hartman & Betz, 2007; Larson, Wei, Wu, Borgen, & Bailey, 2007; Perez-Felkner, McDonald, & Schneider, 2014; Simon, Allus, Dedic, Hubbard, & Hall, 2015). The following literature review examined the four most common personal factors that influence females’ STEM intentions: personality types, interest, self-efficacy, and anxiety.
Personality Types

**Personalities of STEM majors.** Some studies provided significant findings of STEM majors’ personalities. However, findings had discrepancies over levels of agreeableness, extraversion, and neuroticism. van der Molen, Schmidt, and Kruisman (2007) found engineers score higher on extraversion and conscientiousness. Chen and Simpson (2015) found females who chose a STEM major were more likely to have high social personality scores than other females were.

Other studies found different results of extraversion. Williamson, Lounsbury, and Han (2013) found engineers scored lower on extraversion than non-engineers did. Previous research supports Williamson et al.’s findings of lower extraversion traits for STEM majors. Students who majored in engineering and physical sciences had lower social closeness (Larson et al., 2010). A study by Eccles (2007) also supports findings of lower social closeness, a trait of introversion. Females who aspired to science careers placed an abnormally low value on people-oriented and social-oriented aspects of a job compared to their female counterparts (Eccles, 2007). Secondary school studies supported the positive correlation of low extraversion (i.e., low social closeness) and students on science and mathematics tracks (Korpershoek, Kuyper, & van der Werf, 2012; Korpershoek, Kuyper, van der Werf, & Bosker, 2010). More studies cited mathematics- and science-focused students as introverted than extraverted (i.e., Eccles, 2007; Korpershoek et al., 2010; Korpershoek et al., 2012; Larson et al., 2010; Williamson et al., 2013).

Research on levels of neuroticism also had mixed findings. van der Molen et al. (2007) found engineers scored lower on neuroticism. However, Williamson et al. (2013) discovered engineers scored higher on neuroticism than non-engineers did. Korpershoek et al.’s (2010) secondary school study supported findings of lower neuroticism of STEM-profile students.
Korpershoek et al. also provided secondary school results that backed van der Molen et al.’s findings regarding engineers’ lower agreeableness. Alternatively, Rubinstein (2004) reported that female science majors are more agreeable than male natural science majors and law students are. Because college major was shown to be related to interest (Morgan, Isaac, & Sansone, 2001), literature on personality and interest provided additional support for the relationship between college major and personality.

**Interest and personality.** Particular interests also related to personality. Ackerman and Heggestad’s (1997) meta-analysis of general research found openness was positively correlated with investigative interests. Bieri Buschor et al. (2014) reported a relationship between STEM interest and personality specifically in females. Increased interest in interacting with people, an extraversion trait, decreased females’ likelihood of choosing a STEM major. These results supported and extended findings by Williamson et al. (2013) and Larson et al. (2010) of lower extraversion traits of STEM majors.

**Interest and Major**

Interest was a definite predictor of college students’ STEM careers (Morgan et al., 2001). It is also a predictor of intentions. In Lapan et al.’s (1996) longitudinal study from secondary to postsecondary school, females were less interested in mathematics and less likely to choose mathematics and science majors. Weinberger (2004) found similar results and expanded on the reasoning for their decisions against STEM majors; females reported less interest and more perceived difficulty in computer engineering, computer science, and electrical engineering majors than in predominantly female-chosen college majors. Similar results were also found in secondary educational settings. Weber’s (2012) middle and high school study supported reports of females’ lack of interest in technology and engineering vocations compared to males.
For both genders, perceived interest is significantly positivity correlated to the likelihood of pursuing a physical science or mathematical career (Morgan et al., 2001). Secondary studies found similar results for girls. Girls’ early interest in science was related to their college choice of science and mathematics courses (Packard & Nguyen, 2003). Morgan et al.’s (2001) findings along with those of Packard and Nguyen (2003) supported Perez-Felkner et al.’s (2014) conclusions regarding females’ STEM interest and STEM college major decisions. Deep interest and engagement in high school was positively correlated to STEM-pipelined girls’ decisions of STEM majors versus their female counterparts (Perez-Felkner et al., 2014). A preponderance of research supported a relationship between mathematics- and science-related interest and majoring in a mathematics- or science-based field (Lapan et al., 1996; Morgan et al., 2001; Perez-Felkner et al., 2014; Weinberger, 2004).

Self-Efficacy

Self-beliefs include self-concept, self-confidence, and self-efficacy. Low-mathematics self-confidence or self-concept was another reason for not majoring in a STEM field (Parker et al., 2012), particularly for females (Hartman & Betz, 2007; Lapan et al., 1996; Litzler, Samuelson, & Lorah, 2014; Morgan et al., 2001). Although self-concept and self-efficacy were related, this study specifically examined self-efficacy beliefs. Self-efficacy has a “superior predictive and explanatory utility in past [academic motivation] research” (Bong & Clark, 1999, p. 139). In particular, mathematics self-efficacy beliefs along with vocational interests were important factors in predicting mathematics or science majors and facilitating gender differences in vocational and college major decisions (Lapan et al., 1996).

Self-efficacy and major. Self-efficacy was highly positively correlated with choosing a mathematics-associated major (Hackett, 1985). In a sample of engineering and science majors,
Hackett, Casas, Betz, and Rocha-Singh (1992) found moderate levels of occupational self-efficacy. Additionally, engineering and science majors had moderately high academic achievement self-efficacy (Hackett et al., 1992). High self-efficacy beliefs could promote a given career choice (Betz & Hackett, 1997). Specifically, mathematics self-efficacy significantly predicted students’ choice of a science-based college major (Hackett & Betz, 1982). Betz and Hackett (1997) later related self-efficacy and career choices particularly for females: females’ low self-efficacy beliefs hindered specific career choices. Females had lower self-efficacy for tasks involving working with objects than with tasks related to working with people (Whiston, 1993). Preference for working with objects is an intellectual and realistic vocational interest (e.g., mathematician, researcher, engineer, mechanic), and working with people and social interactions are social vocational interests (e.g., counseling and teaching; Holland, 1966). Specifically, mathematics self-efficacy was a determining factor in females’ choice for or against science and mathematics college majors (Lapan et al., 1996). Literature was consistent on the relationship between self-efficacy and college major selection; mathematics self-efficacy was positively related to college major (Hackett & Betz, 1982), particularly for females (Lapan et al., 1996).

**Self-efficacy in relation to interest, anxiety, and personality.** Self-efficacy related to many different personal factors. It was a major factor in STEM intentions, and self-efficacy fully facilitated the aptitudes to interest relationship (Lent et al., 1994). Lapan et al. (1996) expanded on Lent et al.’s (1994) findings. Females’ lower math self-efficacy beliefs resulted in their lower mathematics interests and investigative occupational efficacy beliefs (Lapan et al., 1996). Lower ability beliefs resulted in lower interests. Females’ lower mathematics interest was a result of lower efficacies (Betz & Hackett, 1997; Lapan et al., 1996).
Self-efficacy also predicted other factors. Mathematics anxiety, prior achievement, and prior high school mathematics courses were highly correlated to mathematics self-efficacy (Hackett, 1985). Furthermore, presence of anxiety while performing a task could decrease contingent self-efficacy along with composure and endurance (Lent et al., 1994). In a sample of college undergraduates, Hackett and Betz (1982) found mathematics self-efficacy mediated mathematics anxiety. Simon et al. (2015) expanded on this finding for females; STEM females had higher levels of self-efficacy, which strongly predicted their reported lower negative affect (NA; Simon et al., 2015).

Wigfield and Meece (1988) found similar results to Simon et al. (2015). In a sample of elementary and secondary school students, Wigfield and Meece found constructs of mathematics anxiety similar to Plake and Parker’s (1982) constructs. Wigfield and Meece’s confirmatory factor analysis found two components of mathematics anxiety: negative affect responses to mathematics (i.e., fear, discomfort, and nervousness) and worries about proficient mathematics performance. High NA is the tendency to experience negative emotions (i.e., feelings of worry, nervousness, anger, self-dissatisfaction, and sadness; Watson & Clark, 1984). Low NA related to lower mathematics anxiety, and mathematics anxiety included worries about proficient mathematics performance (Wigfield & Meece, 1988). Wigfield and Meece’s study also found girls have significantly more mathematics NA than boys have. Lapan, Boggs, and Morrill (1989) found that for both males and females, a more efficacious feeling was related to college students’ lower mathematics anxiety. Furthermore, anxiety related to interest. Higher investigative and realistic interests were a function of lower mathematics anxiety and greater mathematics self-efficacy (Lapan et al., 1989).
Self-efficacy was also related to personality. Hartman and Betz (2007) found several distinct relationships between career self-efficacy and personality domains. Conscientiousness had a positive correlation with career self-efficacy, specifically in comparison with the other four personality domains that have career domains in analytical and organizational skills (Hartman & Betz, 2007). Additionally, Hartman & Betz (2007) found openness was most strongly positively correlated to investigative self-efficacy. Because self-efficacy was shown to predict specific mathematics- and science-related interest (Lapan et al., 1996; Lent et al., 1994), the relationship between openness and self-efficacy (Harman & Betz, 2007) was consistent with the relationship of openness and interest (Ackerman & Heggestad, 1997). Neuroticism had a general negative statistically significant effect on career self-efficacy and the strongest negative statistically significant relationship with quantitative (e.g., mathematics) and entrepreneurial skills (Hartman & Betz, 2007).

**Anxiety and Major**

Eccles and Jacobs’s (1986) study of secondary school girls found three major adverse effects of anxiety: (a) girls reported higher levels of mathematics anxiety, and anxiety was a significant predictor of mathematics grades and course intention; (b) anxiety was a hindrance of STEM intentions in a secondary setting; and (c) mathematics anxiety was more strongly related to future mathematics intentions (i.e., course taking) than mathematics aptitude and achievement were. Hackett (1985) had more generalized but similar findings as Eccles and Jacobs. Hackett found selection of STEM-related college majors was directly predicted by gender, amount of high school mathematics, mathematics self-efficacy, and mathematics anxiety.

Some findings of science-based majors’ and science-tracked students’ neuroticism and agreeableness were inconsistent. However, the majority of findings among personality, interest,
self-efficacy, mathematics anxiety, and STEM major were consistent. Particular personality traits were related to self-efficacy in mathematics- and science-based careers and academics (i.e., conscientiousness and openness were positively related, and neuroticism was negatively related to investigative career self-efficacy; Hartman & Betz, 2007). Self-efficacy predicted mathematics- and science-related interests (Betz & Hackett, 1997; Lapan et al., 1996; Lent et al., 1994) and predicted mathematics anxiety (Hackett, 1985; Simon et al., 2015). Interests (Lapan et al., 1996; Morgan et al., 2001; Perez-Felkner et al., 2014), mathematics self-efficacy (Betz & Hackett, 1997; Larson et al., 2007), mathematics anxiety (Eccles & Jacobs, 1986; Hackett, 1985), and personality (Chen & Simpson, 2015; Larson et al., 2010; Rubinstein, 2004; van der Molen et al., 2007; Williamson et al., 2013) predicted choice of science- and mathematics-based majors.

**Anticipated Findings in the Conceptual Framework of Personality, Interests, Self-Efficacy, Anxiety, and STEM Majors**

The present study proposed a conceptual framework to examine the specific connections between STEM major and personality, STEM career interests, STEM self-efficacy, and mathematics anxiety, as through the literature review, many factors emerged as dominant aspects (i.e., personality, interests, self-beliefs, and anxiety) that promote or hinder female STEM majors. Figure B1 depicts expected relationships among the variables of the study based on the literature review. This conceptual framework expanded on the connection among females’ personality, STEM interests, self-efficacy, anxiety, and STEM major selection and proposed anticipated findings for the current study.

**Personality and STEM major.** In line with Rubinstein’s (2004) findings, female STEM majors were expected to be more agreeable than their female counterparts. Female STEM
majors’ level of extraversion was not included in the model due to conflicting findings of female STEM professionals’ and majors’ degree of extraversion. The present study compared personality traits of female STEM and non-STEM majors.

**Interests, personality, and STEM major selection.** Science- and mathematics-related interests were positively correlated to STEM major selection (Morgan et al., 2001) and STEM major intentions for secondary females (Packard & Nguyen, 2003; Weber, 2012). Two studies specifically related females’ STEM interests to STEM major selection (Lapan et al., 1996; Perez-Felkner et al., 2014). Interest in working with people decreased the likelihood of majoring in a STEM field (Bieri Buschor et al., 2014; Eccles 2007). Additionally, Bieri Buschor et al. (2014) reported that increased social traits (e.g., gregariousness, a characteristic of extraversion [McCrae & Costa, 1996]) decreased the likelihood of majoring in STEM. Females who are extraverted were expected to score lower on STEM interest. Furthermore, Ackerman and Heggestad (1997) found openness to be positively correlated to investigative interests. Based on the previous literature, the present study explicitly examined the relationship between personality and STEM interests in addition to the relationship between STEM interest and STEM major selection. Females’ STEM interest was expected to predict STEM major selection. Specific interests were related to majoring in a STEM field. Females with a fair amount of openness and lower amounts of extraversion were expected to have higher STEM interests.

**Self-efficacy and STEM majors.** Females’ low self-efficacy hindered choosing STEM fields (Lapan et al., 1989; Lapan et al., 1996). High levels of self-efficacy (e.g., occupational self-efficacy and academic achievement self-efficacy) positively influenced STEM choices (Hackett et al., 1992), particularly for females (Larson et al., 2007; Simon et al., 2015). Hackett and Betz (1982) along with Hackett (1985) determined mathematics self-efficacy also predicted selecting
science- and mathematics-related majors. Additionally, STEM majors in general had high occupational self-efficacy and academic self-efficacy (Lapan et al., 1996). The present study examined the relationship between STEM self-efficacy beliefs and STEM major selection. Females’ high self-efficacy beliefs were expected to predict STEM college majors.

**Self-efficacy in relation to interests and anxiety.** Higher investigative and realistic interest scores were a function of lower mathematics anxiety and greater mathematics self-efficacy (Lapan et al., 1989). Lower efficacies resulted in females’ lower mathematics interests (Lapan et al., 1996). Thus, females’ self-efficacy was expected to positively correlate with STEM interest. Indicants of anxiety or depression during a task performance could decrease contingent self-efficacy, composure, and endurance (Lent et al., 1994). The current study examined the relationship among STEM self-efficacy, STEM interest, and mathematics anxiety. Along with Simon et al.’s (2015) finding—females’ higher self-efficacy predicted lower negative effect—STEM females’ STEM self-efficacy was expected to predict their mathematics anxiety. Females’ increased self-efficacy was expected to correlate with lower mathematics anxiety and higher STEM interests.

**Self-efficacy and personality.** The current study tested the correlation between personality traits and STEM self-efficacy. Hartman and Betz (2007) discovered a positive relationship with conscientiousness and openness and analytical careers self-efficacy; this relationship was expected to translate to the relationship between female STEM majors’ level of conscientiousness and openness and their STEM self-efficacy. Additionally, their finding of neuroticism being negatively related to self-efficacy of people in analytical careers was expected to translate specifically for female STEM majors’ neuroticism and their STEM self-efficacy.
FEMALE STEM MAJORS

Anxiety, personality, and STEM major selection. Mathematics anxiety was strongly related to mathematics intentions (Eccles & Jacobs, 1986). Hackett (1985) reported that mathematics anxiety negatively relating to STEM majors was expected to hold true for female STEM majors. Particular personality traits were related to anxiety. Anxiety and depression are negative emotions and characteristics of neuroticism (McCrae & Costa, 1996). Neuroticism includes anxiousness and worry (John et al., 2008). Wigfield and Meece’s (1988) secondary school study found female students’ mathematics anxiety related to NA. The present study investigated the correlation of personality traits to mathematics anxiety and the relationship between mathematics anxiety and STEM major selection. Thus, neuroticism was expected to be positively correlated to mathematics anxiety.

Chapter Three: Methods

Purpose

The current study addressed gaps in the literature concerning female STEM majors’ personality, interests, beliefs, and anxiety. The purpose of this study was to (a) increase understanding about the female STEM major population, (b) compare female STEM and non-STEM majors, and (c) identify correlations between and among factors such as females’ personality, interests, self-efficacy, mathematics anxiety, and majoring in STEM. The study also made a prediction model based on STEM interests, STEM self-efficacy, and mathematics anxiety to majoring in STEM. Additionally, this study sought to build upon the existing studies of female STEM majors’ personality (Rubinstein, 2004), interests (Chen & Simpson, 2015; Eccles, 2007; Lapan et al., 1996; Weinberger, 2004), beliefs (Betz & Hackett, 1997; Eccles, 2007; Lapan et al., 1989; Lapan et al., 1996; Larson et al., 2007; Perez-Felkner et al., 2014;
Simon et al., 2015; Whiston, 1993), and anxiety (Eccles & Jacobs 1986). This study took a quantitative approach to investigate these relationships.

**Theoretical Perspective About the Method**

This study used a positivism theoretical framework. Ontological beliefs of this framework included “fixed reality external to people that can be measured and apprehended to some degree of accuracy” (Glesne, 2011, pp. 6–7). This study assumed personality, self-efficacy, interests, and anxiety can be identified, and relationships between these variables can be measured. An objectivism epistemology guided this study’s positivism framework. “From the positivist view-point, objects in the world have meaning prior to, and independently of, any consciousness of them” (Crotty, 1998, p. 27). People possess levels of personality traits, interests, self-efficacy, and anxiety of which the person may or may not be conscious.

Based on this study’s positivist approach, the purpose was to make generalizations about females in STEM majors. This study’s approach to research included using theories and models (HT, SCT; SCCT, and the FFM) to frame how personality, interests, self-efficacy, and anxiety were expected to interact specifically for female STEM majors. Furthermore, consistent with a positivist approach to research, this study used instruments; including personality, interests, and self-efficacy inventories and an anxiety scale; to condense data to numerical quantities and statistically analyze the variables and relationship between variables. The results of the statistical analyses were used to make generalizations about the female STEM major population and correlations among variables and to predict female STEM major decisions based on STEM interests, STEM self-efficacy, and mathematic anxiety. The study also used an ex post facto design because students’ majors were already determined.
Data Collection

Participants included female college undergraduates based on a convenient sample across STEM and non-science field disciplines. Data was collected from 128 female undergraduate students enrolled in a public university located in the southeastern United States. During data collection, males were invited to participate in the survey to avoid females being under mathematics stereotype threat. However, males’ data was not analyzed in this study. Participants were STEM majors \((n = 62); \text{ i.e., } 6\% \text{ information technology } [n = 4], 27\% \text{ computing and software engineering } [n = 17], 19\% \text{ engineering and engineering technology } [n = 12], \text{ and } 47\% \text{ mathematics and science } [n = 29]) \) and non-STEM majors \((n = 63); \text{ i.e., } 3\% \text{ architecture and construction management } [n = 2], 2\% \text{ arts } [n = 1], 10\% \text{ business } [n = 6], 73\% \text{ elementary and middle grades education } [n = 46], 5\% \text{ humanities and social science } [n = 3], \text{ and } 8\% \text{ health and human services } [n = 5]) \). Three participants’ majors were not indicated and were not included in the data analysis. Table C1 summarizes the types of majors and the number of participants by major.

Instruments

Participants were asked to select their major on the survey. The Revised Codes for Degree Program List (United States Immigration and Customs Enforcement, 2012) was used to classify STEM majors and included the following categories: Computing and Software Engineering, Science and Mathematics, Engineering and Engineering Technology. Information Technology majors were verbally asked to specifically indicate their major beside the business category and were classified as a STEM major. Non-STEM majors included: Elementary and Middle Grades Education, Business, Architecture and Construction Management, Humanities and Social Sciences, Arts, Health and Human Services, and University College. Information
regarding major was then coded as a dummy variable (0 represented non-STEM fields, and 1 represented STEM majors).

**Personality measure.** This study used John, Donahue, and Kentle’s (1991) and John et al.’s (2008) Big Five Inventory (BFI) to measure personality traits (see Appendix D). The personality questionnaire used a Likert scale with six points of varying agreement in 44 items (the internal consistency $\alpha = .83$; John et al., 1991). The current study also found the BFI reliable (40 items; $\alpha = .75$). The tool assessed five personality characteristics: extraversion (eight items with three reversed, $\alpha = .86$), agreeableness (nine items with four reversed, $\alpha = .79$), conscientiousness, (nine items with four reversed, $\alpha = .82$), neuroticism (eight items with three reversed, $\alpha = .87$), and openness (10 items with two reversed, $\alpha = .83$; John et al., 1991). Reversed questions were given reverse scores, and each characteristic was given a scale score by averaging responses. Items 3 and 12 were removed from the personality inventory due to their skewness and/or kurtosis greater than $\pm 2$. Additionally, the factorability of the remaining 42 personality items was examined. The Kaiswer-Meyer-Olkin measure of sampling adequacy was .74, above .6, and the Bartlett’s test of sphericity was significant, $\chi^2(861) = 2438.94$, $p < .05$. Forty of the 42 items correlated at least .3 with at least one other item. Items 35 and 41 did not correlate with at least .3 with any other item. Additionally, their extraction values were exceptionally low, .21 and .05, respectively. Therefore, items 35 and 41 were removed from calculating reliability and mean scores.

**Interests inventory.** The present study used Liao, Armstrong, and Rounds’s (2008) Basic Interests Markers (BIM; see Appendix E) to measure STEM interests. Liao, Armstrong, and Rounds generated BMI items and scales from Day and Rounds’s (1997) vocational and career interest research. Participants selected one of four interest scales: engineering,
mathematics, physical science, and information technology. The inventory used a fully anchored 5-point Likert scale measuring each item as “Strongly Dislike,” “Dislike,” “Neutral,” “Like,” or “Strongly Like.” This tool assessed the following interests: Engineering (11 items, $\alpha = .91$), Mathematics (10 items, $\alpha = .95$), Physical Science (12 items, $\alpha = .92$), and Information Technology (12 items, $\alpha = .92$; Liao et al., 2008).

The current study also found each of the four interest inventory scales reliable (10 to 11 items; $\alpha = .79$).

**Self-efficacy inventory.** This study used Nauta’s (1997) 14-item survey to measure college students’ STEM self-efficacy beliefs (see Appendix F). The survey was adapted from Lent, Brown, and Larkin’s (1986) Self-Efficacy for Academic Milestones Scale (AM-S). Eleven of the survey items were from Lent et al.’s AM-S. The survey specifically measured participants’ confidence in mathematics, science, and engineering majors. Nauta added three items of graduate studies due to an anticipated ceiling effect for students further along in their majors. The survey was reliable ($\alpha = .92$; Nauta, 1997). The current study also found the STEM self-efficacy inventory to be highly reliable (11 items; $\alpha = .94$); however, the self-efficacy items accounted for less of the self-efficacy construct.

**Mathematics anxiety measure.** This study used Hopko, Mahadevan, Bare, and Hunt’s (2003) Abbreviated Math Anxiety Scale (AMAS; see Appendix G). The AMAS uses a 5-point Likert-type scale. The nine-item measure was developed with a university undergraduate sample and was found consistent and reliable (Hopko et al., 2003). Primi, Busdraghi, Tomasetto, Morsanyi, and Chiesi (2014) also found the AMAS to be reliable (Cronbach’s $\alpha = .86$, CI .83–.88 and .81, CI .76–.85) and valid for measuring learning mathematics and mathematics evaluation anxiety. The AMAS was strongly associated with the Math Anxiety Rating Scale-Revised
(MARS-R; Plake & Parker, 1982). Hopko et al. argued their confirmatory factor analysis provided compelling support to the claim of their measure possibly being a more superior measure than the MARS-R. The current study also found the mathematics anxiety inventory reliable (nine items; α = .88).

**Open-ended questions.** In addition to the survey, two open-ended questions were included: “What do you believe are factors that promoted your college major choice?” and “What skills do you believe are essential for succeeding in your major?”

**Data Analysis Procedures**

The results of the survey data were entered into IBM SPSS software version 23.0 for statistical analysis. Table H1 summarizes research questions and corresponding statistical analysis. Data screening was performed by checking normality on all items. Factors with skewness and/or kurtosis greater than ±2 were removed. From the self-efficacy inventory, items 9, 10, and 11 were removed. From the interest inventory, item 12 was removed. Items 3 and 12 were removed from the personality inventory.

Pearson correlations were used to answer research question 1. To determine the association between specific personality traits and interest, self-efficacy, and mathematics anxiety, a Pearson correlation was analyzed for each relationship, and the correlation coefficient (r) determined the strength and direction of each relationship. The null hypothesis for each analysis was ρ = 0, and the alternative hypothesis was ρ ≠ 0. The significance level was set at α = .05.

Two simple linear regression analyses were used to answer research question 2. A simple linear regression explained STEM interest in terms of STEM self-efficacy. Additionally, a simple linear regression explained mathematics anxiety in terms of STEM self-efficacy.
efficacy was the independent variable for each analysis. The squared multiple correlation ($R^2$) specifically determined the proportion of interests, and the anxiety variability was explained by self-efficacy.

A binary logistic regression was analyzed to answer research question 3. A logistic regression predicted the probability of STEM major choice in terms of the predictor variables: STEM interests, STEM self-efficacy, and mathematics anxiety. A backward stepwise method was used, and all three predictor variables were entered into one block. The Hosmer–Lemeshow test was used to assess the fit of the model and the model’s significance. The significance of the Wald statistic indicated if each $b$ coefficient for the three predictors was significantly different from zero. The odds ratio determined if a change in odds of majoring in STEM resulted from a unit change in the predictor variables. Press’s Q was used to determine if the predictions were significant.

A multivariate analysis of variance (MANOVA) was analyzed to answer research question 4 and to protect against Type I errors from several independent $t$-tests. The MANOVA was examined for statistically significant differences between the five personality traits of female non-STEM and STEM majors. Independent sample $t$-tests were conducted as post hoc analyses of significant findings. Personality traits were dummy coded. The null hypothesis for each analysis was that the population means for each group is equal. The alternative hypothesis for each analysis was that the population means for each group is not equal. The alpha level was set at 0.05.

Open-ended question responses from only female STEM majors were analyzed. Data from the two open-ended questions were coded using open and axial coding. Key words in both
responses were noted and labeled. Additionally, similar words and concepts were grouped into more abstract concepts.

Chapter Four: Results

Descriptive statistics, including means and standard deviations (SD), of all variables are reported in Tables H2 and H3. The correlation coefficients were interpreted using Coolidge’s (2013) guidelines (i.e., strong negative relationship \([-1 \leq r \leq -.50]\), moderate negative relationship \([-0.50 \leq r \leq -.30]\), moderate positive relationship \([.30 \leq r < .50]\), and strong positive relationship \([.50 \leq r \leq 1]\)). Several moderate correlations were found in the total sample. Statistical analysis results are presented in correspondence with the research questions in the following section. Additional findings from the open-ended questions are summarized at the end.

Correlations for the Overall Sample

The correlation between math anxiety (MA) and conscientiousness \((r = -.339, p < .001, n = 124)\) and between math anxiety and agreeableness \((r = -.341, p < .001, n = 124)\) were significant moderate negative correlations. The correlation between math anxiety and neuroticism was a significant moderate positive correlation \((r = .306, p < .01, n = 124)\). The correlation between STEM interest (INT) and STEM self-efficacy (SE) was a significant moderate positive correlation \((r = .372, p < .001, n = 120)\). Conscientiousness had a significant moderate positive correlation with extraversion \((r = .333, p < .001, n = 125)\) and with agreeableness \((r = .461, p < .001, n = 125)\). Conscientious had a significant moderate negative correlation with neuroticism \((r = -.427, p < .001, n = 125)\). Extraversion had a significant moderate positive correlation with agreeableness \((r = .334, p < .001, n = 125)\) and a significant moderate negative correlation with neuroticism \((r = -.328, p < .001, n = 125)\). One significant strong relationship was found. The correlation between agreeableness and neuroticism was a
strong negative correlation ($r = -.538$, $p < .001$, $n = 125$). The results of the correlations for the overall sample are summarized in Table H2.

Data Analysis Findings

Correlations of interests, self-efficacy, and anxiety with personality for female STEM majors. Pearson correlations were used to answer research question 1: To what extent are female STEM majors’ STEM INT, STEM SE, and MA associated with personality traits? Specifically, to what extent is extraversion and openness correlated to INT? To what degree are neuroticism, conscientiousness, and openness correlated to SE? To what extent is neuroticism correlated to MA?

The correlation between INT and openness was a significant moderate positive relationship ($r = .405$, $p < .01$, $n = 59$). This correlation was a stronger positive relationship than the positive correlation in the combined sample of STEM and non-STEM majors. STEM interest and extraversion had a nonsignificant relationship ($r = .047$, $p > .05$, $n = 59$). However, INT had a significant moderate negative relationship with neuroticism ($r = -.303$, $p < .05$, $n = 59$). This relationship was a stronger negative relationship than that in the total sample.

STEM SE had a significant moderate positive relationship with openness ($r = .382$, $p < .01$, $n = 60$), a stronger positive relationship than the positive relationship in the combined sample. However, neuroticism and conscientiousness were not significantly related to SE.

The correlation between MA and neuroticism was a significant moderate positive correlation ($r = .422$, $p < .01$, $n = 59$), a stronger positive relationship than in the total sample. The correlation between MA and conscientiousness ($r = -.399$, $p < .001$, $n = 59$) and MA and agreeableness ($r = -.421$, $p < .01$, $n = 59$) were significant moderate negative correlations. These
correlations were stronger negative correlations than the negative correlation in found the combined sample.

**Additional findings.** Pearson correlations also revealed MA was moderately negatively correlated with INT ($r = -.347, p < .01, n = 58$) and SE ($r = -.387, p < .01, n = 59$). These correlations were stronger negative relationships than those in the total sample. Additionally, STEM INT was moderately positively correlated to SE ($r = -.384, p < .01, n = 60$). This correlation was a stronger positive relationship than in the total sample.

Furthermore, stronger correlations were also found between personality traits of female STEM majors than in the total female sample. Conscientiousness had a moderate negative relationship with neuroticism ($r = -.439, p < .001, n = 60$). Conscientiousness had a strong positive relationship with agreeableness. Extraversion had a moderate positive relationship with agreeableness ($r = .370, p < .01, n = 60$) and a moderate negative relationship with neuroticism ($r = -.427, p < .01, n = 60$). The relationship between agreeableness and neuroticism was a significant strong negative relationship ($r = -.66, p < .001, n = 60$). The relationship between conscientiousness and extraversion was weaker but still significant ($r = .278, p < .05, n = 60$).

The results of the correlations are summarized in Table G3.

**Relationships of STEM interest and mathematics anxiety with STEM self-efficacy.**

Two simple linear regressions were used to answer research question 2: To what extent are female STEM majors’ STEM INT and MA mediated by STEM SE? A simple linear regression was used to test if SE significantly predicted INT. The results of the first linear regression indicated SE explained 13.3% of the variance, $R^2 = .133, F(1, 58) = 10.03, p < .01$. STEM SE positively and significantly predicted INT ($b = .151, \beta = .384, p < .01$). The prediction model, $y = .2563 + .151x$, was significant ($p < .05$). Cohen (1988) suggested the interpretations of $r^2$
values: small effect size (.01 ≤ $r^2 < .09$), medium effect size (.09 ≤ $r^2 < .25$), and a large effect size (.25 ≤ $r^2$). STEM SE had a medium effect on INT. Additionally, the $r$ value (.384) indicated SE and INT had a moderate relationship.

Another simple linear regression was used to test if SE significantly predicted MA. The results of the second linear regression indicated SE explained 13.5% of the variance, $R^2 = .135$, $F(1, 57) = 10.03, p < .01$. STEM SE negatively and significantly predicted MA ($b = -.156, \beta = -.387, p < .01$). The prediction model, $y = 3.774 + (-.156)x$, was significant ($p < .01$). STEM SE had a medium effect on MA. Additionally, the $r$ value (.387) indicated SE and MA had a moderate relationship.

**Predicting STEM major based on interest, self-efficacy, and anxiety.** A binary logistic regression was conducted to determine whether STEM INT, MA, and STEM SE predicted a STEM major for 118 female students. The binary logistic regression included non-STEM majors ($n = 60$) and STEM majors ($n = 58$). The assumptions of a logistic regression were tested: noncollinearity, linearity, and independence of errors. An enter method was initially used in which INT was the first block, MA was the second, and SE was the third. This order represented the order of importance since more literature found SE to predict a major than INT and MA did. The first two models were no more statistically significant than by chance. The third model was found not a good model by the Hosmer–Lemeshow test, $\chi^2(n = 118) = 16.179, df = 8, p = .04$. Lomax and Hahs-Vaughn (2012) cautioned a strong bivariate correlation between an independent variable and the dependent variable may show as a weak correlation when simultaneously entered with other predictor variables. They recommended a stepwise method when using computer algorithms to build a prediction model versus theory. Thus, a backward stepwise logistic regression was used.
A backward stepwise method indicated steps 2 and 3 were both good fit models based on the non-statistically significant results of the Homer–Lemeshow test, $\chi^2(n = 118) = 14.878$, $df = 8$, $p > .05$, and $\chi^2(n = 118) = 8.617$, $df = 8$, $p > .05$). MA and STEM SE were the predictor variables in step 2, and STEM SE was the predictor variable in step 3. Of the steps deemed good fit models, only STEM SE was a statistically significant predictor of STEM major (Wald = 21.169, $df = 1$, $p < .01$). The Wald standard in steps 1 and 2 established that INT and MA were not significant predictors ($p > .05$). Thus, step 3 was used as the logistic regression model. The odds ratio for STEM SE suggested that for every one-point increase in STEM SE, the odds are 1.574 times greater for majoring in STEM versus non-STEM fields. The odds ratio (1.574) was converted to Cohen’s $d$ (0.25). A medium effect size for step 3 was interpreted using Cohen’s (1988) recommendations (Cox and Snell $R^2 = .223$; Nagelkerke $R^2 = .297$). These results suggested STEM SE reliably differentiated between STEM versus non-STEM majors. Table H4 summarizes the results of the model. Overall, the binary logistic regression model correctly predicted 69.5% of the majors in the sample; the STEM major prediction was 72.4% accurate, and the non-STEM major prediction was 66.7% accurate. Press’s Q was calculated as 17.93; this evidence suggested that the predictions based on STEM SE are significantly better than chance. The predictive equation was: Probability of Majoring in STEM

$$\frac{e^{.454(\text{Mean SE})-2.976}}{1+e^{.454(\text{Mean SE})-2.976}}$$

**Comparing personality traits of STEM and non-STEM majors.** A MANOVA was analyzed to compare STEM and non-STEM majors’ mean measures of personality. All personality factors were measured on a 6-point Likert scale. Coolidge (2013) recommended the
following minimum $r$ values for the effect sizes: small ($0.1 \leq r < 0.243$), medium ($0.243 \leq r < 0.371$), and large ($0.371 \leq r \leq 1$).

An initial MANOVA analyzed STEM and non-STEM majors as independent variables and the five personality traits, OCEAN, as dependent variables. There was no statistically significant difference in personality traits based on the category of major, $F(5, 123) = 1.917$, $p > .05$; Wilk’s $\Lambda = .924$, partial $\eta^2 = .076$. However, the openness variable was approaching significance, $F(1, 123) = 3.452$, $p = .066$, partial $\eta^2 = .028$, with a Bonferroni correction of $\alpha = .01$. Therefore, an independent sample $t$-test was examined for the relationship’s strength and direction.

The null hypothesis was two-tailed. The mean openness score for non-STEM majors was $\bar{x} = 4.35$ ($SD = .811$), and for STEM majors, it was $\bar{x} = 4.61$ ($SD = .725$). The independent sample $t$-test was shown to be not statistically significant ($t = -1.858$, $df = 121$, $p > .05$). Therefore, the null hypothesis that the mean openness scores of STEM and non-STEM majors would be the same was retained. A 95% CI for the difference is between -.533 and .017. However, the independent sample $t$-test was approaching statistical significance for a one-tailed null hypothesis ($t = -1.858$, $df = 121$, $p = .033$). This analysis suggests STEM majors may be more open than non-STEM majors. The effect size was small ($r = .167$).

**Open-ended questions.** Two open-ended questions provided more insight to factors that students felt led them to major in a STEM field and what skills they believed were essential to being a successful STEM major. STEM INT, passion, and enjoyment emerged as a major influential theme. Role models and prior experience in STEM classes also emerged as influential factors. These qualitative findings provided more insight to answering research question 3. The
STEM INT theme suggested STEM INT could predict a STEM major. Additionally, the enjoyment theme, essentially suggested low MA could predict a STEM major.

The second open-ended question produced several themes involving required skills to succeed in a STEM major. The most cited skill related to work ethic. The most commonly used words for this category were: “hard work,” “determination,” “dedication,” “studying,” and “practice.” Another major theme related to STEM content knowledge and ability. Words related to conscientiousness was another major theme. The most commonly used words for this category were: “time management,” “patience,” “focus,” and “attention to detail.” Types of thinking was another theme that emerged. Words such as “open mindedness,” “creating thinking,” and “critical” and “abstract thinking” defined this category. The “open mindedness” finding supported the suggestion from statistically analyzing research question 4 (STEM majors are more open than non-STEM majors). A less dominant but present theme was social abilities such as “communication” and “group” and “social skills.”

Chapter Five: Discussion

Summary and Conclusions

The purpose of the study was to describe, compare, and predict female STEM majors based on the personal factors of INT, SE, anxiety, and personality. The aim specifically was to address these research questions:

1. To what extent are female STEM majors’ STEM INT, STEM SE, and MA associated with personality traits? Specifically, to what extent is extraversion and openness correlated to STEM INT? To what degree are neuroticism, conscientiousness, and openness correlated to STEM SE? To what extent is neuroticism correlated to MA?
2. To what degree are female STEM majors’ STEM INT and MA mediated by STEM SE?

3. To what extent do STEM career INT, STEM SE, and MA predict majoring in STEM? and

4. To what extent do each of the Big Five traits (Saucier & Goldberg, 1996) describe female STEM majors compared to female non-STEM majors?

The correlation analysis revealed several significant relationships between INT, SE, MA, and personality factors. STEM INT had a moderate positive relationship with openness and a moderate negative relationship with neuroticism. STEM SE had a moderate positive relationship with openness. MA had a moderate positive relationship with neuroticism and moderate negative relationships with conscientiousness and agreeableness. These relationships were stronger than in the total sample.

The simple linear regression analysis revealed SE predicted female STEM majors’ INT with a medium positive effect size, and SE predicted MA with a medium negative effect size. Furthermore, the binary logistic regression showed one increase in a female’s mean SE score increased the odds of majoring in a STEM field by 1.574 times. STEM SE predicted many factors of female STEM majors. The additional analysis of MA and INT revealed MA was moderately negatively correlated with INT. This correlation was stronger for female STEM majors than in the total sample.

Independent sample t-tests were used to compare personality traits of STEM and non-STEM majors. The only significant finding was that STEM majors are more open than non-STEM majors are; the effect size was small. Table H6 summarizes the study’s significant findings.
Implication of Findings

**Theoretical implications.** The study found at least one personality trait correlated to INT, SE, anxiety, and college major. Specifically, for female STEM majors, neuroticism was negatively correlated to STEM INT; openness was positively correlated to STEM SE; neuroticism was positively associated with MA, and conscientiousness and agreeableness were negatively associated with MA. Furthermore, female STEM majors were more open than female non-STEM majors were. These findings provided additional support for HT and the FFM connecting personality to INT, efficacy, and beliefs (Costa et al., 1984; McCrae & Costa, 1996) and for HT connecting personality to motives (i.e., avoidances motivation of MA; Holland, 1966). Furthermore, these findings supplied additional support of the FFM and HT linking personality to major (Holland, 1966; John et al., 2008).

The study found SE predicted INT and anxiety. Specifically, for female STEM majors, STEM SE positively predicted STEM INT and negatively predicted MA. These findings support SCCT’s claim that efficacy predicted INT (Lent et al., 1994) and SCT’s claim that SE mediated avoidance behavior (Whiston, 1993). Moreover, this study found STEM SE predicted a STEM major. This finding generated more support of SCCT’s predicative power of efficacy (Larson et al., 2010).

**Relation to previous literature.** Many findings of this research were expected based on previous literature’s findings. Particular personality traits of female STEM majors were found to relate to INT, SE, and MA. This study confirmed Hartman and Betz’s (2007) finding that openness was positively related to SE. This study specifies this finding particularly for the relationship between female STEM majors’ openness and their STEM SE. This study confirmed Ackerman and Heggestad’s (1997) meta-analysis results that openness positively related to
FEMALE STEM MAJORS

investigative interests. Additionally, this study expanded on Ackerman and Heggstad’s findings by showing the relationship existed for a specific sample (female STEM majors) and specific interests (STEM INT). This study expanded on Wigfield and Meece’s (1988) discovery that female secondary school students’ NA was significantly related to MA. This study specifically noted a positive correlation between neuroticism and MA, particularly for female STEM majors.

The relationship of SE to a major was expected as in studies by Hackett and Betz (1982) and Lapan et al. (1996) that showed students’ SE predicts a STEM major selection. However, this study extended these findings, especially for females choosing STEM majors. Because SE mediated the relationship between INT and majoring in STEM and between MA and majoring in STEM, this study did not confirm the ability of INT (Lapan et al., 1996; Packard & Nguyen, 2003; Perez-Felkner et al., 2014) and MA (Hackett, 1985) to predict females’ STEM major choice.

Other findings of SE were more generalized by this study, such as generalizing Lapan et al.’s (1996) result—females’ mathematics SE positively correlated to mathematics interests—to broadly include STEM SE positively related to STEM INT. Additionally, this study helped generalize Simon et al.’s (2015) finding of female science-based majors’ negative relationship between science and mathematics SE beliefs to NA; this study generalized that finding to broadly include the same relationship for SE to MA.

However, some findings were not expected from the literature. This study did not confirm Hartman and Betz’s (2007) results (i.e., a negative relationship between neuroticism and analytical career SE and a positive relationship between conscientiousness and analytical career SE) for female STEM majors’ personality and their STEM SE. Additionally, this study could not confirm Bieri Buschor et al.’s (2014) findings of extroversion traits’ negative relationship to
female STEM majors’ choice. Furthermore, this study did not find female STEM majors more agreeable than female non-STEM majors (Rubinstein, 2004).

Some significant findings of the current study were not expected from the literature. From the review of literature, neuroticism was not expected to have a relationship with INT. A relationship between conscientiousness and agreeableness with MA was not anticipated. Although openness was expected to relate to STEM INT, as in Ackerman and Heggestad’s (1997) study, the relationship between openness and mathematics major was not directly anticipated. However, this finding is an extension of Ackerman and Heggestad’s results.

**Conceptual framework revisited.** After reviewing the findings of the current study, the model of female and STEM major selection was modified, as seen in Figure I1. The model includes research-supported relationships that were not found in the current study in gray. This study did not find extraversion related to STEM INT; extraversion and conscientiousness related to STEM SE; and agreeableness related to majoring in a STEM field. Furthermore, this study did not find STEM INT and MA predicted majoring in a STEM field.

The research-supported relationships that the study confirmed or extended are in bold. The study found openness related to STEM INT and STEM SE and neuroticism related to MA. Also, the study found STEM SE predicted STEM INT and MA, and STEM SE predicted STEM major selection.

Additionally, the study’s findings that were not anticipated for the literature are in italics. Neuroticism was negatively related to STEM INT and positively related to MA. Conscientiousness and agreeableness were negatively related to MA. Openness was approaching significance in predicting a STEM major.
**Application.** The relationship between conscientiousness, agreeableness, and neuroticism with MA could be used to identify female STEM students who likely do or would suffer from MA. Thus, based on the students’ personality profiles, with levels of high neuroticism and low conscientiousness and agreeableness, female STEM majors could be targeted and evaluated for MA, and MA interventions be put into place.

SE interventions could be used in combination with identifying students who could or currently suffer from MA. From this study’s results, STEM SE negatively predicted MA. Thus, interventions to decrease MA of female STEM majors should focus on increasing STEM SE. Interventions could be reactive or proactive efforts. Efforts focusing on increasing females’ STEM SE at the beginning of a STEM course or the start of a STEM major could ward off MA and its effects. If female students’ STEM SE was increased prior to the students having or gaining more MA, then MA could be diminished before affecting the students. Lapan et al. (1996) stressed SE interventions should take place at a secondary school level. Hackett et al. (1992) suggested anxiety and the absence of role models as contributing factors impeding students’ development of academic SE. Hackett et al. stated, “proactive efforts to enhance self-efficacy and provide support, by counselors, administrators, and academic departments, should serve to increase the probabilities for the success of all students underrepresented in the sciences” (p. 537). MacPhee, Farro, and Canetto (2013) and Stout, Dasgupta, Hunsinger, and McManus’s (2011) findings elaborate on types of interventions.

MacPhee, et al.’s (2013) longitudinal study of underrepresented STEM majors found particular mentoring increased female STEM majors’ academic SE. Participants in the study were part of the McNair Program that awards grants to higher education institutions for projects dedicated to providing disadvantaged college students with successful preparation for doctoral
studies (U.S. Department of Education, 2015). Eligibility in 2012 included participants be STEM majors and in one of the underrepresented STEM groups (e.g., females; MacPhee et al., 2013). Part of the McNair Program funds training mentor faculty members so they can build encouraging relationships with their students and know how to promote students’ career development (MacPhee et al., 2013). The study suggested females had increased academic SE upon completing a mentoring program, which was indicative of mentoring’s positive impact (MacPhee et al., 2013).

Research results from Stout et al. (2011) support the use of mentoring programs to increase underrepresented populations in STEM majors. Particularly, they found female students exposed to female STEM experts, such as female STEM professors, promoted female students’ STEM SE. The study suggested that female students’ increased STEM SE was led “by greater subjective identification and connectedness with these individuals [female STEM professors]” (Stout et al., 2011, p. 255). Female STEM professors should take the initiative to build professional relationships with their female STEM students.

These aforementioned researched interventions could help increase STEM SE and thus could decrease female students’ MA. Furthermore, an increase in the likelihood of majoring in a STEM field is another benefit of increased STEM SE. This finding has implications for proactive STEM recruiting efforts. An increase in freshmen and sophomore female students’ STEM SE could lead to more females switching to STEM majors.

**Openness to career.** Individuals’ openness has implications for occupation. Openness, or what McCrae and Costa (1990) called “openness to experience” (p. 44), is measured by the facets of fantasy, aesthetics, action, ideals, and values, according to them. Open people indicate having a wide variety of occupational interests (Costa & McCrae, 1984). This implies female
STEM majors’ conceivably higher levels of openness could indicate why they were open to pursue a field in which their gender is underrepresented. More open females could be targeted in STEM-major recruiting efforts. For recruiting techniques or in vocational counseling efforts, suggestions of particular STEM fields may appeal to the more open females especially when the suggestions are focused on their SE. Open females would be open-minded and receptive to these suggestions. As more open-minded females, they would possibly consider these options and ideas. Ideal times to recruit STEM majors include freshmen orientation and from high schools. College female STEM clubs and special interest groups could aid in these recruiting efforts.

This study did not find a statistically significant difference for non-STEM and STEM females’ level of extraversion. This finding implies classroom activities are not preferential to gregariousness (e.g., group work or projects versus individual projects). However, the higher levels of openness of female STEM majors could imply these students are more open to different forms of traditional teaching and learning, such as authentic learning, problem-based learning, and interdisciplinary learning). Such students could be more motivated to learn using different forms of teaching and learning. These types of students would make an ideal group for teachers to try or expand on their alternative forms of teaching.

Limitations of the Study

The sampling procedure limited the study’s methodology. Using a convenient and purposeful sampling of female STEM majors rather than random sampling limited the generalizability of the findings to the broader population of female STEM majors. Thus, the study is limited to a sample from one large university in the southeastern United States. The results of this study are limited to the small variety of participants. Most non-STEM majors were elementary and middle grades education majors, and most STEM majors were mathematics
majors. Findings of female STEM majors may be more relatable to female mathematics majors. A larger sample size could aid in establishing statistically significant findings in factors approaching significance (i.e., STEM and non-STEM majors’ level of openness). Additionally, a qualitative or mixed methods tradition (e.g., Bieri Buschor et al., 2014) may provide further understanding of the interaction between factors in the present study and reduce the limitations of a quantitative research methodology.

Not all external or internal factors that are shown to affect females’ STEM major decisions were included in the present study. Environmental factors such as a positive relationship with a professor and comparing self to peers can also affect STEM SE (Litzler et al., 2014). External support from parents or positive peer role models played a critical role in females’ persistence in STEM fields (Perez-Felkner et al., 2014).

**Future Research**

Future research could include other factors affecting INT, SE, MA, and STEM major selection. Factors other than personality were shown to correlate with STEM SE. MA, prior achievement, and prior high school mathematics courses were highly correlated to mathematics SE (Hackett, 1985). Additionally, females with a higher gender-bias perception in undergraduate programs reported lower SE beliefs (Ancis & Phillips, 1996). Factors other than SE can explain MA. Females who thought of mathematics as a male subject anticipated more negative mathematics attitudes and having more MA (Nosek & Smyth, 2011). Stereotypes affected personal factors such as worry and anxiety (Spencer, Steele, & Quinn, 1999). This study identified MA as one motivational factor through avoidance motivation. Future work could include different motivational factors, for example, parental support (Bieri Buschor et al., 2014),
autonomy (Gasser, Larson, & Borgen, 2004), or achievement (De Fruyt & Mervielde, 1996; Mann & DiPrete, 2013), to predict STEM major selection.

A replication of the study with a larger variety of STEM majors (e.g., more information systems, computer software engineering, and engineering majors) and non-STEM majors (e.g., more arts, humanities, and social sciences majors) may make some findings more statistically significant (i.e., $p < .05$ rather than $p < .1$). A replication of the study with a larger sample size would avoid the limitations of a convenient sample. Including other university students in a replication of the current study would avoid the use of a purposeful sampling method.

Additionally, analysis of data collected from males in this study would be of interest and answer several questions. Do the relationships between personality and INT, SE, and MA also hold true for male STEM majors? Does STEM males’ SE also predict STEM career INT and MA? Additionally, do males’ INT, SE, and MA predict STEM major selection? Comparing variables in the study between female and male STEM majors would generalize this study’s findings. A pressing question is how the current study’s findings would compare with unanalyzed data from the male students.

**Personal Implications**

The findings of this research call for action. STEM professors and female STEM students must be informed of these findings to help their students and for students to help themselves. Furthermore, as a researcher and a teacher, other females and I are responsible for being role models for females in STEM fields and fostering relationships with female students that promote their STEM SE.
References


Eccles, J. S. (2007). Where are all the women? Gender differences in participation in physical sciences and engineering. In W. J. Ceci & W. M. Williams (Eds.), *Why aren’t more*


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Appendix A

Conceptual Framework Combining Theories

**Figure A1.** Conceptual framework combining Holland’s theory, social cognitive theory, social cognitive career theory, and the five-factor model.
Appendix B

Females’ Personal Factors and Relation to Majoring in STEM

Figure B1. Proposed relationships between females’ personal factors and majoring in STEM. Particular traits mediate interests, self-efficacy, and anxiety. These factors then influence a female’s decision to major in a STEM field.
## Appendix C

### Data Collection: Participants

<table>
<thead>
<tr>
<th>Field</th>
<th>STEM Majors</th>
<th>Non-STEM Majors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Technology</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Computing and Software</td>
<td>17</td>
<td>1</td>
</tr>
<tr>
<td>Engineering Engineering</td>
<td>12</td>
<td>6</td>
</tr>
<tr>
<td>Mathematics</td>
<td>29</td>
<td>46</td>
</tr>
<tr>
<td>Architecture and Construction</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Management</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Arts</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Business</td>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>Elementary and Middle Grades</td>
<td>46</td>
<td>73</td>
</tr>
<tr>
<td>Education</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Humanities and Social Sciences</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>Health and Human Services</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>
Appendix D

The Big Five Inventory

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who *likes to spend time with others*? Please indicate the extent to which *you agree or disagree with that statement*.

<table>
<thead>
<tr>
<th>I am someone who …</th>
<th>Disagree Strongly</th>
<th>Disagree Somewhat</th>
<th>Disagree a Little</th>
<th>Agree a Little</th>
<th>Agree Somewhat</th>
<th>Agree Strongly</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is talkative</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>2. Tends to find fault with others</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>3. Does a thorough job</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>4. Is depressed, blue</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>5. Is original, comes up with new ideas</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>6. Is reserved</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>7. Is helpful and unselfish with others</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>8. Can be somewhat careless</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>9. Is relaxed, handles stress well</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>10. Is curious about many different things</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>11. Is full of energy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>12. Starts quarrels with others</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>13. Is a reliable worker</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>14. Can be tense</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>15. Is ingenious, a deep thinker</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>16. Generates a lot of enthusiasm</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>17. Has a forgiving nature</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>18. Tends to be disorganized</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>19. Worries a lot</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>20. Has an active imagination</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>21. Tends to be quiet</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>22. Is generally trusting</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>23. Tends to be lazy</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>24. Is emotionally stable, not easily upset</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>25. Is inventive</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>26. Has an assertive personality</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>27. Can be cold and aloof</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>28. Perseveres until the task is finished</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>29. Can be moody</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>30. Values artistic, aesthetic experiences</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>---</td>
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<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>31.</td>
<td>Is sometimes shy, inhibited</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>32.</td>
<td>Is considerate and kind to almost everyone</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>33.</td>
<td>Does things efficiently</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>34.</td>
<td>Remains calm in tense situations</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>35.</td>
<td>Prefers work that is routine</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>36.</td>
<td>Is outgoing, sociable</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>37.</td>
<td>Is sometimes rude to others</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>38.</td>
<td>Makes plans and follows through with them</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>39.</td>
<td>Gets nervous easily</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>40.</td>
<td>Likes to reflect, play with ideas</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>41.</td>
<td>Has few artistic interests</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>42.</td>
<td>Likes to cooperate with others</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>43.</td>
<td>Is easily distracted</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>44.</td>
<td>Is sophisticated in art, music, or literature</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Appendix E

STEM Interests Inventory

Pick ONE category (i.e., Engineering, Mathematics, Physical Science, or Information Technology) that most aligns with your major OR the category that interests you the most. Indicate how much you would like to do each activity by circling the number that most closely represents how you feel about it.

<table>
<thead>
<tr>
<th>Engineering Major/Interest</th>
<th>Strongly Dislike</th>
<th>Dislike</th>
<th>Neutral</th>
<th>Like</th>
<th>Strongly Like</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Modify an equipment design to reduce sound level</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2 Develop more user-friendly machines</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3 Redesign an engine to improve fuel efficiency</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4 Maintain the main generator in a power plant</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5 Test a new cooling system</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6 Design electronic systems</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7 Improve efficiency of an assembly process</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8 Design a structure that can withstand heavy stress</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9 Analyze problems in aircraft design</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10 Design a highway overpass</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>11 Design a diagnostic routine for a power plant</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mathematics Major/Interest</th>
<th>Strongly Dislike</th>
<th>Dislike</th>
<th>Neutral</th>
<th>Like</th>
<th>Strongly Like</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Solve an algebra equation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2 Develop mathematical formulas</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3 Understand applications of calculus</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4 Learn about a new branch of mathematics</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5 Graph an equation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6 Take a course in advanced mathematics</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7 Solve geometric proofs</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8 Apply mathematical techniques to practical problems</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9 Calculate the probability of winning a contest</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>10 Use mathematical theorems to solve problems</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
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### Information Technology Major/Interest

<table>
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<th>Neutral</th>
<th>Like</th>
<th>Strongly Like</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Design a technology system for distance learning</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Acquire the latest electronic technology</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Maintain network hardware and software</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Maintain a website for an organization</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Keep up-to-date on the latest software</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Take a course on network administration</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Design a computer system for an organization</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Use computers to archive historical documents</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>Create a computer database</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>Improve computer network efficiency</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>Modify existing software</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>Install a new computer system</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

### Physical Science Major/Interest

<table>
<thead>
<tr>
<th></th>
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<th>Dislike</th>
<th>Neutral</th>
<th>Like</th>
<th>Strongly Like</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Study the laws of gravity</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2</td>
<td>Investigate the molecular structure of substances</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>Search for new solar systems</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Study the nature of quantum physics</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Measure the speed of electrons</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>Study the movement of planets</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Test chemical reactions</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Study rock and mineral formations</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>Describe the structure of an organic compound</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>Study why earthquakes occur</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>11</td>
<td>Use meteorological information to predict the weather</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>Take a course in the physical sciences</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

*Note.* Adapted from Liao, Armstrong, & Rounds, 2007.
Appendix F

STEM Self-Efficacy Inventory

For each task listed, please indicate whether or not you feel you could successfully complete it—assuming you were motivated to make your best effort. For each YES, indicate how sure you are by circling one of the numbers on the 10-point scale.

<table>
<thead>
<tr>
<th>Task</th>
<th>Could you successfully complete the task?</th>
<th>If yes, how sure are you?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Complete the math requirements for most science, math, or engineering majors</td>
<td>Yes No</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>2. Complete the chemistry requirements for most science, math, or engineering majors</td>
<td>Yes No</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>3. Complete the physics requirements for most science, math, or engineering majors</td>
<td>Yes No</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>4. Complete some science, math, or engineering degree</td>
<td>Yes No</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>5. Perform competently in some science, math, or engineering career field</td>
<td>Yes No</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>6. Remain in a science, math, or engineering major over the next semester</td>
<td>Yes No</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>7. Remain in a science, math, or engineering major the next two semesters</td>
<td>Yes No</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>8. Remain in a science, math, or engineering major the next three semesters</td>
<td>Yes No</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>9. Excel in science, math, or engineering over the next semester</td>
<td>Yes No</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>10. Excel in science, math, or engineering over the next two semesters</td>
<td>Yes No</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>11. Excel in science, math, or engineering over the next three semesters</td>
<td>Yes No</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>12. Be accepted into a science, math, or engineering graduate program, law school, or medical school</td>
<td>Yes No</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>13. Successfully obtain a science, math, or engineering graduate degree, a law degree, or a medical degree</td>
<td>Yes No</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
<tr>
<td>14. Excel in a science, math, or engineering graduate program, a law program, or a medical school program</td>
<td>Yes No</td>
<td>1 2 3 4 5 6 7 8 9 10</td>
</tr>
</tbody>
</table>

# Appendix G

**Abbreviated Math Anxiety Scale**

For each item below, please indicate your level of anxiety associated with each scenario.

<table>
<thead>
<tr>
<th></th>
<th>1 Low Anxiety</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5 High Anxiety</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Having to use the tables in the back of the math book</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>2. Thinking about an upcoming math test 1 day before.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>3. Watching a teacher work an algebraic equation on the blackboard.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4. Taking an examination in a math course.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>5. Being given a homework assignment of many difficult problems that is due the next class meeting.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>6. Listening to a lecture in math class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>7. Listening to another student explain a math formula.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>8. Being given a “pop” quiz in math class.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9. Starting a new chapter in a math book.</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

*Note.* Hopko, Mahadevan, Bare & Hunt, 2003.
Appendix H

Table H1

Research Questions and Corresponding Statistical Analysis

<table>
<thead>
<tr>
<th>Research Question</th>
<th>Instrument(s)</th>
<th>Statistical Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) To what extent are female STEM majors’ STEM interest, STEM self-efficacy, and mathematics anxiety associated with personality traits? Specifically, to what extent is extraversion and openness correlated to STEM interest? To what degree are neuroticism, conscientiousness, and openness correlated to STEM self-efficacy? To what extent is neuroticism correlated to mathematics anxiety?</td>
<td>BFI, Interest Inventory, Self-Efficacy Inventory, AMAS</td>
<td>Pearson correlations (r values) (α = 0.05)</td>
</tr>
<tr>
<td>(2) To what extent are female STEM majors’ STEM interest and mathematics anxiety mediated by STEM self-efficacy?</td>
<td>Interest Inventory, Self-Efficacy Inventory, AMAS</td>
<td>Two simple linear regressions (r values and r² values)</td>
</tr>
<tr>
<td>(3) To what extent do STEM career interests, STEM self-efficacy, and mathematics anxiety predict majoring in STEM?</td>
<td>Interest Inventory, Self-Efficacy Inventory, AMAS, Open-ended question (1)</td>
<td>Binary Logistic Regression (b)</td>
</tr>
<tr>
<td>(4) To what extent do each of the Big Five traits describe female STEM majors compared to female non-STEM majors?</td>
<td>BFI, Open-ended question (2)</td>
<td>MANOVA Post hoc test: Independent sample t-tests (α = 0.05)</td>
</tr>
</tbody>
</table>
Table H2

*Summary of Correlation Coefficients for Mathematics Anxiety, STEM Interests, STEM Self-Efficacy, and Personality Factors in Overall Sample (N = 125)*

<table>
<thead>
<tr>
<th>Variables</th>
<th>ANX</th>
<th>INT</th>
<th>SE</th>
<th>O</th>
<th>C</th>
<th>E</th>
<th>A</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>INT</td>
<td>-.246**</td>
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<td>.372***</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>.009</td>
<td>.284**</td>
<td>.188*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>-.339***</td>
<td>.245**</td>
<td>.181*</td>
<td>-.003</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>-.219*</td>
<td>.068</td>
<td>.011</td>
<td>.121</td>
<td>.333***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>-.341***</td>
<td>.106</td>
<td>.043</td>
<td>.086</td>
<td>.461***</td>
<td>.334***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>.306**</td>
<td>-.275**</td>
<td>-.099</td>
<td>-.095</td>
<td>-.427***</td>
<td>-.328***</td>
<td>-.538***</td>
<td></td>
</tr>
<tr>
<td>Means</td>
<td>2.65</td>
<td>3.58</td>
<td>6.33</td>
<td>4.46</td>
<td>4.44</td>
<td>3.90</td>
<td>4.80</td>
<td>3.51</td>
</tr>
<tr>
<td>SDs</td>
<td>.848</td>
<td>.736</td>
<td>2.692</td>
<td>.778</td>
<td>.737</td>
<td>1.021</td>
<td>.767</td>
<td>.927</td>
</tr>
</tbody>
</table>

*Note. ANX = Anxiety (N = 124, \(\bar{x} = 2.65\)), INT = Interest (N = 124, \(\bar{x} = 3.58\)), SE = Self-Efficacy (N = 123, \(\bar{x} = 6.33\)), O = Openness (N = 125, \(\bar{x} = 4.46\)), C = Conscientiousness (N = 125, \(\bar{x} = 4.44\)), E = Extraversion (N = 125, \(\bar{x} = 3.90\)), A = Agreeableness (N = 125, \(\bar{x} = 4.80\)), N = Neuroticism (N = 125, \(\bar{x} = 3.51\)). Significance of correlation is noted as *p < .05, **p < .01, ***p < .001.***
### Table H3

*Summary of Correlation Coefficients for Mathematics Anxiety, STEM Interests, STEM Self-Efficacy, and Personality Factors for Female STEM Majors*

<table>
<thead>
<tr>
<th>Variables</th>
<th>ANX</th>
<th>INT</th>
<th>SE</th>
<th>O</th>
<th>C</th>
<th>E</th>
<th>A</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANX</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INT</td>
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<td>SE</td>
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<td>.384**</td>
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<tr>
<td>O</td>
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<td>.405**</td>
<td>.382**</td>
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<td></td>
<td></td>
<td></td>
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<td>C</td>
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<td></td>
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<tr>
<td>E</td>
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<td>-.047</td>
<td>.034</td>
<td>.088</td>
<td>.278*</td>
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<td></td>
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</tr>
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<td>.288*</td>
<td>.141</td>
<td>.009</td>
<td>.536***</td>
<td>.370**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
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<td>-.303*</td>
<td>-.035</td>
<td>-.035</td>
<td>-.439***</td>
<td>-.427**</td>
<td>-.666***</td>
<td></td>
</tr>
<tr>
<td>Means</td>
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<td>3.72</td>
<td>7.61</td>
<td>4.61</td>
<td>4.46</td>
<td>3.77</td>
<td>4.72</td>
<td>3.52</td>
</tr>
<tr>
<td>SDs</td>
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<td>.781</td>
<td>1.98</td>
<td>.725</td>
<td>.722</td>
<td>1.061</td>
<td>.804</td>
<td>.905</td>
</tr>
</tbody>
</table>

*Note.* ANX = Anxiety, INT = Interest, SE = Self-Efficacy, O = Openness, C = Conscientiousness, E = Extraversion, A = Agreeableness, N = Neuroticism. Significance of correlation is noted as *p < .05, **p < .01, ***p < .001.

### Table H4

*Logistic Regression Step 3 With STEM Self-Efficacy as Predictor Variable*

<table>
<thead>
<tr>
<th>Included</th>
<th>B (SE)</th>
<th>Lower</th>
<th>95% CI for Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-2.976 (.692)</td>
<td></td>
<td>.051</td>
</tr>
<tr>
<td>SE</td>
<td>.454 (.099)*</td>
<td>1.297</td>
<td>1.574</td>
</tr>
</tbody>
</table>

*Note.* SE = STEM Self-Efficacy.

\[
\chi^2 = 8.617, p > .05 \text{ (Hosmer & Lemeshow), .223 (Cox & Snell), .297 (Nagelkerke). Model} \\
\chi^2(1) = 133.83, p < .05. \\
*p < .01.*
### Table H5

**Summary of Significant Findings**

<table>
<thead>
<tr>
<th>Research Question (Statistical Test) (Sample)</th>
<th>Finding</th>
<th>Effect Size and Polarity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Correlations between INT, SE, and MA to P (Pearson Correlations) (Female STEM Majors)</td>
<td><strong>INT correlated to O</strong></td>
<td>Moderate positive</td>
<td>Stronger than total sample</td>
</tr>
<tr>
<td></td>
<td><strong>INT correlated to N</strong></td>
<td>Moderate negative</td>
<td>Stronger than total sample</td>
</tr>
<tr>
<td></td>
<td><strong>SE correlated to O</strong></td>
<td>Moderate positive</td>
<td>Stronger than total sample</td>
</tr>
<tr>
<td></td>
<td><strong>SE correlated to N</strong></td>
<td>Moderate negative</td>
<td>Stronger than total sample</td>
</tr>
<tr>
<td></td>
<td><strong>MA correlated to O</strong></td>
<td>Moderate positive</td>
<td>Stronger than total sample</td>
</tr>
<tr>
<td></td>
<td><strong>MA correlated to N</strong></td>
<td>Moderate negative</td>
<td>Stronger than total sample</td>
</tr>
<tr>
<td></td>
<td><strong>MA correlated to C</strong></td>
<td>Moderate negative</td>
<td>Stronger than total sample</td>
</tr>
<tr>
<td></td>
<td><strong>MA correlated to A</strong></td>
<td>Moderate negative</td>
<td>Stronger than total sample</td>
</tr>
<tr>
<td>(2) SE predicting INT and MA (Simple Linear Regressions) (Female STEM Majors)</td>
<td><strong>SE predicted INT</strong></td>
<td>Medium positive</td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>SE predicted MA</strong></td>
<td>Medium negative</td>
<td></td>
</tr>
<tr>
<td>(3) SE, INT, and ANX predicting STEM major (Binary Logistic Regression) (Female STEM and Non-STEM Majors)</td>
<td><strong>SE predicted STEM major</strong></td>
<td>Small effect</td>
<td>1 increase in Mean STEM Self-Efficacy Score increased odds of majoring in STEM by 1.574 times</td>
</tr>
<tr>
<td>(4) Compare personalities STEM vs. Non-STEM (Independent Sample t-tests) (Female STEM and Non-STEM Majors)</td>
<td><strong>STEM more O than non-STEM</strong></td>
<td>Small effect size</td>
<td>One-tailed</td>
</tr>
</tbody>
</table>

*Note. INT = STEM Interest, SE = STEM Self-Efficacy, ANX = Mathematics Anxiety, P = Personality, O = Openness, C = Conscientiousness, E = Extraversion, A = Agreeableness, N = Neuroticism.

*p < .1. **p < .05.*
Appendix I

Revised Conceptual Framework

STEM Interest

Personality

STEM Self-Efficacy

Math Anxiety

STEM Major

Figure 11. Revised conceptual framework. The study’s findings that were expected from the literature are in bold. Relationships anticipated by the literature but not supported by the current study are in gray. Relationships found by the study not anticipated by the review of literature are in italics.