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STEMing from scholarship and resilience: A case study focusing on U.S. undergraduate women who are thriving in STEM

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ABSTRACT

Research suggests a variety of challenges often impede women's achievement and persistence in science, technology, engineering, and math (STEM) careers. However, some women persist in STEM fields and attain laudable professional standing. As such, the current study employed a case study to examine the characteristics of nascent STEM success within a diverse sample of U.S. undergraduate women (N = 9) participating in a summer research program. Qualitative interviews and observations focused on understanding women's STEM career experiences and trajectories to date. Thematic analysis revealed that educational attitudes and opportunities as well as resilience were integral in women's ability to thrive in STEM. In addition, background characteristics, such as ethnicity, socioeconomic status, and student status provided unique intersectional insight into the nuances of STEM success. Overall, findings extend prior research, which typically focuses on persistence, by illuminating constructs that enable women to thrive in STEM. Moreover, findings can be leveraged to inform interventions that aim to improve women's standing in STEM fields.

KEYWORDS

gender; STEM; career success; intersectionality

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INTRODUCTION

Although the number of women in U.S. science, technology, engineering, and math (STEM) fields has increased since the 1970s, women remain underrepresented in these domains, comprising less than 30% of U.S. STEM workers (Landivar, 2013). This is troubling given the current demand for STEM talent and innovation and the difficulty meeting these needs due to the lack of women in the STEM workforce (Handelsman & Smith, 2016). Women's underrepresentation in STEM is also indicative of broader social-structural limitations women encounter (e.g., gender stereotypes, socialization) that can constrain their participation in STEM (e.g., Halpern et al., 2007). As such, achieving gender parity in STEM is a pressing national matter (Koizumi, 2015; White House OSTP, 2018).

One approach to addressing STEM gender disparities is to focus on women who are thriving in STEM. Identifying factors that contribute to women's success may provide lessons learned that can be incorporated into equity-focused interventions. Accordingly, the current study focuses on undergraduate women from diverse backgrounds who were selected to participate in a summer research program. Qualitative analyses provide insight into attributes and experiences that characterize this successful group of women. Analyses also foreground the role of women's social category memberships, which is important given that intersectional identities can significantly shape women's STEM experiences (Johnson, 2011).

Women in STEM: Challenges and Affordances

Prior research has identified a range of challenges and barriers that women in STEM may encounter (for reviews see Blickenstaff, 2005; Halpern et al., 2007; Kanny, Sax & Riggers-Piehl, 2014). For instance, negative stereotypes regarding women's math ability can impair their STEM self-efficacy (Eccles, 2011; Shapiro & Williams, 2012), even among women who are high-achieving in math (e.g., Robnett & Thoman, 2017). In addition, societal gender roles (e.g., women as homemakers; Wood & Eagly, 2002) and norms (e.g., communal behavioral expectations; Diekman, Brown, Johnston & Clark, 2010) often encourage women to pursue professions outside of STEM. Furthermore, women who do persist in STEM may encounter biases in the classroom (e.g. Robnett, 2016), hiring process (e.g., Moss-Racusin, Dovidio, Brescoll, Graham & Handelsman, 2012), or STEM workplace (Settles, Cortina, Malley & Stewart, 2006; Settles, Cortina, Buchanan & Miner, 2012). Finally, for women of color in STEM the above challenges can be exacerbated by the combination of their race and gender identities (e.g., tokenism; Ong, Wright, Espinosa & Orfield, 2011).

Understanding the difficulties women in STEM face is critical. However, it is equally important to understand what may enable women to thrive in STEM. Specifically, identifying the underpinnings of success may provide insight into how to support women's career development and further gender equity in STEM. This focus is consistent with scholarship in positive psychology and anti-deficit frameworks that advocate for examining what may promote sought-after outcomes (e.g., wellness, happiness, achievement; Harper, 2010; Seligman & Csikszentmihalyi, 2000). For instance, Harper (2010) recommended understanding STEM achievement among students of color by way of pre-college, college, and post-college affordances. Therefore, the current study draws from a positive psychological, anti-deficit perspective to understand what may allow diverse women to thrive in STEM. Consistent with prior work, the current study focuses on two key constructs that may be implicated in women's STEM success: educational context and resilience.

Educational Context

Students' academic performance and features of the U.S. educational context work together to foster STEM persistence. For example, better academic performance within college-level coursework tends to underlie academic persistence in STEM college students (Lent, Brown, & Larkin, 1984). Relatedly, women who perceived themselves as having had adequate academic preparation (e.g., math knowledge and skills; Dika & D'Amico, 2016) were particularly likely to persist in STEM. Furthermore, educational elements such as U.S. STEM classroom composition (e.g., Fischer, 2017) and STEM gateway course experiences (e.g., Ellis, Fosdick, & Rasmussen, 2016; Witherspoon, Vincent-Ruz, & Schunn, 2019) also contribute to women's persistence, or lack thereof, in STEM. Thus, educational context may play a role in women's success in STEM. However, more research is needed to understand women's lived educational experiences in concert with early STEM career success, and whether these experiences vary based on women's background characteristics.

Resilience

Beyond the knowledge and competency necessary to become a STEM professional, women may also need to overcome obstacles to succeed in STEM. *Individual resilience*, which describes adaptive traits (e.g., positive view, appropriately externalizing difficulties), as well as *situational resilience*, which refers to contextual resources (e.g., social support, socioeconomic advantages; Davydov, Stewart, Ritchie, & Chaudieu, 2010; Madewell & Ponce-Garcia, 2016), may be employed by women succeeding in STEM. Prior research demonstrates that U.S. college women who remain in STEM majors and intend to pursue STEM careers employ enhanced social coping skills (Morganson, Jones, & Major, 2010), suggesting ties to situational resilience. Furthermore, some researchers suggest that individual resilience can be instilled in professionals in careers that require a strong science background (i.e., women and men healthcare providers) to help them navigate workplace adversity (McAllister & McKinnon, 2009). Furthermore, such resilience may function according to an ecological, positive psychological framework (McAllister & McKinnon, 2009) and extend to STEM fields beyond healthcare. Thus, resilience may be an important component of women's success in STEM. It merits noting, however, that resilience may have limitations, particularly with respect to STEM structural issues. We elaborate on these points in the discussion.

STEM Success in Context
The current research focuses on a diverse sample of elite U.S. undergraduate women who were selected for a prestigious summer research program. These women are an ideal sample. According to Arnett (2000) and Super (1980), undergraduates are actively forming ideas about professional pursuits in context. In addition, women's intersectional social identities, such as gender and race, can shape STEM persistence (Espinosa, 2011). Therefore, understanding STEM success among high-achieving college women from diverse backgrounds may provide valuable insight at a pivotal point in STEM career development.

Furthermore, active learning programs, such as the summer research program considered in the current research, are excellent venues to investigate women's STEM success. These programs equip students with career-related knowledge and abilities through hands-on experiences and are promoted to enhance STEM retention (Holdren & Lander, 2012). Research also demonstrates a positive association between active learning and college academic performance (Freeman et al., 2014), as well as the desire to pursue graduate training in science and medicine (Harrison, Dunbar, Ratmansky, Boyd, & Lopatto, 2011). Thus, the current study aims to identify the characteristics of women's STEM success by way of the experiences of U.S. women from diverse backgrounds in a college STEM active learning program.

A Multiple Case Study Approach
A qualitative approach is apt for examining women's STEM success in context. Qualitative methods are ideal when exploring nascent areas of research and unearthing individuals' perspectives and experiences (Creswell, 2013). Case study is a qualitative research design that allows for depth of insight into a phenomenon situated in a specific context (Yin, 2014). In this study, the phenomenon is the STEM success of college women from diverse backgrounds and the context is an active learning program. A single case study refers to a deep dive into an individual's experiences, whereas a multiple case study probes the experiences of many people allowing for data pattern replication and comparison (Yin, 2014). Thus, by applying a *qualitative multiple case study*, the current study will be able to describe and identify characteristics that may contribute to the success of diverse women in a STEM active learning program.

Current Research
The current study seeks to better understand the attributes and experiences that characterize successful women in STEM. It situates that inquiry in context by employing a qualitative multiple case study design (Yin, 2014). The research questions guiding the study are as follows:

RQ1. What qualities characterize undergraduate women who are successful in STEM?
RQ2. Do the qualities of a successful woman in STEM vary relative to her individual background characteristics? If so, how?

METHOD

Site and Recruiting

We recruited participants from a prestigious, on-campus summer research program. Specifically, high-achieving U.S. undergraduate students from groups underrepresented in U.S. higher education (e.g., underserved ethnic groups, first-generation students) applied to conduct original research under a faculty mentor from May-August 2017. The program selected student members based on their desire to attend graduate school, their college GPA, and their demographic characteristics. These determinations were made by the program and not the research team. Students received a stipend as well as career development support throughout the program. Students also gave a research presentation and wrote a research paper, which focused on their original research. To recruit participants from the program, the research team sent recruitment materials to students via email and made announcements in person at program events. The research team also reserved time in an on-campus computer lab on multiple occasions and offered snacks to encourage participation. Recruitment was not gender specific; thus, participants were unaware that gender was a focus of the current study. Students were compensated for interview participation with a $10 gift card to a national retailer.

Sample

The current study focuses on nine women who participated in the program. Note that "women" in this paper denotes cis-gender women whose gender identity coincides with their biological sex given at birth. Although the experiences of transgender women are important for understanding women's success in STEM, they are beyond the scope of this study and the data available. Sample demographic information is summarized in Table 1. Participants ranged in age from 19 to 28 years (M=21.9, SD=2.6). They identified as Latina/Hispanic (n = 4), followed by East Asian (n = 3), Multiracial (n = 1; Black/Filipino), and White/European American (n = 1). In addition, participants indicated that they were pursuing training in one of two STEM disciplines: Biological/Life/Health Sciences (n = 6) and Neuroscience (n = 3). This range of disciplines is consistent with the National Science Foundation's definition of STEM fields (NSF: STEM Education Data, 2014). Note that women from all STEM majors included in the summer research program were invited to participate. Those from math-intensive majors (e.g., physics and engineering) merely did not. Many of the women in our sample were first generation college students (n = 5) and most were in their 4th or 5th year of college (n = 7). One woman in our sample was also considered a nontraditional college student based on age (28 years old); she was also the only participant with a child. One woman was a transfer student. The limited number of nontraditional students in this sample was representative of the sample in the parent project (see Design and Procedure below) as well as the broader summer research program.

Table 1: *Participant demographic characteristics*

Name	Age	STEM College Major	Additional Demographics
Jimena	19	Nursing; Medicine	Mexican American, Born abroad, Second-generation college student, Traditional college student
Liliana	20	Neuroscience	Latina, Traditional college student
May	21	Neuroscience	Latina, Traditional college student, First-generation college student
Minnie	21	Biology; Medicine	Chinese American, Traditional college student
Tala	21	Radiography	Filipina American, Second-generation college student, Traditional college student
Tina	22	Ecology	Vietnamese American, First-generation college student, Traditional college student
Shaina	22	Biology	Filipina/African American, Traditional college student, First-generation college student
Sofia	23	Neuroscience	Latina, Transfer student, First-generation college student
Jill	28	Microbiology	European American, First-generation college student, Single parent, Nontraditional college student, Lower SES

Researcher Positionality

The primary research team members (3 women; 1 man) were students and faculty in the social sciences and applied health sciences. The first author identified as a cis-gender, European American/White woman in her thirties. She studies gender and career development and identifies as a feminist. The second author identified as a cis-gender, European American woman in her twenties. She previously examined the role of gender and racial stereotypes on academic performance and was interested in the influences of these topics on an individual's mindset and behavior. The third author identified as a cis-gender, White Hispanic man, and a military veteran in his twenties. He previously examined how racial and gender bias can influence public health and was interested in reducing disparities experienced in underrepresented and/or disadvantaged populations. The fourth author identified as a cis-gender, White woman in her thirties. Her research program focuses on educational equity in STEM fields.

Research team members involved in data collection made reflexive notations (e.g., Malacrida, 2007) and debriefed each other about personal perceptions and beliefs. Also, all research team members were proponents of evidence-based intervention and provided de-identified study results to research program administrators. Note that administrators provided access to participants but did not guide the research.

Design and Procedure

As mentioned earlier, the study employed a qualitative multiple case study approach, or more specifically a *descriptive-exploratory multiple case study* (Yin, 2014). This means we sought to depict women's STEM success in contemporary context to address an established problem (i.e., gender inequity in STEM) and signifies successful women in STEM as a nascent area of research (Yin, 2014). The boundaries of the case were time and sample criteria, such that participants were required to be women in STEM majors in the research program during the summer of 2017. This ensured proper alignment to prior literature on women in STEM, as well as the study's aims.

Interviews

This study was a part of a larger mixed-method project that included a longitudinal (two wave) quantitative survey as well as qualitative interviews and observations assessing variables associated with STEM persistence (e.g., STEM identity, STEM career commitment, resilience) among young adults in STEM majors. Note that a case study approach was employed to examine the qualitative data from the parent project. Participants who completed the initial (time 1) survey in the parent project could indicate an interest in being interviewed by the research team. The parent project generated 15 interviews. Of these interviews, nine were conducted with young adult college women. These nine interviews are the focus herein.

The first three authors led interviews. All but two of the interviews were conducted by two interviewers who jointly facilitated according to a semi-structured approach (e.g., Turner, 2010). The research team inquired about constructs of interest as well as participants' career journeys (see McAdams, 2001) by way of an interview protocol (Appendix A).

Interviews were audio recorded and transcribed, except when participants declined ($n = 2$), in which case interviewer notes were transcribed. Participants who declined appeared slower to warm to the interview process or uncertain about expressing opinions candidly if recorded. Participants helped to clarify and verify interview accuracy where applicable (i.e., member checks; e.g., Carlson, 2010), and interpretation was grounded in research team discussion.

Observations

The research team also conducted observations ($n = 12$ hours) in students' labs and at program events as a complete observer (Baker, 2006) according to a protocol for at least one hour.[1] Observations resulted in field notes that were later transcribed and focused on visible student behaviors aligned (or not aligned) with STEM career development (e.g., STEM abilities, coping skills). These observations were used to supplement interview data.

Summer research program administrators provided written consent for the research team to observe program events throughout the summer of 2017. Faculty advising summer research students also provided written consent for the research team to observe in their research labs/spaces. Note that faculty and students consented separately; only when both a faculty member and their requisite student consented were observations conducted as applicable.

Analytic Approach

The research team systematically coded the interview and observational data according to the procedures below.[2] In deriving findings from the dataset, the research team employed individual and cross-case analyses, whereby either a case was evaluated unto itself, or multiple cases were compared (Yin, 2014). Interview and observational data were triangulated to ensure robust findings (Yin, 2014).

Data were analyzed holistically by way of thematic analysis. Thematic analysis consists of coding for concepts in qualitative data (Braun & Clarke, 2006; Ryan & Bernard, 2003). Initially, the research team took a deductive (theory-informed) approach to coding, whereby codes and resultant themes focused on theoretical constructs such as resilience (Bradley, Curry, & Devers, 2007). Research team members individually read the entirety of the qualitative dataset. The lead author proposed a preliminary deductive coding manual that outlined deductive themes (e.g., resilience), suggested how they presented in the data, and listed examples of when a data element merited (or did not merit) a code. The research team iteratively refined the manual by individually coding 1-2 interviews, contributing theme exemplars, and discussing discrepancies.

Inductive (data-informed) coding occurred after deductive coding was complete and consisted of extracting concepts suggested by the data itself (Braun & Clarke, 2006). The team began by open-coding 1-2 interview transcripts, then met to discuss and synthesize parent codes or themes. An inductive coding manual was formed using the steps outlined for the deductive manual above.

A portion of the qualitative data set (n = 4 out of 9 interviews) was used in calculating inter-rater reliability (Cohen's kappa) for each pair of raters during the coding process. Cohen's kappa is a common method of ascertaining agreement, or the extent to which qualitative data is coded similarly or differently, across raters or coders. Greater agreement, or coding similarity, results in a kappa value closer to 1. Two additional research assistants, both women, then further contributed by reliability coding three of the four interviews. Reliability was calculated for them and coding discrepancies were resolved by discussion. Upon achieving an acceptable level of reliability, kappas across all four interviews were calculated between the lead author and one team member. The research team then coded the entire dataset. All final research team kappa values were above .75 (see Tables 2 and 3), which indicates adequate inter-rater reliability (see Syed & Nelson, 2015).

Table 2: *Inductive: Qualitative data definitions and inter-rater reliability*

Construct	Definition	Reliability (Research Team)	Reliability (Outside Coders)
Educational attitudes and opportunities	Familial beliefs or values around education, as well as the systems or opportunities that individuals have used as scaffolding to build an emerging STEM career	κ = .92 (95% CI, .87 to .98)	κ = 1.0 (95% CI, 1.0 to 1.0)

Table 3: *Deductive: Qualitative data definitions and inter-rater reliability*

Construct	Definition	Reliability (Research Team)	Reliability (Outside Coders)
Individual resilience	Personal attributes or behaviors that help individuals cope, or that they tend to rely on during STEM pursuits	κ = .91 (95% CI, .84 to .97)	κ = .67 (95% CI, .01 to 1.0)
Situational resilience	External support to aid in STEM pursuits	κ = .77 (95% CI, .67 to .86)	κ = .92 (95% CI, .77 to 1.0)

RESULTS

In the following section, data from the study will be presented and interpreted according to the research questions. Initially, we discuss two themes identifying and describing the characteristics of our sample of successful women in STEM. Next, we provide insight into the nuances of these themes per participants' demographic qualities. Both deductive and inductive findings are synthesized throughout. Refer to Table 1 for participant demographic information and Tables 2 and 3 for coding information. All participant names are pseudonyms.

Characteristics of Successful Women in STEM

Our first research question focused on the characteristics of women thriving in STEM. Findings across interviews and observations revealed two key themes: (1) educational attitudes and opportunities and (2) resilience.

Educational Attitudes and Opportunities

As shown in Table 2, *educational attitudes and opportunities* referred to women's values and beliefs around education as well as the educational entities women participated in to construct their careers in STEM. Educational attitudes and opportunities often went hand-in-hand. In other words, when women expressed beliefs related to education, they also tended to engage with career advancement opportunities. This theme presented across all interviews and co-occurred with both individual resilience (n = 5 interviews) and situational resilience (n = 7 interviews) in many of the women's experiences. Observational findings further supported the theme.

Shaina, a biology student, shared how her *educational attitudes* were shaped by those of her parents:

> My mom works at [large casino] and my dad was a bus driver. My dad had a whole bunch of different kind of jobs. He would just find jobs so

> that he could put food on the table. They complain about their type of work. They always told me, "get an education, get your degree, so you don't have to be like us."

Likewise, Sofia, a neuroscience student, discussed how her family's perspective on education influenced her experiences:

> They're [her parents] just very proud because I'm going to be the first one to actually graduate from college. So, they're proud that I'm studious. I think they were always pushing for me to be that way. At an early age, they were reading to me every night, I was really into books and I think they're just proud I stuck with a studious career.

Both women described ways in which their family communicated educational attitudes and how those attitudes shaped their own values. Pursuing a college degree was the way to alternative careers according to Shaina's parents, and Sofia's family showed pride at her academic accomplishments and urged diligence. Thus, success in STEM was synonymous with women holding a strong orientation toward pursuing higher education as instilled by their families.

Relatedly, Liliana, a neuroscience student, and Tina, an ecology student, emphasized the importance of related *educational opportunities* in their STEM career development.

> Liliana: The Summer Research [Program] looked like a really organized and cool program that could…like push me to get this project into completion. Since it kind of forces you to like submit a research paper. This was a very good opportunity to complete this project.
>
> Tina: If it weren't for [the summer research program], I'm not sure if I would have even began research…[the program] was the push to actually get a foot in the door in research...just being able to participate in these projects I got closer and closer to what I wanted to do. I also went to conferences and was able to talk to other people and see what people in the field did and see what was going on in ecology.

Liliana and Tina considered *educational opportunities* important to their STEM success. Liliana discussed program requirements such as submitting a research paper, whereas for Tina, program experiences showed her the types of scientific work possible and advanced her professional network. Participating in the summer research program provided the chance for the women to engage with research and see themselves succeeding in STEM.

Resilience

In addition to educational attitudes and opportunities, women articulated the importance of resilience relative to their STEM success.
Individual resilience occurred when women communicated or displayed personal traits that helped them overcome challenges and facilitated their STEM success (see

Table 3 for definition). In our sample, individual resilience was common across interviews (*n* = 6 interviews). Observational findings also endorsed this theme.

Minnie, a biology pre-medicine student, discussed how a combination of hard work and an optimistic perspective helped her meet her goals in STEM:

> I feel like a lot of people don't shoot high...for me I see things that I can achieve if I work hard enough…I'm like optimistic so I see the better side of things rather than telling myself "oh I can't do them it's too hard."

Similar to Minnie, Sofia discussed her ability to self-reflect and grow in light of difficulties while also taking care of herself:

> I'm learning how to identify my weaknesses and I'm learning how to identify my strengths and use them to keep growing and improving myself…Perseverance is not like a straight line of working hard. It's more like making sure you're taking enough time for self-care, you're making sure you're allowing yourself to be proud of what you do and not feel like you're not where you want to be.

Minnie believed that striving independently toward high aims coupled with being positive, helped her face obstacles. Sofia highlighted the need to reflect on her progress, as well as self-care. Taken together, these findings illustrate some of the ways in which individual resilience was an important characteristic of women's STEM success.

In contrast to individual resilience, *situational resilience* entailed reliance on external factors such as supportive individuals and/or resources to overcome barriers and succeed in STEM (see Table 3 for definition). This was a common theme throughout the interviews (*n* = 8 interviews), which observational findings also supported. Note that situational resilience with respect to educational elements (e.g., academic advisors, program features) differed from educational opportunities. Women engaged with educational opportunities to further their careers, but not as a means for overcoming challenges.

Jill, a microbiology student, described the support she received from a teaching assistant in one of her courses:

> She [teaching assistant] was a really big driving force and she's always been like "Yeah of course you can do this. You're very smart." She recommended me to be a TA for micro[biology] which was like a really big confidence booster.

Jill also discussed support from her academic counselor:

> I'd go in there and be like "I can't do this" and she'd [academic advisor] be like "I don't think you see yourself the same way other people see you." So that made a big difference.

Encouragement from both her teaching assistant and academic advisor enabled Jill to derive a sense of confidence and perspective relative to her abilities. This support enabled her STEM success.

Lastly, May, a neuroscience student, discussed how funding supported her success:

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

The summer research program stipend allowed May to overcome financial difficulties and focus more on her research. Thus, funding promoted her STEM success.

In conclusion, Jill's social supports inspired self-confidence that helped her thrive in STEM and May's funding provided the means to further her research. Such external resources contributed to women's STEM success.

Women's STEM Success Relative to Individual Backgrounds

In addressing whether the qualities of a successful woman in STEM vary relative to individual background characteristics, we leveraged the demographic diversity within our sample to assess our key themes relative to ethnicity and cultural heritage, socioeconomic status, and student status. Please refer to Table 1 for participant demographics, and Tables 2 and 3 for theme definitions.

Ethnicity and Cultural Heritage

For some women, STEM success was also influenced by their ethnicity and intersecting social categories. For example, Shaina, a Black/Filipina first-generation college student, described how the lack of ethnic/racial diversity in biology influenced her *educational attitudes and opportunities* encouraging her to succeed to pave the way for others in STEM:

> I want to start some type of change...I'm doing a graduate school search and looking at all these faculty members. I'm not disturbed that they're all white people...My PI is an old white guy and I love him to death. I don't want to let my race...discourage me from doing something I want to do. I think my biracial upbringing, because I never fit into either category, made me think "I don't care if they look like me or not…" I like being a role model. I hope to be faculty at a university, be tenure track, do research, professor, the whole shebang. I guess what inspired me to do that was being in the physics building and looking at all the professors and the postdoc scholars…and... none of them... look like me. I look black and people treat me like I'm black and if you do go to college very rarely do I ever see black people in the sciences and I guess I had this little revelation of I want to help spark the change.

Thus, for Shaina, being a multiracial woman in STEM included noticing that most of those around her were European American or White and that because she is both Filipina and African American she can fashion her own identity to support her STEM pursuits. These experiences are integral to her *educational attitudes and opportunities* in STEM because they propel her to succeed in STEM so that she can become a role model and change STEM for herself and other aspiring African American and Filipino/a scientists.

Similar to Shaina, Jimena also described experiences with *educational attitudes and opportunities* in concert with her ethnic background. Jimena was a Mexican American woman pursuing an allied health career. Having grown up partly in Mexico and partly in the United States, she conveyed strong values around education. These values were evident in her exposure to the prevalence of higher educational opportunities in Mexico, the examples set by her Mexican relatives, and the resources likely provided by her family that enabled her to delve into intensive career exploration.

With respect to education in Mexico, she mentioned: "there's only one good public university in Mexico and it's competitive, I know how hard it is to get an education there so whatever I have here I value it." Thus, education is important to Jimena because in Mexico it is a luxury.

In addition, important individuals in Jimena's family held post-secondary degrees: Jimena's mother completed a master's degree, her father studied marine biology and computer engineering, and a woman cousin was pursuing a nursing degree. Thus, her Mexican relatives communicated potent *educational attitudes* to Jimena by example, which fueled her STEM success.

Furthermore, Jimena had the resources (e.g., time, funds) to develop a fascination with cardiothoracic surgery. She described watching video clips of "2-3 aortic valve replacements a day" on YouTube while in high school. Jimena also had plans for medical school and had recently completed EKG certification at the local community college "because it involves the heart." She aspired to become a cardio-thoracic surgeon and hospital director: "I feel like I could be it [hospital director], I know I can do it, it's the challenge." Her commitment to pursuing an intense cardiac-related career illustrated the resources to have watched numerous YouTube videos and obtain EKG certification. The scarcity of college training in Mexico, combined with the examples provided by her Mexican relatives and the ways in which her background enabled her to learn about cardiac-related careers, emphasized education. To Jimena success in STEM was furthered by *educational attitudes and opportunities* informed by her cultural upbringing.

Beyond ethnicity, Jill, a European American first-generation college student, described STEM success relative to her religious background. Jill was raised "very conservative" as a "Primitive Baptist", which formed the basis for why she did not initially perceive STEM careers as feasible because "Girls don't do things in the

Baptist church." However, in contrast, she described interactions with her relatives who had science-related careers:

> On my dad's side of the family his sister...she's like in some kind of lab managing position in Washington and she's always talked about research-based science...and his brother and nephew...one of them is a computer programmer and the other one does like video game design...so watching people that I admired and considered to be successful made me think like "well I wish I was good enough to be like that!"

Thus, Jill experienced conflict between religious teachings and gender role ideology, and an interest in relatives' STEM professions which shaped her early *educational attitudes and opportunities* because she initially pursued nursing, a career aligned with gender role expectations. This set the stage for her later STEM success.

Socioeconomic Status

With respect to socioeconomic status, Jill indicated that her family of origin was "pushing middle class." This shaped her subsequent STEM experiences. For instance, while in nursing school, she gave birth to her first child, causing her to become a certified nurse assistant (CNA) which brought about financial tension: "I had been working like crummy jobs getting paid like 10 bucks an hour to do work that I hated with people that I hated. It's not stable. It's not reliable." This encouraged her to return to nursing school in pursuit of a bachelor's degree, "because you need the money. Because you're desperate for the money." She then took a microbiology class; this was the catalyst for her scientific career:

> I took micro[biology] because I figured I could go to nursing school and I loved it so I changed majors and decided to entertain the idea that maybe I can do something.

Although her enthusiasm for science propelled her into microbiology, her experiences continued to be influenced by her socioeconomic status:

> I'm considering grad school but there's always that financial concern... professors tell me like "well it doesn't matter. Your GPA is good you should be going to a funded program. You shouldn't be worried about money"…a lot of funded programs...are not designed for people like me [working parents]...there's [also] a lot of work for bachelor's degree microbiologists. So I'm considering a master's in public health... a PhD in microbiology, and ...going into the private sector to make that money.

Thus, for Jill, being a successful woman in STEM is intertwined with her socioeconomic status. Her need for financial solvency pushed her in and out of nursing coursework and influenced her decisions around pursuing graduate training or industry careers (i.e., *educational attitudes and opportunities*). Jill's socioeconomic background thus shaped her STEM success.

Student Status
Some women also indicated variations in STEM success based on whether they were traditional, nontraditional, or transfer students. Traditional students were individuals who matriculated to college right after high school; nontraditional students were individuals above the age of 24 (see Hittepole, 2019; Macari, Maples & D'Andrea, 2005); and transfer students came to the present institution via community college.

Traditional students. Liliana, a 20-year-old Latina first-generation traditional college student, revealed how attending a magnet school impacted her *educational attitudes and opportunities*:

> I went to East Career and Technical Academy and there I was majoring in the medical field. They really encouraged pursuing higher education and going to college. So, I think high school…not that it really convinced me to go to college but prepared me to go to college.

Similarly, traditional college students May, a 21-year-old Latina first-generation college student, and Tala, a 21-year-old Filipina American student, shared the influence high school peers and parents had on their *educational attitudes and opportunities*:

> May: I'm a first gen[eration] college student so I just like went to high school and everybody else around me was doing college so I was like "okay college is a good thing" and my parents were always kind of reinforcing the idea that I should go to college too so I ended up applying to [four-year institution].
>
> Tala: My dad pursued a law degree and she [her mom] was a bachelor's of science, so it was like also pressure on myself… the first year [in college] I got into nuclear med but then I switched from that and got into x-ray and radiography. I found that I'm more into the "sciencey" side…but it was like seeing them [her parents] have a higher education, I felt like I needed to pursue that as well.

Thus, women's STEM success was influenced by whether they attended college immediately following high school. Liliana's high school allowed her to explore her career interests early on which instilled strong educational attitudes. May sought higher education due to peer norms and parental support. And Tala was pushed to obtain an education like her parents. Overall, these women's experiences instilled strong *educational attitudes and opportunities* that became integral to their success in STEM as traditional college students.

Nontraditional students. With respect to nontraditional college student experiences, Jill, a 28-year-old first-generation college student and the only nontraditional student in our sample, experienced a few trials as a woman in STEM:

> When I had my first child [daughter] I kind of couldn't handle the load of working and going to school and coming home and having a baby to

> take care of. And…I was 20 so I basically like gave up on life in general and I was just like "well whatever". I'm gonna do what everybody expected, and I hated that. I was miserable all the time...When I got pregnant with my son I was like I can't do this anymore…I have to do something. So, I came back to school.

She also mentioned how her status as a nontraditional student placed her at a financial disadvantage for continuing her education:

> I'm considering grad school…but a lot of funded programs are designed for graduate students with you know no kids, parental support, maybe still live with their parents…they're not designed for people like me.

She began college as a traditional student, but the absence of outside support (i.e., *situational resilience*) added to the stress of having to take care of a child while going to school, which caused her to leave academia. Once back in school as a nontraditional student, Jill has tried to achieve in her career in concert with her goals as a parent. Thus, her ability to persevere without *situational resilience* at times, illustrated being a successful woman in STEM while a nontraditional college student.

Transfer students. Sofia, a 23-year-old Latina first-generation college student and the only transfer student in our sample, shared her experiences in STEM:

> I felt really alone and there wasn't much help [when she transferred to the four-year institution]. I had to figure everything out on my own... learning more about the resources here on campus like [the summer research program], the First Gen[eration] Club, the food pantry… I also feel no one really told me, but this was also because I transferred from [the two-year community college], that I had to have a ton of research experience to even hope to get into grad school.

Sofia discussed her initial struggle fitting in within a four-year university setting, the various resources she eventually came across on campus, as well as how community mattered. Thus, for her, being a successful woman in STEM meant making use of inner resourcefulness (i.e., *individual resilience*) and recruiting support from external sources (i.e., *situational resilience*) to thrive in STEM.

DISCUSSION

As Sofia observed, "Perseverance is not like a straight line of working hard." Consistent with her observation, findings from the current study indicated that college women's success in STEM is multifaceted. Results underscored the importance of women's educational attitudes and opportunities as well as resilience. Furthermore, these components of success were experienced differently depending upon women's ethnicity or cultural heritage, socioeconomic status, and student status. Below, both research questions will be revisited, followed by implications and study limitations.

Women's Success in STEM: Core Features

Findings demonstrated that *educational attitudes and opportunities* enabled college women's STEM success. Women discussed familial informed beliefs around the advantages of higher education and their career goals, which are themes that align with prior research. For example, positive feelings toward STEM careers are heightened when parents introduce young children to STEM activities (Dasgupta & Stout, 2014). Also, women in STEM may use their parents' encouragement as a form of motivation (McCormick, Barthelemy, & Henderson, 2014). This suggests that women's STEM success may be associated with whether a woman and her parents find higher educational and/or STEM pursuits worthwhile (see also Harackiewicz, Rozek, Hulleman, & Hyde, 2012). Our study adds nuance to these patterns by revealing familial approaches used to transmit educational attitudes. Some women described examples of "what not to do" (e.g., Shaina avoiding an hourly job), whereas other women learned "what to do" (e.g., Sofia's studiousness). These experiences informed women's values going forward.

In addition, women shared how engaging in educational opportunities, such as the STEM active learning program, gave them valuable experience to advance their careers. This dovetails with prior research indicating that educational programs can provide research opportunities that promote increased STEM participation (e.g., Ong et al., 2011). Our findings extend the literature by illustrating specific ways in which educational opportunities may benefit women succeeding in STEM, such as by providing structure around scientific deliverables (e.g., Liliana's research paper), or by offering career development experiences (e.g., Tina's networking).

In considering the role of *resilience*, the women in our sample articulated personal capabilities (e.g., Minnie's optimism and diligence; Sofia's self-awareness and self-care) as well as external supports (e.g., Jill's relationships; May's funding) as key to STEM success. Although the importance of resilience and benefits of reflective behavior have been discussed in prior work (e.g., Ellis, Carette, Anseel, & Lievens, 2014; Jackson, Firtko, & Edenborough, 2007), the current study offers new insight by demonstrating specific elements (e.g., positive attitude, goal setting, self-care, reflection on progress) that furthered women's STEM success. Future work may continue to explore these elements in successful women in STEM.

With respect to situational resilience, the current study's findings echo prior research on social support. For instance, close relationships with parents and STEM faculty influenced college women's career identities (Creamer & Laughlin, 2005). Also, college STEM students of color who received support from peers and teachers to engage in activities associated with STEM, performed better in STEM (e.g., higher academic GPA; Palmer, Maramba, & Dancy, 2011). Our findings thus concur with past results as well as illustrate other forms of situational resilience (e.g., financial resources) important to women's STEM success.

Women's Success in STEM: Moving Beyond Gender

Women in the current study described unique STEM success experiences rooted in their demographic qualities. For instance, women of color in our sample expressed strong values around higher education and an intense drive to succeed (e.g., Shaina's pursuit of a tenure-track position; Jimena's goal of leading a hospital). Shaina also emphasized helping other individuals of color enter and persist in STEM. Our findings concur with research indicating that successful women of color in STEM consider the ways in which ethnicity shapes their experiences (Carlone & Johnson, 2007). For example, women of color may pursue different STEM careers according to whether their identities as scientists are recognized and supported by the scientific community (Carlone & Johnson, 2007). Also some women of color may pursue STEM careers for altruistic reasons (Carlone & Johnson, 2007; Espinosa, 2011), and underrepresented college students may be more interested in furthering STEM careers when their research contributes to their communities (D. Thoman, Brown, Mason, Harmsen, & Smith, 2015). Our findings extend this literature by suggesting the role of cultural educational attitudes as a foundation for women's STEM success.

Student status also impacted women's STEM success. For instance, Liliana, a traditional student, attended secondary school that prepared her for college achievement. This aligns with existing research on STEM persistence among students of color (Palmer, Maramba, & Dancy, 2011). For our nontraditional student, Jill, social class and finances shaped her present and anticipated STEM pursuits. This corroborates prior research in that women with more economic means may be more likely to pursue STEM graduate study (McCormick, Barthelemy, & Henderson, 2014). Finally, Sofia described the challenges inherent in the transfer student experience, which echoes existing research (e.g., Packard, Gagnon, LaBelle, Jeffers, & Lynn, 2011; Reyes, 2011; Wang, 2013; Wickersham & Wang, 2016). In sum, findings from the current study illustrate the importance of examining the variation in women's experiences to develop a holistic understanding of STEM success.

Implications for Theory

The current study's findings enrich existing theoretical models by revealing individual and system/contextual level features of women's STEM success. For instance, social-cognitive career theory (Lent, Brown, & Hackett, 1994), expectancy-value theory (Wigfield & Eccles, 2000), and Super's (1980) life-space life-span model all propose that personal and environmental inputs shape career outcomes. Our study suggests the role of a woman's personal resilience and educational attitudes as individual level inputs; situational resilience and educational opportunities function as contextual career components.

With respect to anti-deficit models (e.g., Harper, 2010), our study illuminates factors that contribute to women's STEM achievement. For instance, participating in a research program (educational opportunities) and having financial resources (situational resilience) fit within the college achievement portion of Harper's (2010) model. In addition, our study illustrates the ways in which women, particularly women of color, leverage their backgrounds to further their career pursuits (e.g., Shaina, Jimena). This speaks to Yosso's (2005) cultural wealth framework and the idea that characteristics such as ethnicity and race can enable individuals to excel in unique ways. It also supports re-evaluating STEM career counseling provided to underrepresented individuals in light of affordances versus decrements (Byars-Winston, 2014).

In addition, although research tends to consider resilience as *either* trait-based *or* situational (e.g., Connor & Davidson, 2003; Davydov, Stewart, Ritchie, & Chaudieu, 2010), our study suggests that both forms are important to women's success in STEM. However, there are also limitations associated with focusing on resilience. Namely, strengthening resilience among women in STEM is unlikely to rectify the systemic forces (e.g., sexism) that perpetuate gender inequality in STEM. Prior research points to many individual-level variables implicated in women's experiences in STEM such as self-efficacy and self-concept (e.g., Eccles, 2011; Stout, Dasgupta, Hunsinger, & McManus, 2011) or mindset (e.g., Stout & Blaney, 2017). These findings, as well as our own, could be used inappropriately to argue that the solution to women's underrepresentation in STEM is to alter said characteristics in women. However, effective STEM recruitment and retention programs targeting college women employed a combination of STEM skill development and social-structural awareness, while advocating for change in STEM cultural norms (Fox, Sonnert, & Nikiforova, 2009; 2011; see also Ovink & Veazey, 2011). This suggests the need for a coordinated approach whereby women (and men) in STEM seek to develop individual abilities, such as resilience, alongside the awareness and skills required to shift STEM cultural norms.

Implications for Practice

The women in our study worked closely with faculty, graduate students, and others throughout their summer research activities. Some participants considered these individuals critical to their STEM success. This relates to existing research on STEM role models. For instance, women STEM students had higher course grades after reading a letter from a woman role model (Herrmann et al., 2016). Also, the ability to identify with women in particular STEM fields may contribute to the desire for budding women scientists to become role models themselves (e.g., Morganson, Major, Streets, Litano, & Myers, 2015). In our study Shaina indicated the goal of becoming a role model. This suggests benefits of providing students access to women faculty or other STEM professionals who are also from other underrepresented groups, to galvanize student's STEM success.

In addition, the women herein also identified individual resilience factors within themselves (e.g., Minnie's optimism) that helped them thrive in STEM. Some research suggests that resilience can be learned and may benefit women (and men) in facing workplace adversity in STEM-related professions (e.g., healthcare; McAllister & McKinnon, 2009). However, further research is needed. In addition, note that although resilience may facilitate STEM success, it is also important to shift the cultural norms and systemic constraints promoting gender inequality in STEM.

Limitations and Future Directions

Findings from the current study should be interpreted in light of various limitations. For instance, the cross-sectional (i.e., single time-point) case study design precludes an analysis of whether and how women recruit educational attitudes, opportunities, or resilience differently over the course of their career trajectories. Prior longitudinal qualitative work followed women in STEM over many years (Carlone & Johnson, 2007). This work was able to demonstrate the ways in which college experiences informed women's later career outcomes and choices to pursue various STEM professions.

Also, our sample was limited to one nontraditional college student (Jill), who discussed experiences pertaining to religion and socioeconomic status. Jill's case is representative of the number of nontraditional students within our parent project sample and the broader research program, and she provides a distinct and important voice. Although some traditional students in our sample also mentioned financial topics, such as research funding (i.e., May - situational resilience) or pursuing an economically viable career (i.e., Shaina - educational attitudes), traditional students did not discuss religion. Future research could expound upon these topics to further investigate their role in women's STEM success relative to student status.

Finally, our sample consisted of women in the life and health sciences as well as neuroscience. Research indicates that women's representation varies across STEM fields, with more women in the life, health, and social sciences and fewer women in math-intensive fields (e.g., Meyer, Cimpian, & Leslie, 2015; Wang & Degol, 2017). This may impact women's career development and success experiences in notable ways. For instance, research suggests that stereotypes associated with the perceived culture in computer science and engineering may dissuade women from entering those fields (Cheryan, Master, & Meltzoff, 2015; Robnett, 2016). Thus, although our data suggest that the experiences of women herein may relate to those of women in other sociocultural contexts or in math-intensive STEM disciplines, more research is needed to determine whether STEM success differs along those dimensions.

CONCLUSION

Although research implicates many barriers to women's achievement in STEM, this study is one of the first to illustrate two key characteristics in college women's STEM success: (1) educational attitudes and opportunities and (2) resilience. Women also shared critical career development insight based on their diverse identities, illustrating how STEM success can vary in meaningful, nuanced ways. Taken together, these findings extend the literature by focusing on what may facilitate women's STEM success. Results also provide a basis for future empirical and applied work investigating women's experiences throughout the STEM pipeline.

ENDNOTES

1. Please contact the lead author for a copy of the observation protocol
2. Please contact the lead author for a copy of the coding manual

REFERENCES

Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. *American Psychologist, 55*(5), 469-480. https://doi.org/10.1037//0003-066X.55.5.469

Baker, L. (2006). Observation: A complex research method. *Library Trends, 55*(1), 171-189. https://doi.org/10.1353/lib.2006.0045

Blaney, J. M. (2018). Looking beyond representation: How women develop their leadership perceptions during the introductory computing course. In *Proceedings of the 49th ACM Technical Symposium on Computer Science Education* (pp. 453-458). ACM. https://doi.org/10.1145/3159450.3159458

Blickenstaff, J. C. (2005). Women and science careers: Leaky pipeline or gender filter? *Gender and Education, 17*(4), 369-386. https://doi.org/10.1080/09540250500145072

Bradley, E. H., Curry, L. A., & Devers, K. J. (2007). Qualitative data analysis for health services research: Developing taxonomy, themes, and theory. *Health Services Research, 42*(4), 1758-1772. https://doi.org/10.1111/j.1475-6773.2006.00684.x

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77-101. https://doi.org/10.1191/1478088706qp063oa

Byars-Winston, A. (2014). Toward a framework for multicultural STEM-focused career interventions. *The Career Development Quarterly, 62*(4), 340-357. https://doi.org/10.1002/j.2161-0045.2014.00087.x

Carlone, H. B., & Johnson, A. (2007). Understanding the science experiences of successful women of color: Science identity as an analytic lens. *Journal of Research in Science Teaching, 44*(8), 1187-1218. https://doi.org/10.1002/tea.20237

Carlson, J. A. (2010). Avoiding traps in member checking. *The Qualitative Report, 15*(5), 1102-1113. Retrieved from https://nsuworks.nova.edu/tqr/vol15/iss5/4

Cheryan, S., Master, A., & Meltzoff, A. N. (2015). Cultural stereotypes as gatekeepers: Increasing girls' interest in computer science and engineering by diversifying stereotypes. *Frontiers in Psychology, 6*, 49. https://doi.org/10.3389/fpsyg.2015.00049

Clauss-Ehlers, C. S. (2008). Sociocultural factors, resilience, and coping: Support for a culturally sensitive measure of resilience. *Journal of Applied Developmental Psychology, 29*(3), 197-212. https://doi.org/10.1016/j.appdev.2008.02.004

Connor, K. M., & Davidson, J. R. (2003). Development of a new resilience scale:

The Connor-Davidson resilience scale (CD-RISC). *Depression and Anxiety, 18*(2), 76-82. https://doi.org/10.1002/da.10113

Creamer, E. G., & Laughlin, A. (2005). Self-authorship and women's career decision making. *Journal of College Student Development, 46*(1), 13-27. https://doi.org/10.1353/csd.2005.0002

Creswell, J. W. (2013). *Qualitative inquiry and research design: Choosing among five approaches* (3rd ed.). Thousand Oaks, CA: Sage.

Dasgupta, N., & Stout, J. G. (2014). Girls and women in science, technology, engineering, and mathematics: STEMing the tide and broadening participation in STEM careers. *Policy Insights from the Behavioral and Brain Sciences, 1*(1), 21-29. https://doi.org/10.1177/2372732214549471

Davydov, D. M., Stewart, R., Ritchie, K., & Chaudieu, I. (2010). Resilience and mental health. *Clinical Psychology Review, 30*(5), 479-495. https://doi.org/10.1016/j.cpr.2010.03.003

Diekman, A. B., Brown, E. R., Johnston, A. M., & Clark, E. K. (2010). Seeking congruity between goals and roles: A new look at why women opt out of science, technology, engineering, and mathematics careers. *Psychological Science, 21*(8), 1051-1057. https://doi.org/10.1177/0956797610377342

Dika, S. L., & D'Amico, M. M. (2016). Early experiences and integration in the persistence of first-generation college students in STEM and non-STEM majors. *Journal of Research in Science Teaching, 53*(3), 368-383. https://doi.org/10.1002/tea.21301

Eccles, J. (2011). Gendered educational and occupational choices: Applying the Eccles et al. model of achievement-related choices. *International Journal of Behavioral Development, 35*(3), 195-201. https://doi/org/10.1177/0165025411398185

Ellis, S., Carette, B., Anseel, F., & Lievens, F. (2014). Systematic reflection: Implications for learning from failures and successes. *Current Directions in Psychological Science, 23*(1), 67-72. https://doi.org/10.1177/0963721413504106

Ellis, J., Fosdick, B. K., & Rasmussen, C. (2016). Women 1.5 times more likely to leave STEM pipeline after calculus compared to men: Lack of mathematical confidence a potential culprit. *PloS One, 11*(7), e0157447. https://doi.org/10.1371/journal.pone.0157447

Espinosa, L. (2011). Pipelines and pathways: Women of color in undergraduate STEM majors and the college experiences that contribute to persistence. *Harvard Educational Review, 81*(2), 209-241. https://doi.org/10.17763/haer.81.2.92315ww157656k3u

Fox, M. F., Sonnert, G., & Nikiforova, I. (2009). Successful programs for undergraduate women in science and engineering: Adapting versus adopting the institutional environment. *Research in Higher Education, 50*(4), 333-353. https://doi.org/10.1007/s11162-009-9120-4

Fox, M. F., Sonnert, G., & Nikiforova, I. (2011). Programs for undergraduate women in science and engineering: Issues, problems, and solutions. *Gender & Society, 25*(5), 589-615. https://doi.org/10.1177/0891243211416809

Fischer, S. (2017). The downside of good peers: How classroom composition differentially affects men's and women's STEM persistence. *Labour Economics, 46*, 211-226. https://doi.org/10.1016/j.labeco.2017.02.003

Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings of the National Academy of Sciences, 111*(23), 8410-8415. https://doi.org/10.1073/pnas.1319030111

Graham, M. J., Frederick, J., Byars-Winston, A., Hunter, A. B., & Handelsman, J. (2013). Increasing persistence of college students in STEM. *Science, 341*(6153), 1455-1456. https://doi.org/10.1126/science.1240487

Handelsman, J., & Smith, M. (2016, February). STEM for all. Obama White House Archives. Washington, D.C. Retrieved from https://obamawhitehouse.archives.gov/blog/2016/02/11/stem-all

Halpern, D. F., Benbow, C. P., Geary, D. C., Gur, R. C., Hyde, J. S., & Gernsbacher, M. A. (2007). The science of sex differences in science and mathematics. *Psychological Science in the Public Interest, 8*(1), 1-51. https://doi.org/10.1111/j.1529-1006.2007.00032.x

Harackiewicz, J. M., Rozek, C. S., Hulleman, C. S., & Hyde, J. S. (2012). Helping parents to motivate adolescents in mathematics and science: An experimental test of a utility-value intervention. *Psychological Science, 23*(8), 899-906. https://doi.org/10.1177/0956797611435530

Harper, S. R. (2010). An anti-deficit achievement framework for research on students of color in STEM. *New Directions for Institutional Research, 148*(148), 63-74. https://doi.org/10.1002/ir.362

Harrison, M., Dunbar, D., Ratmansky, L., Boyd, K., & Lopatto, D. (2011). Classroom-based science research at the introductory level: Changes in career choices and attitude. *CBE-Life Sciences Education, 10*(3), 279-286. https://doi.org/10.1187/cbe.10-12-0151

Herrmann, S. D., Adelman, R. M., Bodford, J. E., Graudejus, O., Okun, M. A., & Kwan, V. S. (2016). The effects of a female role model on academic performance and persistence of women in STEM courses. *Basic and Applied Social Psychology, 38*(5), 258-268. https://doi.org/10.1080/01973533.2016.1209757

Hittepole, C. (2019). Nontraditional students: Supporting changing student populations. Retrieved from: www.naspa.org/images/uploads/main/Hittepole_NASPA_Memo.pdf

Holdren, J. P., & Lander, E. (2012). Report to the President—Engage to excel: Producing one million additional college graduates with degrees in science, technology, engineering, and mathematics. *President's Council of Advisors on*

Science and Technology. Retrieved from https://files.eric.ed.gov/fulltext/ED541511.pdf

Jackson, D., Firtko, A., & Edenborough, M. (2007). Personal resilience as a strategy for surviving and thriving in the face of workplace adversity: A literature review. *Journal of Advanced Nursing, 60*(1), 1-9. https://doi.org/10.1111/j.1365-2648.2007.04412.x

Johnson, D. R. (2011). Women of color in science, technology, engineering, and mathematics (STEM). *New Directions for Institutional Research, 2011*(152), 75-85. https://doi.org/10.1002/ir.410

Kanny, M. A., Sax, L. J., & Riggers-Piehl, T. A. (2014). Investigating forty years of STEM research: How explanations for the gender gap have evolved over time. *Journal of Women and Minorities in Science and Engineering, 20(*2), 127-148. https://doi.org/ 10.1615/JWomenMinorScienEng.2014007246

Koizumi, K. (2015, February 2). Investing in America's future through R&D, innovation, and STEM education: The President's FY 2016 budget. Retrieved from https://www.whitehouse.gov/blog/2015/02/02/investing-america-s-future-through-rd-innovation-and-stem-education-president-s-fy-2

Landivar, L. C. (2013). Disparities in STEM employment by sex, race, and Hispanic origin. *Education Review, 29*(6), 911-922. Retrieved from https://www.census.gov/prod/2013pubs/acs-24.pdf

Lent, R. W., Brown, S. D., & Larkin, K. C. (1984). Relation of self-efficacy expectations to academic achievement and persistence. *Journal of Counseling Psychology, 31*(3), 356-362. http://dx.doi.org/10.1037/0022-0167.31.3.356

Lent, R. W., Brown, S. D., & Hackett, G. (1994). Toward a unifying social cognitive theory of career and academic interest, choice, and performance. *Journal of Vocational Behavior, 45*(1), 79-122. https://doi.org/10.1006/jvbe.1994.1027

Macari, D. P., Maples, M. F., & D'Andrea, L. (2005). A comparative study of psychosocial development in nontraditional and traditional college students. *Journal of College Student Retention: Research, Theory & Practice, 7*(3), 283-302. https://doi.org/10.2190/BV5H-3630-18CU-6C3B

Madewell, A. N., & Ponce-Garcia, E. (2016). Assessing resilience in emerging adulthood: The Resilience Scale (RS), Connor–Davidson Resilience Scale (CD-RISC), and Scale of Protective Factors (SPF). *Personality and Individual Differences, 97*, 249-255. https://doi.org/10.1016/j.paid.2016.03.036

Malacrida, C. (2007). Reflexive journaling on emotional research topics: Ethical issues for team researchers. *Qualitative Health Research, 17*(10), 1329-1339. https://doi.org/10.1177/1049732307308948

McAdams, D. P. (2001). The psychology of life stories. *Review of General Psychology, 5*(2), 100-122. https://doi.org/10.1037/1089-2680.5.2.100

McAllister, M., & McKinnon, J. (2009). The importance of teaching and learning resilience in the health disciplines: A critical review of the literature. Nurse

Education Today, 29(4), 371-379. https://doi.org/10.1016/j.nedt.2008.10.011

McLean, K. C., & Pratt, M. W. (2006). Life's little (and big) lessons: Identity statuses and meaning-making in the turning point narratives of emerging adults. *Developmental Psychology, 42*(4), 714-722. http://dx.doi.org/10.1037/0012-1649.42.4.714

McCormick, M., Barthelemy, R. S., & Henderson, C. (2014). Women's persistence into graduate astronomy programs: The roles of support, interest, and capital. *Journal of Women and Minorities in Science and Engineering, 20*(4), 317-340. https://doi.org/10.1615/JWomenMinorScienEng.2014009829

Meyer, M., Cimpian, A., & Leslie, S. J. (2015). Women are underrepresented in fields where success is believed to require brilliance. *Frontiers in Psychology, 6*, 235. https://doi.org/10.3389/fpsyg.2015.00235

Morganson, V. J., Jones, M. P., & Major, D. A. (2010). Understanding women's underrepresentation in science, technology, engineering, and mathematics: The role of social coping. *The Career Development Quarterly, 59*(2), 169-179. https://doi.org/10.1002/j.2161-0045.2010.tb00060.x

Morganson, V. J., Major, D. A., Streets, V. N., Litano, M. L., & Myers, D. P. (2015). Using embeddedness theory to understand and promote persistence in STEM majors. *The Career Development Quarterly, 63*(4), 348-362. https://doi.org/10.1002/cdq.12033

Moss-Racusin, C. A., Dovidio, J. F., Brescoll, V. L., Graham, M. J., & Handelsman, J. (2012). Science faculty's subtle gender biases favor male students. *Proceedings of the National Academy of Sciences, 109(41)*, 16474-16479. https://doi.org/10.1073/pnas.1211286109

National Science Foundation: STEM Education Data. (2014). What kinds of degrees do workers in S&E occupations have? [Data file]. Retrieved from https://www.nsf.gov/nsb/sei/edTool/index.html

Ong, M., Wright, C., Espinosa, L., & Orfield, G. (2011). Inside the double bind: A synthesis of empirical research on undergraduate and graduate women of color in science, technology, engineering, and mathematics. *Harvard Educational Review, 81*(2), 172-209. https://doi.org/10.17763/haer.81.2.t022245n7x4752v2

Ovink, S. M., & Veazey, B. D. (2011). More than "getting us through:" A case study in cultural capital enrichment of underrepresented minority undergraduates. *Research in Higher Education, 52*(4), 370-394. https://doi.org/10.1007/s11162-010-9198-8

Packard, B. W. L., Gagnon, J. L., LaBelle, O., Jeffers, K., & Lynn, E. (2011). Women's experiences in the STEM community college transfer pathway. *Journal of Women and Minorities in Science and Engineering, 17*(2). https://doi.org/10.1615/JWomenMinorScienEng.2011002470

Palmer, R. T., Maramba, D. C., & Dancy, T. E. (2011). A qualitative investigation of factors promoting the retention and persistence of students of color in STEM. *The*

Journal of Negro Education, 80(4), 491-504. Retrieved from: https://www.jstor.org/stable/41341155

Reyes, M. E. (2011). Unique challenges for women of color in STEM transferring from community colleges to universities. *Harvard Educational Review, 81*(2), 241-263. https://doi.org/10.17763/haer.81.2.324m5t1535026g76

Robnett, R. D. (2016). Gender bias in STEM fields variation in prevalence and links to STEM Self-Concept. *Psychology of Women Quarterly, 40*(1), 65-79. https://doi.org/10.1177/0361684315596162

Robnett, R. D., & Thoman, S. E. (2017). STEM success expectancies and achievement among women in STEM majors. *Journal of Applied Developmental Psychology, 52*, 91-100. https://doi.org/10.1016/j.appdev.2017.07.003

Ryan, G. W., & Bernard, H. R. (2003). Techniques to identify themes. *Field Methods, 15*(1), 85-109. https://doi.org/10.1177/1525822X02239569

Seligman, M. E., & Csikszentmihalyi, M. (2000). Positive psychology: An introduction. *American Psychologist, 55*(1), 5-14. https://doi.org/10.1037//0003-066X.55.1.5

Settles, I. H., Cortina, L. M., Buchanan, N. T., & Miner, K. N. (2012). Derogation, discrimination, and (dis) satisfaction with jobs in science: A gendered analysis. *Psychology of Women Quarterly, 37*(2), 179-191. https://doi.org/10.1177/0361684312468727

Settles, I. H., Cortina, L. M., Malley, J., & Stewart, A. J. (2006). The climate for women in academic science: The good, the bad, and the changeable. *Psychology of Women Quarterly, 30*(1), 47-58. https://doi.org/10.1111/j.1471-6402.2006.00261.x

Shapiro, J. R., & Williams, A. M. (2012). The role of stereotype threats in undermining girls' and women's performance and interest in STEM fields. *Sex Roles, 66*(3-4), 175-183. https://doi.org/10.1007/s11199-011-0051-0

Stout, J. G., & Blaney, J. M. (2017). "But it doesn't come naturally": How effort expenditure shapes the benefit of growth mindset on women's sense of intellectual belonging in computing. *Computer Science Education, 27*(3-4), 215-228. https://doi.org/10.1080/08993408.2018.1437115

Stout, J. G., Dasgupta, N., Hunsinger, M., & McManus, M. A. (2011). STEMing the tide: using ingroup experts to inoculate women's self-concept in science, technology, engineering, and mathematics (STEM). *Journal of Personality and Social Psychology, 100*(2), 255-270. http://dx.doi.org/10.1037/a0021385

Super, D. E. (1980). A life-span, life-space approach to career development. *Journal of Vocational Behavior, 16*(3), 282-298. https://doi.org/10.1016/0001-8791(80)90056-1

Syed, M., & Nelson, S. C. (2015). Guidelines for establishing reliability when coding narrative data. *Emerging Adulthood, 3*(6), 375-387. https://doi.org/10.1177/2167696815587648

The White House Office of Science and Technology Policy (2018). Summary of the 2018 White House State Federal STEM Education. Washington, DC. Retrieved from https://www.whitehouse.gov/wp-content/uploads/2018/06/Summary-of-the-2018-White-House-State-Federal-STEM-Education-Summit.pdf

Thoman, D. B., Brown, E. R., Mason, A. Z., Harmsen, A. G., & Smith, J. L. (2015). The role of altruistic values in motivating underrepresented minority students for biomedicine. *BioScience, 65*(2), 183-188. https://doi.org/10.1093/biosci/biu199

Turner III, D. W. (2010). Qualitative interview design: A practical guide for novice investigators. *The Qualitative Report, 15*(3), 754-760. Retrieved from https://nsuworks.nova.edu/tqr/vol15/iss3/19

Wang, M. T., & Degol, J. L. (2017). Gender gap in science, technology, engineering, and mathematics (STEM): Current knowledge, implications for practice, policy, and future directions. *Educational Psychology Review, 29*(1), 119-140. https://doi.org/10.1007/s10648-015-9355-x

Wigfield, A. & Eccles, J. S. (2000) Expectancy–value theory of achievement motivation. *Contemporary Educational Psychology, 25*(1), 68-81. https://doi.org/10.1006/ceps.1999.1015

Witherspoon, E. B., Vincent-Ruz, P., & Schunn, C. D. (2019). When making the grade isn’t enough: The gendered nature of premed science course attrition. *Educational Researcher*, *48*(4), 193-204. https://doi.org/10.3102/0013189X19840331

Wood, W., & Eagly, A. H. (2002). A cross-cultural analysis of the behavior of women and men: Implications for the origins of sex differences. *Psychological Bulletin, 128*(5), 699-727. https://doi.org/10.1037/0033-2909.128.5.699

Yin, R. K. (2014). *Case study research: Design and methods* (5th ed.). Thousand Oaks, CA: Sage.

Yosso, T. J. (2005). Whose culture has capital? A critical race theory discussion of community cultural wealth. *Race Ethnicity and Education, 8*(1), 69-91. https://doi.org/10.1080/1361332052000341006

Appendix A: 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., Research Lab, empty 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

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.

1. 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?

2. Career story:

- Tell me what led to you to college and your field of study (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).

3. Resilience in context:
- 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?
- Probe for resilience traits, strategies, self–insight (Davydov et al., 2010; Clauss-Ehlers, 2008).

4. 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