May 2018

Beyond the Bench and the Bedside: Examining Women's Success in STEM via Active Learning Projects

Sarah E. Thoman

BEYOND THE BENCH AND THE BEDSIDE: EXAMINING WOMEN'S SUCCESS IN STEM VIA ACTIVE LEARNING PROJECTS

By

Sarah E. Thoman

Bachelor of Arts – Psychology
The University of Texas at Austin
2007

Bachelor of Business Administration – Management
The University of Texas at Austin
2007

Master of Arts – Organizational Psychology
Teachers College, Columbia University
2010

A thesis submitted in partial fulfillment of the requirements for the

Master of Arts – Psychology

Department of Psychology
College of Liberal Arts
The Graduate College

University of Nevada, Las Vegas
May 2018

UNLV | GRADUATE COLLEGE

Thesis Approval

The Graduate College
The University of Nevada, Las Vegas

May 1, 2018

This thesis prepared by

Sarah E. Thoman

entitled

Beyond The Bench and the Bedside: Examining Women's Success in STEM via Active Learning Projects

is approved in partial fulfillment of the requirements for the degree of

Master of Arts – Psychology
Department of Psychology

Rachael Robnett, Ph.D.
Examination Committee Chair

Kathryn Hausbeck Korgan, Ph.D.
Graduate College Interim Dean

Jennifer Rennels, Ph.D.
Examination Committee Member

Murray Millar, Ph.D.
Examination Committee Member

Stefani Relles, Ph.D.
Graduate College Faculty Representative

Abstract

Gender inequality is a persistent challenge in fields related to science, engineering, technology, and math (STEM) in the U.S. The current study aims to advance the literature in a burgeoning area of inquiry by identifying factors that may help to account for women's success in STEM. To evaluate STEM success, I used a mixed methods design to investigate STEM identity, career identity status, career commitment, and both individual and situational resilience among women undergraduates. Students were engaged in two project-based STEM programs organized at a large, diverse, research intensive university in the Southwest U.S. Associations between resilience and career commitment, as well as narrative insight into resilience and career identity status emerged. Results further psychological insight into STEM success while providing insight into women's experiences in active-learning programs. Findings also suggest avenues to enrich theoretical models and help inform new directions to examine in educational and career development programs or interventions in STEM.

Acknowledgments

The author would like to acknowledge the students and administrators of the McNair and AANAPISI Scholars Programs at the University of Nevada, Las Vegas, the students and administrators of the Health Improves Together (HIT) Program at the University of Nevada, Las Vegas School of Medicine, as well as the research team at the Social-Developmental Lab in the Department of Psychology at the University of Nevada, Las Vegas for their contributions to this study.

Additionally, the author would like to thank Dr. Rachael Robnett, PhD, as well as Tori DiBona and James Abelar. Dr. Robnett's encouragement and guidance, as well as Ms. DiBona's and Mr. Abelar's diligence, time, and devotion to the project, made a world of difference.

Finally, the author would like to thank her loved ones and mentors for providing ongoing care and support from project inception to completion; as always they enable all endeavors large and small.

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Introduction

Most would agree that humanity strives for a world in which all individuals are able to pursue opportunities uniquely suited to their abilities and interests. Such an ideal state would enable one to reach self-actualization, or the highest form of the self (Maslow & Arieti, 1961; Koltko-Rivera, 2006). Beyond fulfilling individual potential, however, self-actualization may also enable self-transcendence wherein one is able to further the greater good (Koltko-Rivera, 2006). Therefore, a world supportive of "unbounded self-actualization" (Murtaza, 2011, p. 581) at the individual level would likewise benefit broader human societies and economies sustained by the collective wisdom of individuals operating at their highest capacity (Murtaza, 2011).

Unfortunately, in the pursuit of self-actualization and possible self-transcendence, people encounter systemic challenges and limitations. More specifically, gender stereotypes and bias limit individual career advancement. For example, in the U.S., women currently receive less than $0.80 for every $1.00 a man receives for comparable work (Hill, 2016). Also women continue to be underrepresented at the highest levels of government and business (Chu & Posner, 2013), and are often encouraged to adhere to gender roles reinforcing focus on the family, home, and "female-appropriate" pursuits (Halpern et al., 2007).

STEM fields, or disciplines in science, technology, engineering, and math, are examples of academic and career domains in which women are underrepresented (Landivar, 2013). Although some areas of STEM such as the health professions see greater female enrollment, (Corbett, Hill & St. Rose, 2008), the demand for qualified talent in healthcare far outpaces supply (Cooper, Getzen, McKee & Laud, 2002; Petterson et al., 2012), and women continue to pursue largely gendered subfields within these disciplines (e.g., pediatrics; Lambert & Holmboe,

2005). Additionally, in spite of relatively equal representation in health fields, women in healthcare continue to experience bullying and other forms of sexism (Berry, Gillespie, Gates & Schafer, 2012; Herbst, 2016).

Enhancing inclusion in STEM fields is a national priority (Koizumi, 2015). However, relatively little is known about the factors that may account for women's success in STEM. This is a critical knowledge gap that must be filled in order to inform theory and intervention. As detailed in the pages to come, the current study addresses this missing link in the literature by exploring variables that may be linked to STEM success (i.e., career identity, career commitment, and resilience) among women pursuing STEM careers in applied contexts.

Literature Review

Gender: A Social Category

To understand the experiences women may encounter en route to career pursuits in STEM fields, it is important to briefly highlight the origin and influence of gender stereotypes, bias, and gender roles. Gender is one of a variety of social categories, which are mental representations of human traits and qualities that help individuals understand the world. Examples of social categories include race, gender, and age. As infants, individuals learn to use social categories as evolutionarily adaptive cognitive shortcuts to quickly delineate social information (Spelke & Kinzler, 2007). Social categories are generally useful in expediting mental processes, though they can also be harmful if linked to snap judgments rooted in bias, prejudice, and stereotypes.

Gender is a critical social category, not only because it is rife with stereotypes and bias, but also because it is integral to individual development and a person's sense of self, thus shaping experiences across the lifespan (Banaji & Prentice, 1994). For instance, research on how individuals define themselves in light of their gender and whether they "fit" with their gender based on societal norms has implications for psychosocial outcomes and health (Egan & Perry, 2001). Furthermore, gender extends beyond the individual and influences culture and social systems (Wood & Eagly, 2002). These circumstances set the stage for gender roles, which are prescribed traits and behaviors associated with gender (e.g., men as leaders; women as nurturers; Wood & Eagly, 2002).

Gender roles can constrain behavior at home and in the workplace. For instance, in heterosexual unions and families, women may be expected to take on particular tasks and endeavors, such as housekeeping or primary responsibility in child-rearing, alongside demanding

professional careers (Mason & Goulden, 2004). Additionally, in the workplace certain classes of positions or job types may be more commonly ascribed to each gender (e.g., “pink collar” jobs or administrative roles for women; Bagchi-Sen, 1995; Dewan & Gebeloff, 2012). Thus, gender remains an important social category at both the societal and individual levels and appears to influence life outcomes. One such outcome of interest is that of career trajectories.

Women in STEM

STEM includes a variety of disciplines (e.g., natural sciences, math, applied math fields, computer sciences, health sciences, and social sciences; Gonzalez & Kuenzi, 2012). It is worth noting that the state of gender inequality across STEM fields varies. For instance, math-intensive fields (e.g., engineering, physics) tend to illustrate the greatest gender differences (Landivar, 2013), whereas women enter and remain in the health professions (e.g., medicine, nursing), life sciences, and social sciences at higher rates (Corbett et al., 2008).

However, despite the influx of women into certain STEM areas, their experiences differ from those of their male counterparts. For instance, in healthcare women continue to track into specialties differentially by gender. As an example, pediatric medicine has a higher proportion of women, whereas orthopedic medicine has a higher proportion of men (Erikson, Jones & Tilton, 2012; Lambert & Holmboe, 2005). This is particularly perplexing given that women and men currently enter medical school at approximately equal rates (Association of American Medical Colleges, 2015). Furthermore, women in healthcare continue to experience hostile treatment such as bullying as nurse trainees (Berry et al., 2012) and sexist commentary as resident physicians in the surgical suite (Herbst, 2016). Also with respect to the life sciences, in 2006 although women earned more than half (59.8%) of the undergraduate degrees in biology, they represented only 29% of those with PhDs employed full time in the field (Hill, Corbett, & St. Rose, 2010). Thus,

while there are likely more women persisting in the life sciences and health professions as compared to other STEM fields, women continue to pursue their careers differentially based on their gender, continue to report bias in the workplace, and are underrepresented in areas of the workforce.

Significant research to date has explored gender inequality in STEM fields. For instance, women tend to have lower STEM self-concept, or a lack of belief in their STEM-related abilities (e.g., math skills), as compared to their male counterparts (Eccles, 2011; Eccles, 2015; Robnett & Thoman, 2017). Additionally, research has implicated work-life balance choices in favor of family (Ceci & Williams, 2011) and social and family expectations surrounding women's roles in child-rearing (Halpern et al., 2007) in women's underrepresentation in STEM fields. Furthermore, women in STEM report experiencing gender bias in the hiring process (Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012), from peers in the field (Robnett, 2016), and from within the STEM workplace (Settles, Cortina, Buchanan, & Miner, 2012; Settles, Cortina, Malley, & Stewart, 2006).

However, focusing on the reasons for the paucity of women in STEM covers only certain aspects of the story. In order to fully understand gender differences in STEM and design effective interventions to enhance STEM inclusion, it is important to understand both the struggles of women in STEM as well as the keys to their success.

Women in STEM: Success the Next Frontier

Focusing on women's success in STEM provides the missing link to understanding women's career trajectories and experiences in STEM. To date, success has been approximated via research focused on retention statistics (Corbett et al., 2008) and persistence (Lent, Brown & Larkin, 1984; Lent et al., 2001). Such work can be built upon by giving voice to the experiences

of the women who are thriving in STEM. An awareness of the factors contributing to women's success in STEM will enable researchers and practitioners to design interventions knowing what is already effective. To this end, I will explore STEM success among women pursuing STEM careers in applied contexts. As detailed below, my focus centers on the following constructs: identity, career commitment, and resilience.

Career success: Identity and career commitment. Identity formation or the process of answering "who am I?" is considered a key developmental process in the transition from adolescence to adulthood. Erickson initially theorized identity as culminating in the individual successfully arriving at a singular, integrated view of the self by the end of adolescence (i.e., by approximately 18-19 years of age by Western standards; Schwartz, Zamboanga, Luyckx, Meca, & Ritchie, 2013). Recent work has extended this timeframe into the late 20s to early 30s. For instance, Arnett (2000) argues that identity exploration is a key feature of emerging adulthood, which is a developmental period bridging adolescence and adulthood. During emerging adulthood, individuals seek out experiences in order to explore roles and interests in an effort to mold their adult identity relative to career, love, and world views (Arnett, 2000). Career-related identity experiences are often particularly salient to emerging adults in Western/post-industrial countries who are transitioning into post-secondary educational and professional pursuits (Arnett, 2000).

Marcia's identity status model describes one potential process by which emerging adults may arrive at their career-related identity (Marcia, 1966; Schwartz et al., 2013). According to the model, one arrives at an identity (*commitment*) by way of activities that afford opportunities to filter through possible identities (*exploration*; Schwartz et al., 2013). The extent to which individuals are actively engaged in exploring potential identity options determines whether they

fall within one of four identity statuses (Marcia, 1966; Schwartz et al., 2013). For example, with limited exploration one may belong to either the *foreclosure* identity status if they have selected an identity upon minimal investigation (e.g., "I've always known I'd be a doctor."), or they may belong to *diffusion* if they have little interest in engaging in the process and have not settled on a particular identity (e.g., "I have no idea what to do and am not seeking out further insight."). In contrast, if an individual has fully participated in exploring they may belong to either *moratorium* (e.g., "I've done many internships but haven't decided between medicine, dentistry, or nursing."), or *achievement* (e.g., "After a year of research across two labs, I know I want to be an astronomer;" Marcia, 1966; Schwartz et al., 2013). Although research indicates that the shift from moratorium to achievement may be iterative and that perhaps identity exploration and commitment continue to occur beyond emerging adulthood (Schwartz et al., 2013), Marcia's identity status model provides one lens through which to view the role of career identity formation among emerging adult women in STEM fields.

The process of career identity and career identity formation is likely integral to the success of women in STEM fields. For instance, there appears to be a strong link between undergraduates' identification with STEM and their commitment to pursuing a STEM career in the future (e.g., Chemers, Zurbriggen, Syed, Goza, & Bearman, 2011). Career commitment also has ties to organizational commitment, or one's intention to remain with a company or place of work. This is important because both career commitment and organizational commitment are linked to desirable workplace outcomes (e.g., increased job satisfaction, reduced turnover; Lee, Carswell & Allen, 2000). However, it is unclear how career-related identity formation occurs when individuals are presented with socio-cultural conflict (e.g., pursuing a gender-atypical career). It is also unknown whether career commitment or identity may enable success in context

(Schachter, 2004). Thus, further investigation of the role of identity and career commitment among women in STEM may point to the ways in which each construct contributes to women's career success.

Career success: Role of resilience. Beyond the potential role of career identity and career commitment in the success of women in STEM, resilience may also play a part. Resilience is of particular interest for women in STEM due to the potential challenges such women may experience in pursuit of a profession counter to gender norms and expectations. The current research focuses on two forms of resilience. *Individual resilience*, which reflects a person's ability to cope with stressful life circumstances, is often influenced by genetics as well as personality and temperament (Davydov, Stewart, Ritchie, & Chaudieu, 2010). *Situational resilience* encompasses the extent to which individuals benefit from larger systemic factors that reinforce their adaptation (e.g., social support or higher socioeconomic status; Davydov et al., 2010).

Research suggests positive associations between both individual and situational resilience and meaningful outcomes. For instance, individually resilient women were found to be higher on self-transcendence, or the ability to overcome self-limits (Kim, Lee, & Lee, 2013. Additionally, research found that personality attributes indicative of individual resilience (conscientiousness, agreeableness, ego-resiliency) predicted higher performance on reading and math achievement tests (Kwok, Hughes, & Luo, 2007). With respect to situational resilience, an ethnically diverse sample of college women reported using a range of coping strategies derived from sociocultural factors (e.g., SES-related resources, or social support) to persevere in the face of adversity (e.g., prior experiences of bullying, teasing, racism, or sexism, both within and outside of the classroom; Clauss-Ehlers, 2008). Furthermore, recent research has underscored the interplay of

individual and situational resilience in early adulthood, and recommends assessing both variants in emerging adult populations (Madewell & Ponce-Garcia, 2016).

Both individual and situational resilience and associated skills have been encouraged as appropriate for facing workplace challenges associated with bias in STEM fields (Jackson, Firtko, & Edenborough, 2007). Also, teaching such skills is posited to help improve the experiences of health profession trainees (McAllister & McKinnon, 2008). Additionally, resilience was found to be positively associated with job satisfaction, work happiness, and organizational commitment in employees across a range of industries (Youssef & Luthans, 2007). In sum, although prior research has begun to examine the role of individual and situational resilience in achievement and in coping with adversity, only limited work has considered the role of resilience in the workplace and in the experiences of women who are thriving in STEM fields.

Women in STEM: Success in Context

Further investigating the role of identity, career commitment, and resilience in the success of women in STEM may provide insight into the factors that contribute to their ability to thrive as STEM professionals. Programs that emphasize discovery-based research and active-learning are ideal settings in which to examine STEM success. In these programs, STEM students learn and develop career-related competencies through hands-on experiences. Examples of discovery-based research and active-learning paradigms include project-based learning, which involves experiential application of theory in context (Tseng, Chang, Lou, & Chen,2013), and problem-based learning, which involves using theory to solve a real-world issue or challenge (Savery, 2006).

Discovery-based research has been advocated as a means of improving STEM retention (Holdren & Lander, 2012). Further, meta-analytic evidence provides evidence of a positive association between active-learning opportunities and student academic performance (Freeman et al., 2014). This association is important given the links between performance and persistence in STEM (Lent et al., 1984). Additionally, hands-on biology fieldwork, an example of project-based learning, heightened student desire to pursue graduate training in science and medicine (Harrison, Dunbar, Ratmansky, Boyd, & Lopatto, 2011). Problem-based learning also improves student engagement in STEM fields (Smith, Sheppard, Johnson, & Johnson, 2005) and facilitates the development of non-technical "soft skills" in STEM (Kumar & Hsaio, 2007). However, little work to date has investigated active-learning contexts in STEM with respect to women's success.

Current Research and Scholarly Contribution

The current study addresses a gap in the literature by offering insight into STEM success. Specifically, I assessed psychological attributes associated with success (i.e., STEM identity, career identity status, career commitment, and resilience) in undergraduate and post-baccalaureate students who were involved in active learning programs. Undergraduate and post-baccalaureate students are an apt sample because, as emerging adults, they are in the midst of forming their career identity (Arnett, 2000).

Given that quantitative findings may not fully characterize the nuances of individual STEM success, I used a mixed-method explanatory sequential study design (Creswell, 2015) to triangulate a thorough understanding of STEM success. An explanatory study design consists of conducting a quantitative component (e.g., survey), followed by a distinct qualitative component in order to build on and elucidate the quantitative findings (Creswell, 2015). The quantitative portion of the study consisted of administering a survey to assess participants' STEM identity,

career identity status, career commitment, and individual and situational resilience at two time points (time 1 and time 2). Corresponding hypotheses are listed as follows:

- H1a: STEM identity will significantly increase from time 1 to time 2.
- H1b: Participants who are higher in resilience at time 1 will show higher levels of STEM identity at time 2.
- H2a: Career commitment will significantly increase from time 1 to time 2.
- H2b: Participants who are higher in resilience at time 1 will show higher levels of career commitment at time 2.
- H3: Relative to students low in resilience, students high in resilience will be significantly more likely to transition from a moratorium to an achieved career identity status from time 1 to time 2.

The qualitative portion of the study consisted of participant interviews and observations in between time 1 and time 2. I used interviews to examine how individuals conceptualized their career identities drawing elements from life story narratives (see McAdams, 2001). Narratives, particularly those with turning points (e.g., an abrupt change or learning opportunity), are well suited to understanding identity formation in emerging adults (McLean & Pratt, 2006). Participants' intent to continue in STEM (i.e., career commitment) and their experiences relative to resilience were also discussed within the interview context. Lastly, observations supplemented survey and interview data by focusing on visible student behaviors aligned (or not aligned) with the constructs of interest. Corresponding research questions follow:

- RQ1: How do STEM students describe and experience success? What active learning experiences appear to characterize success?

- RQ2: Which experiences and behaviors appear to characterize those who shift in identity status over time?

Methods: General

Participants and Site

Overall sample. The total sample at time 1 consisted of 46 undergraduate and post-baccalaureate students. Analyses for the current study focus on a subset of 25 of those participants who were women, under the age of 36, and pursuing a STEM field of study. Such participants were between the ages of 19-35 (*M* = 22.7, *SD* = 3.5). They identified as Latina/Hispanic (40%), followed by East Asian (28%), Other/Multiracial (12%), Native American or Pacific Islander (12%), White/European American (4%), and Black/African American (4%). Additionally, participants indicated pursuing training in a range of STEM disciplines: Biological/Life/Health Sciences (56%), Social Sciences (40%), and Engineering (4%). Most were in their 4th or 5th year of college (*n* = 19, 76%). All students were participants in either a summer research-intensive program (*n* = 22, 88% time 1), or a community health outreach program (*n* = 3, 12% time 1).

Longitudinal sample. A subset of the time 1 women were retained at time 2 (*n* = 12, 48.0%) and completed the full longitudinal portion of the study. As an incentive, time 2 participants were entered into a raffle to receive a $200 gift card to a national retailer with each survey in which they correctly completed six out of eight attention check questions (see Huang, Bowling, Liu, & Li, 2014). The longitudinal participants ranged in age from 21-28 (*M* = 22.3, *SD* = 2.0). They were pursuing the Biological/Life/Health Sciences (75%) or Social Sciences (25%) and most were in their 4th or 5th year of college (*n* = 11, 91.7%). Participants were a part of the summer research-intensive program (*n* = 11, 91.7%) or the community health program (*n* = 1, 8.3%), and identified as Latina/Hispanic (41.7%), East Asian (33.3%), Other/Multiracial (16.7%) or White/European American (8.3%). There were no statistically significant differences

found with respect to participants who declined to participate after time 1 and those who continued on to complete time 2 with respect to demographics or variables of interest (e.g., STEM identity, resilience). However, post-hoc power analyses indicated that all quantitative analyses—including the aforementioned attrition analysis—were underpowered due to the small longitudinal sample size.

Site: summer research and community health programs. This study focused on students in two programs that typify active learning contexts: a summer research-intensive program and a community health outreach program. In the summer research program, undergraduate students from groups underrepresented in American higher education (e.g., women, ethnic groups, first-generation students) applied to conduct original research under the guidance of a faculty mentor from May-August 2017. Students received a stipend as well as career development support. Upon completion of the program, students produced an original, empirical written deliverable and poster. Posters were presented in October 2017 in a conference-style format. Only program students in STEM disciplines were included in the current study.

In the community health outreach program, undergraduate and post-baccalaureate students self-selected to join through relationships with STEM faculty and staff at the University of Nevada, Las Vegas (UNLV) and Nevada State College. Cohorts of students are added each January, June, and September, with participants in the current study being a part of the January 2017 (or earlier) cohort. Students chose to work at one of a variety of community healthcare establishments within the Las Vegas metro area ranging from medical clinics to local municipal and government offices. Students were expected to learn about the clients, the site, and enhance

the site's efforts with an eye to the patients. For instance, a prior student project included building a patient nutrition education initiative.

Design

The mixed-method explanatory sequential study design (Creswell, 2015) consisted of administering the quantitative components (i.e., survey) to the community health program students at two time points (time 1: February 2017 and time 2: April 2017) and to the summer research-intensive program students at two time points (time 1: June 2017 and time 2: August 2017). Interviews and observations across both programs occurred in between time 1 and time 2. Time 1 approximately coincided with the addition of a new cohort to each of the respective programs.

Methods: Quantitative

To optimize understanding, this section presents the quantitative methods immediately followed by the quantitative results. Then the qualitative methods and results are provided. Both quantitative and qualitative findings will be integrated in the discussion section.

Quantitative Design and Measures

I administered a web-based survey (see Appendix A) to all program participants at two time points during their participation in their respective program. In addition to questions pertaining to the current study, the survey included questions about students' program site selection (where applicable), projects, career intentions, and demographic information. Students completed the surveys at their leisure on an internet-capable device in a location of their choosing. Below, I provide information about each of the measures assessed for the current research.

Marcia's identity statuses. Marcia's identity statuses, specifically career identity statuses, were measured via the Extended Objective Measure of Ego Identity Status (EOM-EIS) instrument adapted from Bennion and Adams (1986). The measure included 8 career-focused items (2 items for each identity status) that participants rated on a scale ranging from 1 (*Strongly Agree*) to 6 (*Strongly Disagree*). Sample items included "I'm still trying to decide how capable I am as a person and what jobs will be right for me" (Moratorium), and "It took me a long time to decide but now I know for sure what direction to move in for a career" (Achievement). Based on their responses to each item, participants were classified into one of Marcia's four identity statuses relative to career. Specifically, responses for pairs of items assessing each identity status were summed. This produced four sums per participant. The lowest sum indicated the identity

status of the participant. Because each identity status was assessed with only two items, bivariate correlations at time 1 are reported instead of Cronbach's alpha. The two items corresponding to an achieved status were positively correlated (r =.61, p <.01). Items corresponding to a moratorium status were also positively correlated (r =.54, p <.01), as were those for diffusion (r = .68, p <.001). Items corresponding to foreclosure were negatively correlated and the correlation did not reach statistical significance (r = -.06, p = .76). Thus, internal consistency was adequate for the achieved, moratorium, and diffused identity statuses, but low for the foreclosed identity status.

STEM identity. STEM identity was measured by items adapted from Chemers et al. (2011). The measure included 6 items rated on a five-point scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Thus, higher scores indicated stronger STEM identification. Sample items included "In general, being a STEM student is an important part of my self-image" and "I am a STEM student." The reliability of this scale was excellent (α = .97) at time 1.

Career commitment. Career commitment, or intent to continue one's STEM pursuits, was measured by items adapted from Chemers et al. (2011). The measure included 7 items rated on a five-point scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*). Thus, higher scores indicated greater STEM career commitment. A sample item from the measure included "I intend to work in a STEM field." The reliability of this scale was excellent (α = .98) at time 1.

Individual resilience. Resilience based on cognitive-individual factors, such as personal traits, was measured by items adapted from Connor and Davidson (2003). The Connor-Davidson Resilience Scale (CD-RISC) included 25 items rated on a five-point scale ranging from 0 (*Not True at All*) to 4 (*Nearly All the Time*). Higher scores indicated higher levels of

individual resilience. Sample items may be made available upon written request to Davidson. The reliability of this scale was good (α = .85) at time 1.

Situational resilience. Resilience based on contextual protective factors, such as social support, was measured by items adapted from Ponce-Garcia, Madewell, and Kennison (2015). The measure, the Scale of Protective Factors (SPF-24), included 24 items rated on a seven-point scale ranging from 1 (*Disagree completely*) to 7 (*Completely agree).* Thus, higher scores indicated higher levels of situational resilience. Sample items included "My friends/family are supportive of one another" and "I am confident in my ability to succeed." The reliability of the SPF-24 was good (α = .85) at time 1.

Analysis Plan

Below, I begin by reporting preliminary analyses that illustrate the descriptive characteristics of the data and sample. Next, I report the results of repeated measures ANOVAs and multiple regression analyses that were used to test the quantitative hypotheses; these analyses focus on participants who participated at both time-points. Due to the relatively small sample size in the longitudinal sample, I also conducted post-hoc power analyses using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) for each of the quantitative analyses. The findings are discussed where applicable.

Results: Quantitative

Preliminary Analyses

Analyses were conducted at time 1 to determine if mean differences occurred in STEM identity, career identity status, career commitment, or resilience based on students' demographics (e.g., age, ethnicity). Significant mean differences were found across STEM fields for STEM identity and career commitment at time 1. Specifically, biological/life/health science students had higher mean STEM identity and higher mean career commitment than social sciences students at time 1 (STEM identity: F (1, 22) = 17.6, p <.001, partial η^2 = .44; career commitment: F (1, 22) = 15.03, p <.01, partial η^2 = .41). I did not control for STEM field in subsequent analyses because this variable was not pertinent to the current study's hypotheses and may provide variation that is worth capturing.

A correlation matrix of each of the continuous measures at both time 1 and time 2 are presented in Table 1 (Appendix F). At both time 1 and time 2, STEM identity and career commitment were positively associated with one another. Individual resilience was strongly positively associated with situational resilience at time 1 and time 2. These findings point to some consistency in how both measures assessed resilience. Furthermore, the resilience measures were positively associated with STEM identity and career commitment. For instance, situational resilience at time 2 was positively associated with STEM identity at time 2 and career commitment at time 2. These results provide preliminary support for the hypotheses, in that higher time 1 STEM identity and career commitment were associated with higher time 2 STEM identity and career commitment, respectively. Additionally, higher time 2 situational resilience was associated with higher career commitment and STEM identity at time 2 in the study.

Multiple Regression and Repeated Measures ANOVAs: Hypotheses 1 and 2

To address H1a (i.e., STEM identity will significantly increase from time 1 to time 2), I employed a repeated measures ANOVA with identity measured within subjects. The repeated measures ANOVA was nonsignificant (F (1, 11) = .11, p = .74). Thus, counter to expectations, women's mean STEM identity did not significantly increase from time 1 to time 2. A post hoc power analysis indicated that the power for the repeated measures ANOVA may have been low (.11), and the effect size small (f =.10), which may have impacted the ability to detect mean differences.

To address H1b (i.e., Participants who are higher in resilience at time 1 will show higher levels of STEM identity at time 2), I tested two multiple regression models to investigate whether resilience was associated with change in STEM identity from time 1 to time 2. Predictors in the first model included STEM identity at time 1 and individual resilience at time 1. STEM identity at time 2 was the dependent variable. The overall model was significant (R^2 = .49, F (2, 9) = 4.39, p = .05), yet individual resilience was not a significant predictor (β =.06, p = .16). Predictors in the second model included STEM identity at time 1 and situational resilience at time 1, with STEM identity time 2 as the dependent variable. The overall model for STEM identity and situational resilience was nonsignificant (F (2, 9) = 3.03, p = .09). Thus, counter to expectations, resilience at time 1 was not significantly associated with STEM identity at time 2. A post hoc power analysis indicated that the power for these multiple regression analyses may have been adequate for individual resilience (.73) and somewhat low for situational resilience (.58). Effect sizes were large for individual resilience (f^2 =.98) and situational resilience (f^2 =.68). Thus, power may have been sufficient to detect an association of individual resilience, and potentially situational resilience, with STEM identity in this sample.

Similar to the above, I employed a repeated measures ANOVA with career commitment measured within subjects to assess H2a (i.e., STEM career commitment will significantly increase from time 1 to time 2). The results were nonsignificant (F (1, 11) = .60, p =.46). Therefore, contrary to the hypothesis, women's mean levels of career commitment did not significantly increase from time 1 to time 2. A post hoc power analysis indicated that the power for the repeated measures ANOVA may have been somewhat low (.55), and the effect size medium (f =.25), which may have impacted the ability to detect mean differences in this sample.

With respect to hypothesis H2b (i.e., Participants who are higher in resilience at time 1 will show higher levels of career commitment at time 2), I again tested two multiple regression models to examine whether resilience was associated with changes in career commitment from time 1 to time 2. Predictors in the first model included career commitment and individual resilience at time 1. Career commitment at time 2 was the dependent variable. The overall model was significant (R^2=.71, F (2, 9) = 11.18, p <.01). Individual resilience at time 1 was a marginally significant predictor (β = .04, p = .058). Predictors in the second model were career commitment at time 1 and situational resilience at time 1. Career commitment at time 2 was the dependent variable. The overall model was significant (R^2=.61, F (2, 9) = 7.07, p =.01). However situational resilience was not a statistically significant predictor (β = .11, p = .32). Therefore, women who were higher in individual resilience at time 1 experienced marginally higher career commitment at time 2. A post hoc power analysis indicated that the power for these multiple regression analyses may have been high for individual resilience (.99) and situational resilience (.91). Effect sizes were large for individual resilience (f^2 =2.5) and situational resilience (f^2 =1.6). Thus, power may have been sufficient to detect an association between

individual resilience, and potentially situational resilience, and career commitment in this sample.

Exploratory MANOVAs: Hypothesis 3

Hypothesis 3 predicted that relative to students low in resilience, students high in resilience would be significantly more likely to transition from a moratorium to an achieved career identity status from time 1 to time 2. However, only two women changed their career identity statuses from time 1 to time 2. One was in an expected direction (n=1, moratorium to achieved) and one in an unexpected direction (n=1, achieved to diffusion). Further, all of the participants who were retained at time 2 reported an achieved or moratorium career identity status at time 1. (Potential reasons for these findings will be explored in the discussion.) Given that there was not enough change in career identity statuses to test hypothesis 3, I conducted exploratory MANOVAs to examine whether students of different career identity statuses demonstrated mean differences in individual or situational resilience.

A MANOVA was used to examine whether women's career identity statuses at time 1 (i.e., achieved and moratorium) were associated with different mean resilience levels at time 1. Results indicated that women with achieved and moratorium career identity statuses did not significantly differ in their mean levels of individual or situational resilience at time 1 (Wilk's $\Lambda = .70$, F (2, 9) = 1.92, p =.20). A post hoc power analysis indicated that the power for the MANOVA analysis may have been low (.38). The effect size was medium ($f^2(V)$ =.43). Thus, power may not have been sufficient to detect mean differences in this sample.

MANOVA was again used to investigate whether women's career identity statuses at time 1 (moratorium or achieved) were associated with different mean resilience levels at time 2. Results indicated that women with achieved and moratorium career identity statuses did not

significantly differ in their mean levels of individual or situational resilience at time 2 (Wilk's Λ = .64, F (2, 9) = 2.56, p =.13). Therefore, the MANOVAs taken in total suggest that women's mean levels of resilience did not significantly differ at time 1 or time 2 on the basis of their career identity status at time 1. A post hoc power analysis indicated that the power for the MANOVA analysis may have been low (.49). The effect size was medium ($f^2(V)$ =.57). Thus, power may not have been sufficient to detect mean differences in this sample. All power analyses throughout this paper, however, should be interpreted with caution and will be further deliberated in the discussion.

Methods: Qualitative

As mentioned earlier, per the mixed-methods design, qualitative data captured students' experiences relative to STEM identity, career identity status, career commitment, and resilience to help build on the quantitative results (Creswell, 2015). The following presents the qualitative methods and results. Both quantitative and qualitative findings will be integrated in the discussion.

Qualitative Design and Measures

Interviews. I recruited participants for interviews if they had either an achieved (n = 21) or moratorium (n = 3) career identity status at time 1. In total, 48.0% (N = 12) of the participants agreed to participate in a one-hour interview, which occurred between time 1 and time 2. The research team consisted of the author and two trained research assistants (one woman, one man). All but two of the interviews were conducted by two interviewers who shared in facilitating the discussion. Interviews followed a semi-structured approach similar to Turner's (2010) "general interview guide" format. This structure allowed for natural conversation with occasional prompting. Interviews were audio recorded and transcribed, except when students declined (in which case interviewer notes were transcribed). Participants helped to clarify and verify interview accuracy where applicable (i.e., member checks). Students were compensated for participation in an interview with a $10 gift card to a national retailer.

As little is known about STEM success, the interviews were designed to richly describe each participant's personal experience of STEM success to date. During the interviews, interviewers probed how participants conceptualized their career identities with a focus on life story narratives (see McAdams, 2001). Additionally, interviews drew from methods adopted in

prior research (Marcia, Waterman, Matterson, Archer & Oflofsky, 1993). The research team also inquired as to whether students identified with being STEM professionals (i.e., STEM identity). Participants' intent to continue in STEM (i.e., career commitment) and their experiences relative to individual and situational resilience were discussed as well. For an outline of the interview content, please see Appendix B. Note that the protocol broadly queried students' career and background experiences and did not aim to lead them towards a particular line of inquiry.

Observations. In between time 1 and time 2, the research team also conducted observations (n =12 hours of observation) to supplement the survey and interview data by focusing on visible student behaviors aligned (or not aligned) with STEM identity development, career status identity development (e.g., career exploration), career commitment, and resilience (e.g., coping skills). The research team observed students as a complete observer (Baker, 2006) according to a protocol (see Appendix C) for at least 1 hour during program seminars or events or at students' project sites. For instance, students were observed while conducting their experiments in a biology laboratory and during program workshops (e.g., while interacting with a panel of STEM career professionals). Observations resulted in handwritten notes that were later transcribed.

Analyses

Interview and observational data were analyzed holistically by way of thematic analysis. Thematic analysis consists of coding qualitative data for concepts representing what is explicitly or implicitly expressed in the data (Braun & Clarke, 2006; Ryan & Bernard, 2003). The research team took a deductive (theory-informed) approach to coding (Bradley, Curry, & Devers, 2007).

Initially, research team members individually read the entirety of the qualitative dataset. I then proposed a preliminary deductive coding manual. The coding manual outlined the deductive themes (e.g., STEM identity), suggested how they presented in the data, and listed examples of when a data element merited or did not merit, a particular kind of code. The research team as a whole iteratively refined the manual by individually coding 1-2 interviews, contributing exemplars of each theme, and meeting to discuss progress and resolve discrepancies. A portion of the qualitative data set (n = 4 out of 12 interviews, 33.3%) was used in calculating inter-rater reliability (Cohen's kappa) during the coding process. Reliability was calculated for each pair of raters. Coding discrepancies and manual clarification were then resolved by discussion. Upon achieving an acceptable level of reliability, kappas across all four interviews were calculated between the author and one team member and codes were then applied to the remainder of the qualitative dataset. All of these final kappa values were above .75 (see Table 2, Appendix G for specific reliability values for each coding category), which indicates adequate inter-rater reliability. Deductive results are reported below.

Results: Qualitative

The qualitative findings serve to further illuminate the experiences of the participants relative to STEM identity, career identity status, career commitment, and resilience (individual and situational). Below, I begin by presenting findings pertaining to Research Question 1: *How do STEM students describe and experience success? What active learning experiences appear to characterize success?* I then discuss findings for Research Question 2: *Which experiences and behaviors appear to characterize those who shift in identity status over time?* Data from observations are interspersed throughout to further contextualize the interview data.

STEM Success: Identity

Across all of the interviews and throughout some of the observations, participants demonstrated *STEM identity* (see definition in Table 2, Appendix G). This was often accompanied by personal pronouns in conjunction with their STEM field or STEM activities, or responses or behavior illustrating scientific acumen. The following provides excerpts from Shaina, who provided archetypal examples of STEM identity with respect to her summer research experiences:

> S: I'm a biology major, my emphasis is on ecology and evolution. But I do research in the integrative physiology lab…I was just really intrigued by like research. I think it is really cool. So right now, I'm our lab's designated microbiologist. I have a strong background in it. I always tell people I didn't choose fruit flies the flies chose me type of thing.
>
> Observation: For three hours on a weekend morning, Shaina weighed desiccation flies (i.e., drought tolerant flies) and "sexed" them (i.e., determined if they were male or

> female). She explained the purpose of doing so was to determine whether the flies are able to survive in an arid environment. She told the observer how "literature says that females live longer due to harboring more carbohydrates". Shaina explains to a lab mate how to place the flies into vials.

Shaina articulated a major in science, and specified how her research niche fits within her broader discipline. In addition, Shaina discovered an aspect of the field that compelled or fascinated her (e.g., "the flies chose me"). She also described strong personal associations towards research, her unique role within her lab, and the close affiliation she feels to her work. While in the lab, she demonstrated knowledge of relevant content, completed tasks largely on her own, and taught a colleague. In addition to the examples of STEM identity Shaina portrayed, STEM identity was also conveyed when participants confirmed their major, took an influential course, or participated in informative career-oriented extracurriculars.

Similarly, the following documents an interview conversation where Joanna expressed her interests in medicine. While Shaina discussed STEM identity in a scientific lab setting, Joanna discussed STEM identity in the context of an applied/clinical setting. (Note: Joanna declined to be recorded, so an excerpt from the research team members' notes is provided):

> From a young age she was drawn to "cardiothoracic surgery." She thinks "surgery is amazing…to have your hands in the body and fix it" With respect to cardiothoracic surgery she says "you get to hold a human heart" which she finds "fascinating and amazing."
>
> From the time she was in high school she thought "surgery was cool." She started watching videos online - "2-3 aortic valve replacements a day." She still watches videos

today, though does not have the time to watch as many per day. She recently obtained EKG [electrocardiogram] certification to become an EKG technician at a hospital.

Joanna expressed strong ties to medicine, specifically heart surgery, by way of personal pronouns and deep personal involvement such that she would watch videos of multiple heart surgeries daily and has independently pursued EKG technician certification (a certification to measure the electrical activity of a human heart). Both Shaina and Joanna strongly reflect how STEM identity was experienced and represented in the qualitative data by demonstrating deep personal association and draw to science, as well as robust career skill sets.

Beyond STEM identity, Marcia's identity statuses relative to career identity status were also prevalent in the data. Every interview expressed aspects of these statuses. Note that achieved and moratorium career identity statuses are described here as these were the only two statuses of the women recruited for interviews. However, occasionally such women would make comments indicative of other career identity statuses. For insight into responses that illustrated the remaining identity statuses (i.e., foreclosed and diffusion) please see Appendix D. As shown below, Liliana illustrated an *achieved* career identity status (see Table 2, Appendix G for the definition) by way of her career journey from medicine/biology to psychology/neuroscience by describing a process of arriving at a distinct profession after deliberate searching:

> L: So originally it was the whole idea of wanting to go into med school, be a doctor, and find a cure for hemophilia was my original motivator. First there was a transition going into college and being a biology major and realizing "I'm not liking this." Thinking college was absolutely hideous and disgusting. That got me to reevaluate my life and got me thinking I need to do what actually makes me happy.

So I am majoring in psychology and minoring in neuroscience…at the time being there is no neuroscience major …I took some psych classes back in high school and took AP psych, and I fell in love with the course, but something that really captivated me was the whole psychiatric disorders. So that got me really into neuroscience and then once I took the intro to neuroscience class with Dr. [Smith], I fell in love with the field…I was like, "This is it. I found my path" Now, I love it.

After I graduate I want to get into grad school. Right now I'm seeking a Ph.D. program in neuroscience. After that it would be nice to work at a university and have my own lab, or work with a research institute and find answers to the mysteries of the brain.

Liliana expressed a period of exploration that led her to a career choice which reinforced her interests and goals (e.g., attempting medicine/biology, finding college "hideous", then discovers neuroscience). Liliana also articulated the specific pursuit of a PhD in neuroscience and sees herself working on brain science.

While participants expressing an achieved status tended to communicate a sense of certainty following a period of exploration, other students described their career path to date with a more flexible resolution. Nina illustrated a *moratorium* identity status, as she investigated different careers and continues in that vein. Moratorium participants, such as Nina, outlined the "journey" of having tried various activities, or the synthesis of activities (coursework, research, input from peers or family, an influential mentor), but have yet to finalize their professional direction:

N: In high school, I was actually studying hospitality but I think after experiencing a lot of the hospitality field I wasn't as interested anymore. Mostly having to deal with so many people.

> I first joined in biology my freshman year because I was interested in veterinary sciences. But I had worked for a veterinarian for 2 years and I realized that medicine was not the field that I wanted to go into… talking to other veterinarians and shadowing …it also confirmed that…I like more of the learning about animals rather than directly helping them and by directly, I mean medicine.
>
> So, after taking I think ecology 101 I was more interested in working [with] wildlife and interactions between living organisms and plants. It took me a while until I found out what exactly I was interested in and that is probably going to change too in a couple years or even next semester. I am hoping to stay in academia, I think. That could change as well. Maybe I'll go to my Ph.D. if there is anything available or maybe I'll want to work in the field for a while. I want to focus on restoration ecology but have more of a focus on invertebrates or maybe something in entomology as well.

Similar to Liliana, Nina communicated a lengthy period of exploration from hospitality, to veterinary medicine, and now ecology. However, in contrast to Liliana, Nina remained uncertain with respect to which topics within ecology interest her, or what she may pursue beyond her bachelor's degree.

STEM Success: Career Commitment

Participants expressed *career commitment* when communicating the intention to continue in STEM, often taking the form of specific future STEM-related plans (e.g., graduate or professional school in STEM, job in STEM; see Table 2, Appendix G for definition). The majority of participants expressed a fairly strong sense of commitment to further STEM pursuits. For instance, Shaina indicated attending graduate school for a PhD in STEM (e.g., studying microorganisms, biology):

S: I really want to continue with my research going into grad school, studying how microorganisms impact their hosts in a symbiotic point of view… I'm going to get my PhD.

Career commitment also materialized when participants indicated both primary and secondary career plans in STEM, as Tami described below:

R: Yes you could. Do you see teaching as your backup plan? Let's say you decide not to do med[ical] school, would you go into teaching?

T: Most likely yeah I would probably um shoot for a PhD.

Tami's immediate and long-term plans are to continue in STEM (i.e., medicine), but in the event that medicine does not materialize for her, her alternative path is a PhD in science. Responses such as Tami's, where a secondary career plan was also in STEM, provided additional evidence of career commitment. This did not necessarily mean that such an individual was any more committed to STEM than others. The presence of a second or back-up plan in STEM indicated career commitment as did having solely a primary (in most cases, only) plan to continue on in STEM.

STEM Success: Resilience

Beyond identity and career commitment, participants displayed and discussed a range of behaviors associated with both individual and situational resilience over the course of developing their STEM careers. The common thread with respect to *individual resilience* (see Table 2, Appendix G for the definition) was an ethos of agency and self-reliance whereby participants faced a challenge through some action on their own, or expressed the utility of a personal trait (e.g., optimism). This was the case for Lam, who experienced a challenge when her research mentor changed a key aspect of the study she was working on:

> L: that [was a] turning point where we switched proteins [during our summer research project]. Like we were all supposed to be doing P53 and then we were all doing different ones and he gave us all wrong ones apparently. So K117, my protein is not in P53, like not even existing on P53, it's in E2F1, like luckily I read up on it briefly so I knew some actual information about it, so that was good. Then I tried to see the positive side of things, but then internally when I get home I'm like, "This is all I know about it, I don't know anything else."

Lam discussed personal traits (e.g., "I tried to see the positive side of things"), and proactively taught herself something (e.g., "I read up on it briefly so I knew some actual information") in an effort to overcome the challenge of having switched proteins during her research project.

Outside of individual actions and traits, participants also expressed *situational resilience* when they were able to rely on some sort of external support to help them persist in their STEM pursuits. Examples of situational resilience in the data included cases when students indicated reliance on financial resources, social support from program staff, supervisors/advisors, mentors, peers/colleagues, family, and current or prior instructors, or other support (e.g., prominent religious figures). Social and financial supports were the most frequent sources of situational resilience, with social being the most prevalent throughout interviews and observations. Below are examples by way of Sonia's reliance on funding and Jill's reliance on social support:

> S: I'm still working a lot but I've been able to like take some days off when certain important things are happening in the lab and not really stress out about it cause I know that I am going to have that money [re: the summer research program stipend] on the back end.

J: My TA in my microbiology class, she was a really big driving force and she's always been like "yeah of course you can do this. You're very smart." You know she um she recommended me to be a TA for micro, which was like a really big confidence booster. Cause I would happily say that my worst enemy and like the roughest thing is that I don't have confidence in my own abilities to like do this stuff. And so when she told me like "yeah you're good enough at this to TA or to UTA" and also like my academic counselor. I'd go in there and be like "I can't do this" and she'd be like "I don't think you see yourself the same way other people see you". So that made a big difference as well.

Sonia described the ability to rely on the program's financial stipend so as not to have to work as much outside of her research and studies. Jill indicated key relationships with a microbiology teaching assistant and an academic counselor who bolstered her confidence. Such reliance on external people, circumstances, or resources/objects demonstrated situational resilience.

STEM Success: Identity Status Changes

Another aim of the qualitative portion of this study was to address Research Question 2: *Which experiences and behaviors appear to characterize those who shift in identity status over time?* As mentioned above, very few women (n = 2) changed career identity statuses, and none of these women agreed to be interviewed. This precludes analyses related to Research Question 2. In the parent sample, which included men, a man who shifted from achieved to diffused agreed to be interviewed. His data are not discussed here, given that men were not the focus of the current research; however, an overview of his interview is provided in Appendix E.

Discussion

The current study was designed to help advance an initial understanding of STEM success. Taken in total, findings address the goal of providing a window into the experiences of successful women in STEM by elucidating associations among STEM identity, career identity status, career commitment, and resilience over time. Findings also give voice to the experiences of successful women in STEM. Although quantitative findings indicated that participants did not experience significant change in mean levels of STEM identity or career commitment over time, they did indicate the role of resilience with respect to change in career commitment. Furthermore, qualitative findings underscored how the constructs presented in students uniquely situated in active learning contexts and provided additional insight into inquiries that quantitative data alone were unable to assess (e.g., experiences of those with particular career identity statuses, or of those who shifted in career identity statuses). In total, these findings suggest that these constructs may be associated with STEM success.

STEM Success: Initial Insights

Hypotheses 1 and 2. Neither hypothesis H1a, that STEM identity would significantly increase over time, nor hypothesis H2a, that career commitment would significantly increase over time, were supported. Women's levels of STEM identity and career commitment remained high over the course of the study. For instance, mean STEM identity scores were 4.9 out of 6, and mean career commitment scores were 5.2 out of 6 at time 1 and stayed similarly high at time 2. As discussed below, this ceiling effect may help to explain the inability to detect an increase in the levels of these constructs over time.

Although H1a and H2a were not supported, several intriguing findings emerged. For instance, STEM identity and career commitment were positively correlated at time 1 and time 2. These findings replicate prior research (e.g., Chemers et al., 2011), which tends to show that identity and career commitment are closely related. The association between STEM identity and career commitment in this study further indicates that within a sample of successful STEM women, increased STEM identity is linked to greater intention to continue pursuits in STEM.

Interview and observational data provided deeper insight into the connection between STEM identity and career commitment by illustrating how these constructs co-occurred. For instance, STEM identity tended to present as akin to a sense of belonging in STEM. This was often accompanied by behavior indicative of scientific skill or mastery (e.g., teaching others, plans for publication or similar), with many students indicating turning points or a sense of passion that solidified their sense of self with respect to STEM (e.g., confirming their major, feeling compelled or fascinated by their chosen field). Relatedly, in participant interviews, career commitment presented as the intention to continue on in STEM. This often took the form of a participant's specific future STEM-related plans (e.g., graduate or professional school in STEM, job in STEM). Furthermore, within the interviews, a sense of belonging and mastery (i.e., STEM identity) tended to coexist with the intent to continue on in the field (i.e. career commitment). This co-occurrence appears to concur with the positive correlations between the quantitative measures of STEM identity and career commitment. Taken together, the qualitative and quantitative findings lend novel insight into how STEM identity and career commitment are felt and experienced by successful STEM women (e.g., by way of skill mastery, or having a primary and secondary career plan in STEM). Also, this study's results, largely from women of color in STEM, connect with prior findings on such individuals. For instance, research indicates that

despite their underrepresentation in STEM fields, women of color are equally interested and engaged in STEM and seek out STEM careers (Ong, Wright, Espinosa & Orfield, 2011).

Hypotheses 1b and 2b probed the role of resilience with respect to STEM identity and career commitment by predicting that those higher in resilience at time 1 would experience higher STEM identity at time 2 or career commitment at time 2, respectively. I obtained partial support for hypothesis H2b. Higher individual resilience at time 1 was associated with marginally heightened career commitment at time 2. These findings align with findings in the vocational and career development literature. In this body of work, career commitment is conceptualized as a multifaceted construct partly attributable to *career resilience*, which involves persisting amidst challenges in conducting the work itself. For instance, Kidd and Green, (2006) found that among research science employees, greater career resilience (e.g., willingness to deal with the challenges inherent in conducting scientific work) predicted lower intention to leave the field one year later. However, whereas career resilience pertains to resiliency with respect to work tasks, individual resilience as measured in this study pertains to trait-based resiliency applicable within and beyond the workplace. Therefore, the association between higher individual resilience at time 1 and marginally higher career commitment at time 2 found here may serve to extend vocational theories beyond career resilience to also include individual resilience.

The current study's qualitative findings further illuminate the interplay of individual resilience and career commitment through the sense of personal ownership demonstrated across both constructs. For instance, in the qualitative data, individual resilience emerged as an ethos of agency and self-reliance. In such cases, participants faced a challenge on their own, or expressed the utility of a personal trait in times of adversity, akin to work suggesting personal agency as a

resilience-based approach employed in times of challenge (Rutter, 2006). Similar to individual resilience, career commitment was often expressed as a participant's own intent to continue on in STEM. Therefore, both individual resilience and career commitment lent themselves to "I" statements and personal pronouns (e.g., "I'm an optimist"; "I'm going to obtain a PhD"). Perhaps this individualized conception of career commitment was slightly more aligned with individual resilience than situational resilience. However, using that lens, a connection between STEM identity and individual resilience would also seem likely, given the personalized nature of STEM identity, and yet this association did not materialize in the quantitative findings.

With respect to situational resilience, bivariate correlations demonstrated expected associations between situational resilience at time 2 and STEM identity and career commitment at time 2. However, I did not obtain support for the prediction that situational resilience would predict changes in STEM identity and career commitment. The lack of quantitative support for my hypothesis is at odds with the qualitative results. For instance, during interviews, participants communicated a range of situational resilience supports (e.g., family, mentors, colleagues, financial resources) that helped them persist in their STEM pursuits (i.e., career commitment) and in their experiences as nascent STEM experts (i.e., STEM identity).

It is not clear why situational resilience came through as an important influence in the qualitative data, but did not play a more prominent role in the multiple regression models. One possibility pertains to the way in which STEM identity, career commitment, and individual resilience were conceived and assessed (e.g., as individualistic experiences) as compared to how situational resilience was assessed (e.g., as a communal endeavor). Perhaps as more individualized constructs, STEM identity, career commitment, and individual resilience operate similarly and remain relatively stable once established, whereas situational resilience, may

fluctuate depending on the circumstances. If so, situational resilience may thus be harder to assess over time in a longitudinal study. Additionally, perhaps the role of situational resilience confronts broader cultural norms that focus on the individual. For instance, in Western and American culture "master narratives" emphasize individualistic effort and redemptive plots (e.g., a person's phoenix-like ascent to success after hardship) focused on individual agency and accomplishment as compared to community-aided success (McLean & Syed, 2015). Perhaps the weight of such master narratives encouraged students to downplay the role of situational resilience in their survey responses as compared to during interviews or observations, where they may have felt more at ease, or somehow led to the discrepant findings between the quantitative and qualitative data. Also, the majority of the participants in this study were women of color with plans for academic science careers. Prior work suggests the value of self-reliance and relational networks (i.e., individual and situational resilience) in the careers of African American women in the academy (Harley, 2008). The current study's discrepant findings appear at odds with respect to expectations regarding resilience in women of color's career pursuits.

Hypothesis 3. As only a very small number of participants changed Marcia's career identity statuses over the course of the study, hypothesis 3, which predicted that students higher in resilience would be more likely to transition from a moratorium to an achieved career identity status over time, was not supported. However, exploratory MANOVAs sought to probe variable relationships relative to this hypothesis. The exploratory findings revealed that women with an achieved career identity status at time 1 did not differ with respect to mean levels of individual or situational resilience at time 1 or time 2 as compared to those with moratorium statuses.

The qualitative data however, occasionally illustrated variation with respect to career identity status and resilience. For instance, some moratorium individuals provided less of a

narrative around resilience, as compared to achieved individuals. As an example: when discussing situational resilience supports, a moratorium participant simply stated, “tutoring was helpful”, whereas an achieved participant provided greater depth in their response: “having a support group, there are times where I think ‘Do I even want to pursue a Ph.D. program, I can just do my masters and maybe I’ll be okay with that.’ But having someone, not just someone but a group of people telling me ‘No you can do this.’ ‘I know you can’”. While these patterns were not characteristic of all participants, such trends may suggest differences with respect to how achieved and moratorium status individuals experience or perceive situational resilience and integrate it into their personal career narratives. Perhaps achieved individuals may more thoroughly attend to and intertwine situational resilience in how they consider their career journey.

Additionally, two of the women in the study changed identity statuses over time. Neither of these women participated in an interview, though one male from the broader study who also transitioned from achieved to diffusion did (see his responses in Appendix E). A recent meta-analysis examined literature from 1966-2005 to provide insight into change in identity statuses across adolescents and young adults (Kroger, Martinussen & Marcia, 2005). The findings indicated a decline in moratorium statuses after age 19 and an increase in achieved statuses into adulthood (Kroger, Martinussen & Marcia, 2005), which appears to broadly corroborate the current study’s findings. However, Kroger and colleagues’ (2005) meta-analysis focused on only the results of quantitative measures, revealed trends across standard populations (i.e., not successful individuals as studied here), and did not enumerate the experiences of those who transitioned in uncommon directions (e.g., achieved to diffusion) specific to career. Thus, Kroger and colleagues’ (2005) analyses do not fully answer the hypotheses and research questions in this

study either. Also, it is possible that the current study did not detect change in Marcia's career identity statuses due to design limitations (see below). Further research may help clarify the nuances with respect to resilience and Marcia's career identity statuses, such as whether the lack of a more integrated narrative around resilience for moratorium individuals remains over an extended period of time, or is characteristic of moratorium women in other gender atypical professions beyond STEM. Additional work could also help address transitions from achieved to diffuse statuses and the specific experiences of successful STEM students who change career identity statuses.

Implications for Empirical Research and Theory

The present study furthers psychological insight into the attributes associated with career success in STEM, demonstrating that STEM identity, career identity status, career commitment, and both individual and situational resilience are present and operating in unique ways within a sample of successful early-career STEM women. Results build on existing work by illuminating affordances that facilitate STEM success among women. For example, individual resilience lent support to career commitment. This adds a new dimension to prior work focusing on gender equity in STEM, which has often focused on the challenges and barriers facing women (Halpern et al., 2007). Indeed, recent research has termed STEM fields a "glass obstacle course" for women, requiring that they navigate a system of dynamic barriers (DeWelde & Laursen, 2011, p. 589). The results of the current study may shed light on potential strategies in the context of said obstacle course (e.g., those associated with individual or situational resilience such as personal agency efforts, or financial support) vs. further illuminating the course itself. Researchers could thus apply these findings to expand or validate theoretical models. For instance, social cognitive career theory (Lent, Brown & Hackett, 1994) and expectancy-value theory (Wigfield & Eccles,

2000) provide models for career choice and motivation in the career counseling and educational literatures, respectively. Each of the models includes individual and contextual variables as inputs in career decision making. Resilience, both individual and situational, might be a worthwhile construct to consider within these models.

Implications for Practitioners

For practitioners, findings from this study may help to inform STEM intervention efforts. For instance, findings showed that higher individual resilience was associated with greater career commitment. Prior work suggests resilience may be bolstered or taught (e.g., McAllister & McKinnon, 2008). For instance, an electronic training intervention with a resilience component was helpful in fostering persistence in women in STEM doctoral programs (Bekki, Smith, Bernstein & Harrison, 2013). Therefore, organizations or educational institutions may consider pursuing a resilience-focused training intervention study for those trending towards STEM careers. Additionally, organizations may find it fruitful to assess early-career STEM professionals on constructs such as resilience and career commitment in order to design targeted career development programs and support (e.g., to pair those with elevated resilience with those of burgeoning resilience to share strategies).

This study's findings also aid in evaluating the community health outreach program and summer research program whose students participated in the research. In particular both programs appear to be attracting students with elevated levels of STEM identity, career commitment, and resilience. Students in the programs measured here also tended to have achieved or moratorium career identity statuses. Knowing this may alter how the programs design and build offerings for their students. For example, programs may consider a tiered mentoring approach whereby achieved students might mentor moratorium students. This would

allow the achieved students to further their commitment to their field and share insights, while enabling the moratorium students a venue for obtaining input and peer guidance as they hone their interests. Both programs are to be presented with relevant data from this study to aid in their evaluation efforts.

Limitations & Future Directions

The current study's results need to be interpreted in light of potential limitations. For instance, findings indicated that students scored high across the STEM identity, career commitment, and individual and situational resilience scales, potentially demonstrating a ceiling effect. Past cross-sectional (i.e., single time-point) research has encountered similar ceiling effects (e.g., Chemers et al., 2011); however, in the current study, participants' high scores made it difficult to test key longitudinal associations such as whether a woman's level of individual or situational resilience would predict change in her STEM identity. Selection effects constitute a related challenge. Specifically, perhaps students participate in active-learning programs in STEM because students are confident and committed in their STEM pursuits, and have already weathered challenges en-route to their success. To improve upon these design limitations, future work could employ a longitudinal design where students are assessed earlier in the career pipeline (e.g., upon entry to college) and followed through their participation in STEM programs. Findings from such a study would provide insight into the trajectories and formative experiences of students before, during, and after program participation. Furthermore, constructs beyond resilience may impact STEM success (e.g., first-generation college student status) and may explain some of the variance in students' STEM identity or career commitment. Thus, future research may consider assessing such variables with respect to STEM success, or testing

whether the findings in this study hold in a sample of students with different background characteristics.

Additionally, it is possible that the short-term longitudinal design used in the current research impacted its ability to detect statistically significant change over time. Specifically, many students in this study were later in their undergraduate academic careers (e.g., 4th and 5th year of college or had recently graduated) and fairly established with respect to the constructs of interest. Following them leading up to this time in their lives, or continuing to follow them as they enter the workforce, may have enabled the research team to better assess change. Accordingly, future research may find it worthwhile to employ a longitudinal design with a longer time horizon. For instance, Robnett, Chemers, and Zurbriggen (2015) found changes in STEM identity as influenced by research experiences and STEM self-efficacy, in STEM undergraduates over the course of a two-year period. Additionally, recent mixed method work examining the transition from high school to college among adolescent women in STEM followed participant trajectories and experiences for two years (Bieri Buschor, Berweger, Keck Frei, & Kappler, 2014), while qualitative work on undergraduate women of color in STEM followed participants for six years (Carlone & Johnson, 2007). Although the mixed methods study found a fair amount of consistency in students' earlier identity in STEM and later college enrollment in STEM (Bieri Buschor, Berweger, Keck Frei, & Kappler, 2014), qualitative findings indicated change over time in students' career pursuits with respect to three overarching identity categories: research scientist, altruistic scientist, and disrupted scientist (Carlone & Johnson, 2007). After six years, the research scientist women pursued PhD programs in science, the altruistic scientist women pursued health science graduate training, and the disrupted scientist

women indicated an interest in science but varied pursuits in STEM (Carole & Johnson, 2007). Thus, a longer time horizon may enhance the ability to assess changes over time.

Also, most of the participants had moratorium or achieved career identity statuses at both time 1 and time 2. This may have limited the extent to which changes in career identity status could be assessed. For instance, perhaps an achieved career identity status among women in STEM naturally coincides with elevated STEM identity or career commitment. Future research may seek to expand on this study by targeting STEM programs with greater variation across career identity statuses. For instance, in lieu of active learning programs such as the ones examined here, perhaps researchers could sample participants from a STEM mentoring program or a STEM educational outreach program, as both kinds of programs may enhance STEM participation among women but attract students representing a wider range of career identity development.

Beyond the longitudinal design limitations, some of the quantitative analyses, particularly in the longitudinal dataset, may have been underpowered. For instance, post-hoc power analyses revealed that the analyses assessing mean differences in STEM identity and career commitment from time 1 to time 2, as well as those exploring mean level differences in resilience by way of career identity status, may have been underpowered. These results should be interpreted with caution, however. While some researchers suggest performing post hoc power analyses to accompany non-significant results (Onwuegbuzie & Leech, 2004), post hoc power calculations rest largely on the basis of observed power which may not be indicative of true power in the population of interest (Lenth, 2007). As a result, while the post hoc findings suggest that this study would have been strengthened by a larger sample of women, they may also serve as simply

confirmation that significance was not obtained and that study replication may help bolster findings (Lenth, 2007).

Additional future directions pertain to how the qualitative components of the current study can help inform future quantitative efforts. For instance, given the prevalence of individual and situational resilience in the qualitative data, psychometric scales could be developed to measure STEM success via items that incorporate both career commitment and resilience items, on the idea that assessing both constructs together may better approximate STEM success than either construct individually. Researchers recommend iteratively refining and validating quantitative measures on the basis of mixed-method designs where qualitative data is used to expand on quantitative results (Creswell, 2015), such as in this study. Future empirical work may also build on this study by assessing the variables investigated here in other samples. For instance, additional research could help to determine whether STEM identity, resilience, and/or career commitment are characteristic of successful STEM graduate students, as only undergraduate and post-baccalaureate students participated in the current study. Also researchers could assess the variables studied here during key career transitions (e.g., from college to the workforce), or by examining potential associations with other important psychological constructs (e.g., personality traits such as extraversion). Similarly, future work could also examine whether variables such as STEM identity and resilience present more among successful students in STEM as compared to less successful students in STEM, or explore person-centered variable approaches in a larger sample to determine whether unique configurations of these constructs (e.g., high STEM identity, lower resilience individuals as compared to lower STEM identity, lower resilience individuals, etc.) may lend themselves to specific student outcomes or experiences. Further research could also probe the bivariate associations between individual and

situational resilience found here in order to understand how the two may function together in successful STEM individuals, or when a person may recruit one type of resilience or both. For instance, in this study both individual and situational resilience were positively associated. Thus, future work could explore whether situational resilience may reinforce individual resilience. Finally, this study was not designed to assess the active learning context or how much of a "success incubator" the programs provided. Thus, results may not be generalizable beyond these particular programs, and will not definitively support whether program participation leads to certain outcomes. Additional research is needed to draw associations between program participation and future outcomes. For instance, a study could be conducted in which the context is considered a manipulation. In such a situation, some successful students in STEM would be participants in an active-learning program and others would not, or may also join a "program" created by the research team as a placebo condition (i.e., control group).

Conclusion

This study addresses a gap in the literature by offering unique insight into women's STEM success via the experiences of undergraduates in active learning programs in STEM. Findings suggest the role of resilience with respect to participant's success in and intent to continue in STEM. Additionally, results illustrate experiences authoring both STEM identity and career identity status in concert with career commitment. The current research is among the first to illuminate constructs implicated in women's STEM career success. These insights can help inform interventions aimed at shoring up STEM occupational pipelines and support further research examining what enables women, and all individuals, to thrive in their careers.

Appendix A: Questionnaire

The following details the questionnaire items used for one of the student programs in this study. Note that the psychological measures and demographics of both surveys are similar minus slight variation which reflects the nuances of the particular program.

Welcome to the Research Scholars Institute Survey!

Please complete the captcha and push the >> button to continue.

Informed Consent Document (Survey)

- I do not wish to participate
- I choose to participate

Selection Questions

Research Scholars Institute Participation (Yes; Current active participant)

Are you currently an active participant in the Research Scholars Institute? << *If* Research Scholars Institute*: No/Unsure>>End of Survey*

- Yes
- No
- Unsure

Previously Been a Research Scholar

Have you participated in the Research Scholar Institute in the past?

- Yes
- No

STEM field pursuing (Adapted from http://www.nsf.gov/nsb/sei/edTool/data/workforce-05.html)

Please indicate the Science, Technology, Engineering, and Math (STEM) field in which **you are currently pursuing** your highest degree of education: *<< If I'm not pursuing a STEM related degree>>End of Survey*

- Agricultural sciences
- Biological sciences
- Computer sciences
- Engineering
- Environmental life sciences
- Mathematical sciences
- Physical sciences
- Social sciences
- Other, please specify
- I'm not pursuing a STEM related degree

Age (Over 18)

Please enter your current age (round up to the nearest year): *<<If Age: Less than or equal to 17>>End of Survey*

Part A: Life Experiences

For each item, please select the choices below that best indicates how much you agree with the following statements as they apply to you over the last month. If a particular situation has not occurred recently, answer according to how you think you would have felt.

Resilience: Individual Resilience: Connor-Davidson Resilience Scale (CD-RISC) (Connor & Davidson, 2003)

5-point Scale: 0. Not True at All to 4. True Nearly All the Time

Note: Scale can be made available upon written request to Davidson.

Resilience: Situational Resilience: Scale of Protective Factors (SPF-24) (Ponce-Garcia, Madewell, & Kennison, 2015)

7-point Scale: 1. Disagree Completely, 2. Disagree Moderately, 3. Disagree Somewhat 4. Neither Disagree nor Agree, 5. Agree Somewhat, 6. Agree Moderately, 7. Agree Completely

The following questions describe how you may or may not feel about yourself. Read each statement carefully. Please select the number next to each statement that most reflects your life. There are no right or wrong answers.

1. I am good at starting new conversations.
2. My friends and/or family, keep me up to speed on important events.
3. I am good at making new friendships.
4. My friends and/or family, are supportive of one another.
5. When working on something, I make a list of things to do in order of importance.
6. I am confident in my ability to solve problems.
7. My friends and/or family, spend free time together.
8. When working on something, I set priorities before I start.
9. I am confident in my ability to succeed.
10. I am confident in my ability to think out and plan.
11. I am confident in my ability to think on my feet.

12. I am good at working with others as part of a team.

13. I am good at socializing with new people.

14. I am confident in my ability to achieve goals.

15. When working on something, I organize my time well.

16. I am good at interacting with others.

17. I am good at being with other people.

18. When working on something, I plan things out.

19. I am confident in my ability to make good decisions/choices.

20. My friends and/or family see things the same way as I do.

21. My friends and/or family are seen as united.

22. When working on something, I do better if I set a goal.

23. My friends and/or family are optimistic.

24. When working on something, I can see the order in which to do things.

Brief Resilience Scale (BRS) (Smith et al., 2008)

6-Point Scale: 1. Strongly Disagree, 2. Disagree, 3. Neutral, 4. Agree, 5. Strongly Agree

Please indicate the extent to which you agree with each of the following statements by using the following 5-point scale.

1. I tend to bounce back quickly after hard times.

2. I have a hard time making it through stressful events.

3. It does not take me long to recover from a stressful event.

4. It is hard for me to snap back when something bad happens.

5. I usually come through difficult times with little trouble.

6. I tend to take a long time to get over set-backs in my life.

Part B: Educational and Career Experiences

Identity: Marcia's Identity Statuses: Revised Version of the Extended Objective Measure of Ego Identity Status (Bennion & Adams, 1986)

6-point Scale: 1. Strongly Agree, 2. Moderately Agree, 3. Agree, 4. Disagree, 5. Moderately Disagree, 6. Strongly Disagree

The following questions will ask you to consider your educational and career-oriented experiences, as well as your related thoughts and feelings. Again, there are no right or wrong answers.

Read each item and indicate to what degree it reflects your own thoughts and feelings. If a statement has more than one part, please indicate your reaction to the statement as a whole. Indicate your answer by choosing one of the following responses.

1. I haven't chosen the occupation I really want to get into, and I'm just working at whatever is available until something better comes along. (Occupation/Diffusion)
2. I'm still trying to decide how capable I am as a person and what jobs will be right for me. (Occupation/Moratorium)
3. I might have thought about a lot of different jobs, but there's never really any question since my parents said what they wanted. (Occupation/Foreclosure)
4. I'm really not interested in finding the right job, any job will do. I just seem to flow with what is available. (Occupation/Diffusion)
5. It took me a while to figure it out, but now I really know what I want for a career. (Occupation/Achievement)
6. My parents decided a long time ago what I should go into for employment and I'm following through their plans. (Occupation/Foreclosure)

7. It took me a long time to decide but now I know for sure what direction to move in for a career. (Occupation/Achievement)
8. I just can't decide what to do for an occupation. There are so many that have possibilities. (Occupation/Moratorium)

The following questions will ask you to consider your educational and career-oriented experiences, as well as your related thoughts and feelings. Please respond according the following 6-point scale.

Identity: Identity as a Scientist (Chemers et al., 2011)

6-point Scale: 1. Strongly Disagree, 2. Disagree, 3. Slightly Disagree, 4. Slightly Agree, 5. Agree, 6. Strongly Agree

1. In general, being a STEM student is an important part of my self-image.
2. I have come to think of myself as a STEM student.
3. I am a STEM student.
4. Being a STEM student is an important reflection of who I am.
5. I feel like I belong in the STEM field.

Career Commitment: Commitment to a STEM Career (Chemers et al., 2011)

6-point Scale: 1. Strongly Disagree, 2. Disagree, 3. Slightly Disagree, 4. Slightly Agree, 5. Agree, 6. Strongly Agree

1. I intend to work in a job related to the STEM field.
2. I expect that a career in STEM will be very satisfying.
3. I definitely want a career for myself in STEM.
4. I will work as hard as necessary to achieve a career in STEM.
5. I feel that I am on a definite career path in STEM .

6. The STEM fields are the ideal areas of study for my life.

General Demographics

The following questions will ask about you and the specifics of your participation in the Research Scholars Institute.

Research Scholar Research Project

Research Project Description

Please briefly describe (in two sentences or less) your research project this summer.

Research Scholars Institute Site

Please indicate the setting in which you will be primarily working on your research project.

Scientific Lab

Field Work

Classroom

Remote/Home Office

Other, please specify

Research Faculty Mentor

Please indicate the first and last name of your faculty mentor.

Recommendation of Research Scholars Institute

How likely would you be to recommend the Research Scholars Institute to a friend interested in pursuing STEM-related research?

5-Point Scale: 1. Not at all Likely, 2. Somewhat Unlikely, 3. Neither Likely Nor Unlikely, 4. Somewhat Likely, 5. Highly Likely

Overall Experience in Research Scholars Institute

Participating in Research Scholars Institute has been a rewarding experience.

5-Point Scale: 1. Strongly Disagree, 2. Somewhat Disagree, 3. Neither Agree Nor Disagree, 4. Somewhat Agree, 5. Strongly Agree

Experience in Research Scholars Institute

In one or two sentences, please describe one Research Scholars Institute experience **you found very valuable** to your career development.

Room for Improvement in the Research Scholars Institute

In one or two sentences, please describe one way in which you think the Research Scholars Institute **could be improved.**

The following questions will ask you about your current career plans.

Post College Plans

Which of the following do you plan to pursue post college? Please select all that apply.

- Graduate or professional school
- Find a job in a STEM field
- Find a job not in a STEM field
- Non-degree certificate or licensure in a STEM field
- Non-degree certificate or licensure not in a STEM field
- Other, please specify

Graduate or Professional School Disciplines

Which of the following graduate/professional school disciplines are you considering applying to? Please select all that apply. *<<If plan to pursue post college: graduate or professional school>>*

- Agricultural sciences
- Biological sciences
- Computer sciences

- Engineering
- Environmental life sciences
- Mathematical sciences
- Medicine
- Nursing
- Pharmacy
- Physical sciences
- Social sciences
- Other healthcare (e.g., dentistry, mental health, physical therapy, public health, veterinary, etc.) Please specify.
- Other, please specify

When Planning to Apply

When do you plan to apply to a graduate/professional program for admittance? *<<If plan to pursue post college: graduate or professional school>>*

- Already applied to a program: Fall 2018
- Plan to apply to a program: Fall 2019
- Thinking of applying but not sure when

Highest Degree of Completed Education

Please indicate your **highest degree of completed education**:

- HS Diploma/GED
- Some College
- Associates Degree
- Bachelors Degree

- Masters Degree
- MD/DPT/JD/PhD or equivalent degree

Student Status

Are you **currently** an undergraduate student?

- Yes
- No

Year in School

<<*Student Status: Yes*>> What is your year in college?

- First
- Second
- Third
- Fourth
- Fifth or later

Employment Status

Please indicate your **current employment status.** *Do not include student positions or scholarship/educational funding sponsored positions:*

- Full time (40 or more hours per week)
- Part time (30 or more hours per week)
- Less than Part time (< 30 hours per week)
- Unemployed

Income (2014 American Community Survey http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk)

Household Income

Please indicate your current **household** income (round up to the nearest whole dollar amount):

- Less than $10,000
- $10,000 - $14,999
- $15,000 - $24,999
- $25,000 - $34,999
- $35,000 – $49,999
- $50,000 - $74,999
- $75,000 - $99,999
- $100,000 - $149,999
- $200,000 or more
- Unsure

Personal Income

*<<If Employment Status: Full time, part time, less than part time>>*Please indicate your current **personal** income (round up to the nearest whole dollar amount):

- Less than $10,000
- $10,000 - $14,999
- $15,000 - $24,999
- $25,000 - $34,999
- $35,000 – $49,999
- $50,000 - $74,999
- $75,000 - $99,999
- $100,000 - $149,999
- $200,000 or more

- Unsure

Household

Please indicate your **current household living arrangement**:

- Alone
- With family/relatives
- With a romantic partner
- With roommates
- Other, please specify
- Gender
- Please indicate your gender:
- Male
- Female
- Other, please specify

Identification with LGBTQ Community

Do you personally identify with the LGBTQ community?

- Yes
- No

Openness about LGBTQ Membership

<<Identification to LGBTQ Community: Yes>> I am open about my membership to the LGBTQ community.

6-Point Scale: 1. Strongly Disagree, 2. Disagree, 3. Slightly Disagree, 4. Slightly Agree, 5. Agree, 6. Strongly Agree

Marital status

Please indicate your marital status:

- Single
- Married
- Cohabitating, not married
- Divorced
- Other, please specify

Citizenship

Are you a permanent resident or a U.S. citizen?

- Yes
- No

Ethnic/Racial Background

Please indicate your ethnic/racial background:

- Black/African descent
- East Asian (e.g., China, Japan)
- Latino/Latina or Hispanic
- Middle Eastern
- Native American/Pacific Islander
- South Asian (e.g., India, Pakistan)
- White/European
- Other/Multiracial, please explain

Type of Household Raised in

Please indicate the type of household that you were raised in. Select all that apply.

- Raised by Two Heterosexual Parents

- Raised by Two Same Sex Parents
- Raised by a Single Parent
- Raised by Relative(s)
- Parent Education

Father's Education

Please indicate your father's highest level of completed education:

- Less than HS Diploma/Grade School
- HS Diploma/GED
- Some College
- Associates Degree
- Bachelors Degree
- Masters Degree
- MD/DPT/JD/PhD or equivalent degree
- Not Applicable

Mother's Education

Please indicate your mother's highest level of completed education:

- Less than HS Diploma/Grade School
- HS Diploma/GED
- Some College
- Associates Degree
- Bachelors Degree
- Masters Degree
- MD/DPT/JD/PhD or equivalent degree

- Not Applicable

Comments

Please use the box below to let us know if you have any additional comments regarding this survey.

Please enter your email address.

Doing so will help us connect survey data across time points and enable us to contact you should you win a Target or Starbucks gift card (contingent upon assessing your responses to attention check questions). Note that the gift card drawing will be held after the second survey is administered in July. Remember your email will be kept confidential among the research team.

- Enter Email
- Enter Email Again

Interest in Being Interviewed

As mentioned in the informed consent, you may be invited to an interview with the research team. Are you interested in being contacted to participate in an interview?

- Yes, please contact me at the email provided in order to participate in an interview.
- No, please do not contact me in order to participate in an interview.

Attention Grabbing Items

(Eight attention grabbing items developed by Huang et al. (2014) interspersed throughout the study. All answers should be towards “disagree”. Specific scale reflects that of surrounding survey questions.)

1. I can run 2 miles in 2 min.
2. I eat cement occasionally.
3. I can teleport across time and space.

4. I am interested in pursuing a degree in parabanjology.
5. I have never used a computer.
6. I work fourteen months in a year.
7. I will be punished for meeting the requirements of my job.
8. I work twenty-eight hours in a typical work day.

Appendix B: Interview Protocol

Pre-Interview

Schedule 1-hour session with interviewee via email

Suggest a quiet place to enable quality conversation and interviewee comfort (e.g., Social Development Research Lab, empty NSC classroom)

- Make sure the space will have appropriate seating for you as interviewer
- Contact interviewee to confirm scheduling day before interview
- Visit the interview site prior to the interview time
- Make sure you know how to get there and where to go

Interview

- During the interview: make eye contact, listen, focus on recording what is said and tone, as well as body language or mannerisms during conversation
- Record content of the conversation – try to delineate your own thoughts/feelings

Interview Content

Interviewee First Name:

Date:

Time:

Location:

Program Cohort, Site Assignment, Tenure at Site/in Institute:

Thank you for taking the time to speak with me today.

This interview is to help us understand your professional experiences to date, including those pertaining to your time in the community health program/summer research program. We'll meet

for about an hour now. Your responses will be kept confidential and not linked back to you personally. You're welcome to end the interview at any time.

Demographics:

- Can you please state and spell your name for me?
- What is your current age?
- Describe your cultural background.
- What is your current field of study?

Career story:

- Tell me what led to you to college and your field of study (adapted from McAdams, 2001).
- What key relationships (family/friends/professional) have influenced your career journey as of this point in time?
- Tell me about an important transition or change with respect to how you understand yourself as a pre-health/STEM practitioner (e.g., adapt "STEM" to participant, so may say "pre-med" if they've indicated they are pre-med) (adapted from McLean & Pratt, 2006).

Resilience in context:

Probe for resilience traits, strategies, self –insight, and relational resilience (Davydov et al, 2010; Clauss-Ehlers, 2008; Jordan, 2013).

- Tell me about a difficult academic or professional situation you've faced.
- How do you approach difficult school or professional situations?
- What have you learned from difficult school or professional situations in the past?

Future aims:

- What are your future career aspirations and goals?
- Thank you so much for your time. Is it okay to contact you if I have any questions or need to clarify what we discussed?

Post-Interview

- Within a day of the interview, transcribe interview notes and any additional interviewer thoughts/feelings related to the interaction or to the content
- Follow up with interviewee the next day to thank them for their time

Appendix C: Observation Protocol

Observation Methods

- Role: Complete Observer (Baker, 2006)
- Time of Day: Between 8am – 5pm (record actual start/end times in field notes)
- Location: Various pre-approved sites throughout Las Vegas
- Observer reminders: Well-fed, well-slept, wear layers, sit in the same spatial location, schedule observation during a timeslot when you will not be rushed.

Observation Timeline

Pre-Observation:

- Visit the observation site prior to observation day.
- Note any arrangements that need to be made to accommodate observer, or any physical impediments to observational data.
- Plan how to explain your presence as the observer, if asked by a participant
    - "My name is Sarah. I'm observing the community health program/summer research program students to understand their experiences in the program."
- Draw a map/layout – diagram physical orientation of the space in the 10 min before observation time begins; mark locations of key individuals or items.
- Make sure you are physically/mentally/emotionally at ease and alert to observe.

During Observation (Duration – 1 hour):

- Note: Date, Day, Start/End Time, Location of observations.
- Record observations – see, hear, smell, touch.

    - Take detailed notes to report what you observe and take in.
    - Separate/label interpretation from direct perception.
    - Focus on key individuals – students of interest, other key site workers (appearance, emotions, verbal, nonverbal, age, gender).
    - Note any changes to physical/spatial orientation of individuals, as well as the number of individuals, and feel of the event.
- Try to remain in the same spot/physical location for the entirety of the observation session.

Post Observation:

- Directly after observation (within 20min post observation) record any additional experiences/thoughts/feelings, particularly personal reactions or thoughts.
- Clarify original field notes from observations that just occurred. Note observations to follow up on during interviews or future observations. Within a day of observation, review field notes. Record any additional memories or ideas, as well as changes to be made going forward, new research questions, and reflections/learning. Transcribe into Microsoft Word and code the data.

Appendix D: Additional Marcia's Identity Status Qualitative Responses

Study participants occasionally expressed a singular career interest without the presence of exploration or, a *foreclosed* career identity status (see definition in Table 2, Appendix G). Tami, for instance, indicated an interest in medicine from an early age without considering alternatives:

R: So what led you to college?

T: Um I want to become a doctor.

R: And when did that start, when did you first think about becoming a doctor?

T: Since I was a kid I don't know what age but I've just always wanted to be one.

R: Do you remember how it kind of came about?

T: I guess my parents kind of asked me what I wanted to be as a kid and um I just told them like I want to be a doctor and I never changed my mind after that like I don't know what I would be if I didn't become a doctor if that makes sense.

Tami has not deviated from her career focus on medicine. A foreclosed identity status was relatively rare in the qualitative data collected and appeared more frequently coupled with life science careers (e.g., medicine, biology researcher) as opposed to other areas of STEM.

Finally, the data revealed very little evidence of a *diffused* identity status (see Table 2, Appendix G for a definition) amongst participants. This is perhaps expected as all participants elected to join an active learning program indicating some level of exploration of, or commitment to, a STEM career. However, occasionally a participant would provide responses such as Amy's:

A: And I didn't even know what I wanted to major in. I just picked it randomly.

Amy indicated limited engagement with respect to deciphering career direction or interests (e.g., "I just picked it randomly") and little commitment to a particular STEM field. Such comments illustrated minimal effort to try to clarify career pursuits.

Appendix E: Marcia's Identity Status – Transition from Achieved to Diffusion

Of the three participants who changed identity statuses throughout the study, one of the participants who transitioned from achieved to diffusion participated in an interview. Although this student was a male, his experiences are discussed below.

In the interview, Paul described how he came to study nutrition illustrating an achieved career identity status by way of a journey to discovering a "love" for the subject:

> P: For the longest [time] I wanted to do social work but I took social work 101 here [in college] and realized it wasn't for me no more. And I literally went on a hike and thought about my life, "What can I do here?" I didn't even know they offered nutrition here because I haven't heard much about it. I looked into it and I'm like that is something I'd really like to do …I love it

Paul actively explored social work, engaged in deliberate self-reflection (e.g. "I literally went on a hike and thought about my life"), and came to discover nutrition as a good match. Thus within the context of his overall career path to date, he expressed an achieved career status (e.g. "I love it [nutrition]"). Yet, when describing career goals, Paul illustrated both career commitment (specific plans to continue in nutrition) and a lack of active career pursuits:

> P: I definitely want to be a registered dietitian which I'll be eligible to get once I get my bachelors. There is a lot of different things you can go in, you can go into hospitals, schools, with athletes. Do I know which one specifically? Not exactly at the moment. Pretty much taking care with what is in front of me.

Overall, the responses above suggest a combination of exploration informed commitment to nutrition as a career, but also a certain amount of a lack of engagement with the future (e.g., "pretty much taking care with what is in front of me") which may be somewhat indicative of

both achievement and diffusion with respect to certain aspects of this participant's career journey. Further research is needed to determine whether students that transition from an achieved to diffuse identity status echo the sentiments or experiences Paul relayed. Furthermore, it may also be possible that rather than fully transitioning between statuses, Paul may have simultaneously been holding disparate career identity statuses (similar to a post-modern identity construction; see Schachter, 2004). Additional research may help to further elucidate the experiences of students such as Paul.

Appendix F: Table 1 Associations Among Study Variables at Time 1 (T1) and Time 2 (T2)

Table 1

Associations Among Study Variables at Time 1 (T1) and Time 2 (T2)

	M	*Mdn*	*SD*	1	2	3	4	5	6	7
1. CDRISC (T1)	75.00	74.50	11.57							
2. SPF-24 (T1)	22.32	22.00	2.56	.74**						
3. STEM identity (T1)	4.93	5.10	1.40	.25	.31					
4. Career commitment (T1)	5.18	5.67	1.38	.20	.33	.96**				
5. CDRISC (T2)	75.08	77.00	11.51	.86**	.62*	-.03	-.04			
6. SPF-24 (T2)	22.82	23.59	2.58	.79**	.75**	.28	.30	.84**		
7. STEM identity (T2)	4.78	6.00	1.90	.50	.38	.60*	.67*	.52	.72**	
8. Career commitment (T2)	5.39	6.00	1.22	.53	.45	.65*	.75**	.48	.72**	.95**

Note. N=12, CDRISC = Individual Resilience; SPF-24 = Situational Resilience.

*$p < .05$ **$p < .01$

Appendix G: Table 2 Qualitative Data Definitions and Inter-rater Reliability

Table 2

Qualitative Data Definitions and Inter-rater Reliability

Construct	Definition	Reliability
STEM identity	Belonging to STEM or mastery of STEM-related skills	κ = .89 (95% CI, .81 to .97)
Marcia's identity statuses (career identity)	Achieved: indicated a specific STEM career niche following a period of exploration, or activities that led to a career choice	κ = .90 (95% CI, .85 to .95)
	Moratorium*:* involved in extensive STEM career exploration and continuing in that vein	
	Foreclosure: a singular STEM career interest without the presence of exploration	
	Diffusion*:* limited active engagement with respect to STEM career direction or interests and little commitment to a particular STEM field	
Career commitment	Intention to continue on in STEM, often accompanied by specific future STEM-related career plans or both primary and secondary plans in STEM	κ = .91 (95% CI, .83 to .99)
Individual resilience	Personal attributes or behaviors that help individuals cope, or that they tend to rely on during STEM pursuits	κ = .91 (95% CI, .83 to .98)
Situational resilience	External support to aid in persistence of STEM pursuits	κ = .76 (95% CI, .66 to .86)

Note. Cohen's unweighted observed kappa for Marcia's identity statuses are reported across statuses as a whole.

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Curriculum Vitae

Sarah E. Thoman
thoman@unlv.nevada.edu

EDUCATION

University of Nevada, Las Vegas – Las Vegas, NV
Doctor of Philosophy, Psychology – Experimental Psychology: Developmental Emphasis, Anticipated December 2019
Master of Arts, Psychology – Experimental Psychology: Developmental Emphasis, Anticipated May 2018
Psychology Quantitative Certificate Program, Anticipated May 2018

The University of Texas at Austin – Summer Statistics Institute – Austin, TX
- 24 hours of statistical training in power analysis and Bayesian statistics, *May 2017*
- 12 hours of statistical training in questionnaire design and survey analysis, *May 2011*

Teachers College, Columbia University – New York, NY
Master of Arts, Organizational Psychology, February 2010

The University of Texas at Austin – Austin, TX
Bachelor of Arts, Psychology, December 2007
Bachelor of Business Administration, Management, December 2007

ACADEMIC HONORS &AWARDS

University of Nevada, Las Vegas – Summer Session Scholarship
Summer 2017
University of Nevada, Las Vegas – Graduate Access Scholarship
Fall 2015 - Present

Member of Mortar Board National Senior Honor Society
Spring 2007– Present
University of Texas - University Honors Recipient/Liberal Arts Honors Student
Fall 2004 – December 2007
National Dean's List Recipient- University of Texas at Austin
Fall 2005

Merit Based Non-Resident Tuition Exemption- University of Texas at Austin
Fall 2004 – December 2007
Academic Sustainability Tuition Grant- University of Texas at Austin
Fall 2004 – December 2007

PROFESSIONAL ASSOCIATIONS

Association for Psychological Science – *Graduate Student Affiliate*
Fall 2017 – Present

Society for Industrial-Organizational Psychology (SIOP) - *Associate Membership*
Spring 2013 – Present

American Psychological Association - *Associate Membership*
Fall 2008 – Present

Organizational & Human Development Consulting Club (OHDCC) - Columbia University
Fall 2008 –2009

PUBLICATIONS

Robnett, R. D., Buck, J. E., Underwood, C. R., & Thoman, S. E. (2018). Sexism and gender stereotyping. To appear in S. Hupp & J. Jewell (Eds.), *The Encyclopedia of Child and Adolescent Development* (2nd Ed.). New York, NY: Wiley Blackwell.

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*Thoman, S. E., & Zelin, A. I. (2018). *Suits and aprons: Effects of gender typicality on women's work experiences and romantic relationships.* Manuscript in preparation. *Equal author contribution; authors listed alphabetically.

Thoman, S. E. (2017). *Beyond the bench and bedside: Women's success in STEM via active learning projects.* (Unpublished master's thesis). University of Nevada, Las Vegas, Las Vegas, NV.

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CONFERENCE PRESENTATIONS

Thoman, S. E., DiBona, T., Abelar, J., Robnett, R. D. (2018, February). *The Flies Chose Me": Qualitative Insight into Women's Success in STEM.* Poster presented at the Ethnographic and Qualitative Research Conference, Las Vegas, NV.

*Boucher, E., Codhock, T., Hatcher, W., Hayden, S., Spinrad, M., Thoman, S., Tyler, T., Nehls, K. (2018, February). *The Business of International Students at a Community College.* Presentation given at the Ethnographic and Qualitative Research Conference, Las Vegas, NV. *Equal author contribution; authors are primarily listed alphabetically.

DiBona, T., Abelar, J. Thoman, S. E. (2017, November). *Beyond the Bench and Bedside: Women's Success in STEM via Active Learning Projects.* Poster presented at the Healthcare Businesswomen's Association Annual Conference, Philadelphia, PA.

Stephens, A.K., Thoman, S. E., Robnett, R. D. (2017, November). *Beakers or Babies: Work-Life Balance among Women in STEM.* Poster presented at the Healthcare Businesswomen's Association Annual Conference, Philadelphia, PA.

Thoman, S. E., Zelin, A. I., Snowdy, L. (2017, November). *Briefcases or Spatulas?: Role of*

Gender Norms on Work and Love. Poster presented at the Healthcare Businesswomen's Association Annual Conference, Philadelphia, PA.

Robnett, R. D., & Thoman, S. E. (2016, October). *Configurations of efficacy and academic achievement among women in STEM majors: a longitudinal analysis.* Poster presented at the Gender Development Research Conference, San Francisco, CA.

Stephens, A.K., Thoman, S. E., Robnett, R. D. (2016, October). *Advantage or obstacle: Associations between romantic relationships, academic self-efficacy, and career identity.* Poster presented at the Gender Development Research Conference, San Francisco, CA.

Thoman, S. E., Underwood, C. R., Stephens, A.K., Buck, J. E, Robnett, R. D. (2016, October). *Test tubes or soccer practice: Retention and work-life balance among women in STEM.* Poster presented at the Gender Development Research Conference, San Francisco, CA.

Underwood, C. R., Thoman, S. E., Buck, J. E., Robnett, R. D., & Barakat, M. (2016, October). *Redefining tradition: Generational differences in same-sex couples' surname decisions.* Poster presented at the Gender Development Research Conference, San Francisco, CA.

RESEARCH & RELEVANT ACADEMIC EXPERIENCE

Graduate Assistant – University of Nevada, Las Vegas
Diversity Assistant August 2017 - Present
Research Collaborator July 2016 – Present
Researcher, Social Development Lab August 2015 – Present
Research Assistant, TILT December 2016 – July 2017

Independent Research – Teachers College, Columbia University Fall 2009
Student Researcher

MENTORING & TEACHING EXPERIENCE

Graduate Assistant – University of Nevada, Las Vegas
Diversity Assistant August 2017 - Present

Graduate Assistant – University of Nevada, Las Vegas August 2015 – Present
Research Mentor Fall 2015 - Present
Teaching Assistant Fall 2015 – Fall 2016

SERVICE ACTIVITIES

Outreach Undergraduate Mentoring Program (OUMP) Mentor – Las Vegas, NV
Fall 2015 – Present

LSAMP Presenter: Advising Undergraduates on Post-Baccalaureate Studies – Las Vegas, NV
Fall 2017

Nevada State College Graduate Student Panelist – Henderson, NV
Spring 2017

Capital Area Food Bank Volunteer – Austin, TX
Spring 2011 – Fall 2015

Organizational & Human Development Consulting Club (OHDCC) - Columbia University
Fall 2008 -2009

University of Texas First-year Interest Group Peer Mentor – Austin, Texas
Spring 2006 – Fall 2007

University of Texas Alcohol and Drug Education Program Peer Educator – Austin, Texas
Fall 2004 – Fall 2007

RELEVANT PROFESSIONAL WORK EXPERIENCE

CUNA Mutual Group – Madison, WI — August 2013 – October 2014
Workforce Consultant

iGillott Research Inc. (iGR) – Austin, TX — July 2012 – August 2013
Independent Contractor – Market Research

iGillott Research Inc. (iGR) – Austin, TX — March 2011 – June 2012
Market Research Analyst

iGillott Research Inc. (iGR) – Austin, TX — May 2010 – March 2011
Associate Market Research Analyst

Sirius XM Satellite Radio - New York, NY — February 2009 – May 2009
HR Staffing and Recruitment Intern

The University of Texas Learning Communities – Austin, TX — January 2008 – July 2008
Student Development Specialist I