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CONNECTIONS MATTER: ACCESSING INFORMATION ABOUT EDUCATION AND CAREERS IN STEM

Julie J. Park,[1,*] Cinthya Salazar,[2] Roshan M. Parikh,[1] Jia Zheng,[1] Arman M. Liwanag,[3] & Leigh Dunewood[1]

[1]*University of Maryland, College Park, 3214 Benjamin Building, College Park, MD 20742*

[2]*Texas A&M University, 511 Harrington Tower, 4226 TAMU, College Station, TX 77843-4226*

[3]*San Francisco State University, 1600 Holloway Avenue, Administration Building 211, San Francisco, CA 94132*

*Address all correspondence to: Julie J. Park, PhD, University of Maryland, College Park, 3214 Benjamin Building, College Park, MD 20742; Tel.: +301-405-7998; Fax: +301-405-9995, E-mail: parkjj@umd.edu

This study examines experiences with social ties for individuals in science, technology, engineering, and math (STEM), and how these experiences vary by race and gender. Using case study methodology, we interviewed 40 working professionals in the greater Washington, DC, area. We used inductive and deductive coding as well as cross-case analysis to analyze the findings. Participants reflected on how different social ties facilitated the exchange of information around academic or professional opportunities as well as challenges to social tie formation. The findings showed that strong social ties were facilitated through ethnic support communities, friendships, and on rare occasions faculty; weak ties were associated with academic sources, student organizations, and acquaintances. However, women and people of color uniquely experienced barriers to social tie formation. We highlight the importance of directly addressing the multiple inequities that women of color, in particular, are subject to regarding network formation, as well as the need for race-conscious policies to pursue a critical mass of people of color in STEM.

KEY WORDS: *STEM, social ties, social capital, inequality, race, gender, case study*

1. INTRODUCTION

As the famous saying about social connections goes, "It's not what you know, but who you know." Research on science, technology, engineering, and math (STEM) settings highlights the significance of various types of relationships, including those with faculty, mentors, support organizations, and peers (Cole and Griffin, 2013; Mondisa, 2020; White et al., 2006). Such relationships are especially critical for women and people of color because negative interactions can negatively affect retention both in educational spaces (Carlone and Johnson, 2007; Ko et al., 2013; Park et al., 2020b) and the STEM working world (Sassler et al., 2017). However, questions remain regarding how individuals actually gain concrete information through their social connections, particularly in the area of professional advancement. How do people in STEM navigate the next

steps of learning about opportunities either during college or once they have earned their degrees, and who supports them in these endeavors?

Research indicates that both close relationships (e.g., friends and mentors) (see, for example, Grandy, 1998; Mondisa, 2020) and more casual acquaintanceships (i.e., weak social ties) influence educational and professional advancement (Granovetter, 1973; Martin et al., 2013; Murray et al., 1981). However, not many works on weak social ties and information about employment have focused specifically on STEM environments, leaving a dearth of insight about how people in STEM actually find out about professional opportunities. Furthermore, few studies have addressed how exclusion affects the ability of people of color and White women to form and access social networks in STEM, which in turn influences access to information circulated within networks of social ties.

Utilizing case study methodology, we examine these issues within a racially diverse sample of 40 STEM working professionals in the Washington, DC, region, all of whom have at minimum an undergraduate degree in STEM. We report their experiences from both higher education and the working world in order to highlight the influence of both settings on social ties in STEM. We address the following questions. What roles do more casual acquaintances (weak ties) versus closer relationships (strong ties) play in how individuals working in STEM access (or have accessed) information and opportunities around academic or career advancement? How do patterns vary by race/ethnicity and gender?

1.1 Literature Review

Given our interest in how social ties affect how individuals in STEM access information, we first address research on relationships in STEM higher education settings; we then discuss research on the postgraduate pathways of STEM graduates and corresponding inequality.

2. SOCIAL TIES AND RELATIONSHIPS IN STEM CONTEXTS

The relationships students establish before and during college can influence whether a student succeeds as a STEM major and later in the workforce (Martin et al., 2013). Within STEM education, relationships fostered through student–faculty interactions are important for students' growth and development (Cole and Espinosa, 2008; Cole and Griffin, 2013; Mondisa, 2020). Through these relationships, students ideally gain access to resources such as letters of recommendation or information about opportunities (Stanton-Salazar, 1997). Graduate students in STEM particularly benefit from student–faculty ties since professors look to help develop future faculty in their fields (MacLachlan, 2006; Waldeck et al., 1997), preparing protégés for careers in academia or industry (Pruitt-Logan et al., 2002). However, students of color often experience racial inequities in interactions with faculty (Chang et al., 2011; Espinosa, 2011). For example, students of color enrolled at predominantly White institutions viewed STEM faculty as unsup-

portive, emotionally disconnected, and unapproachable (Park et al., 2020a; Hurtado et al., 2011). Underrepresented students of color, in particular, have challenges finding mentors from similar backgrounds due to the lack of diversity among STEM faculty (Salazar et al., 2020).

Key challenges also impede the formation of positive social ties among peers across demographic lines (Burt et al., 2018). The challenging racial climate within STEM departments and broader institutions strains the ability of students from different backgrounds to form positive relationships, both close and casual (Amelink and Creamer, 2010; Dortch and Patel, 2017; Johnson, 2012). Students of color can be shut out of study groups or other informal socializing that facilitates social tie formation (Burt et al., 2018; Justin-Johnson, 2004). Female students, both White and women of color, can also experience exclusion or negative treatment that undermines positive social ties (Amelink and Creamer, 2010; Ong et al., 2011).

Broader demographic factors at both the institutional and departmental level affect social tie formation. Extensive research documents that positive cross-racial interaction, which is linked with a wide array of benefits (Bowman and Park, 2014), is more likely to happen at institutions with higher levels of racial heterogeneity in the student body (Park et al., 2013). However, an institution with broader racial diversity can still lack diversity within certain departments (such as those in STEM), leading to an environment of marginalization and strained intergroup relations and limiting cross-racial social tie formation (McGee, 2013; Strayhorn et al., 2013). Furthermore, in a more homogeneous department and/or institution, majority-status students (i.e., White males) have more demographic opportunities to connect with same-race peers versus crossing racial boundaries (Park, 2013), limiting the ability of students to form diverse networks. Underrepresented students of color may join affinity group organizations [e.g., National Society of Black Engineers (NSBE)] that provide job information and same-race peer support, but may still face challenges to forming interracial social networks that could expand their access to information.

2.1 Post-Graduation Pathways and Inequality among STEM Graduates

The aforementioned inequities continue into the workforce, as reflected in high rates of attrition from STEM. Overall, the percentage of women working in STEM is much lower than the percentage of women who have received STEM degrees (Xie and Shauman, 2003), and women with STEM degrees have substantially lower wages compared with their male counterparts within the industry sector (Buffington et al., 2016). Similarly, the percentage of STEM graduates of color who work in jobs unrelated to their majors is higher than their White counterparts (Melguizo and Wolniak, 2012; Xu, 2013). Women and people of color face multiple systemic barriers to forming positive social ties with coworkers and/or supervisors (Raabe and Beehr, 2003), hindering opportunities for mentorship and positive social ties.

For women of all races, workplace policies often do not offer adequate support for parental leave and other family responsibilities, an inequity especially evident during

the coronavirus pandemic (Taub, 2020). Unsupportive supervisors and tokenization may also foster a negative climate (Fouad et al., 2011, 2016). People of color may experience harassment and bullying, and/or may be bypassed for promotions (Noon and Hoque, 2001). In engineering, underrepresented minorities are less likely to advance than White counterparts due to bias in the hiring and promotion process, a lack of access to workplace connections, stereotype threat, and other forms of racism (Hofacker, 2014). Black scientists not only experience disparities in pay, but their scholarship is cited less frequently, impeding career advancement (Ladyzhets, 2020).

In particular, women of color experience compounded isolation and marginalization due to the intersections of gender and race (Rice and Alfred, 2014). The underrepresentation of women of color in various STEM work environments makes them vulnerable to tokenization. Women of color face double jeopardy in a hostile workplace climate, reporting experiences of racial and sexual harassment, blatant racism and sexism, microaggressions, and stereotype threat (Buzzanell et al., 2015; Flores, 2018; Johnson et al., 2017). Obiomon et al. (2007) found that, due to being the only one or one of a few, African American women in STEM experienced heightened visibility with their performance being magnified and overly scrutinized. Women of color also experience additional barriers to accessing advice, informal peer networks, and mentors, which further hinders career advancement (Alfred et al., 2019; Johnson et al., 2017; Obiomon et al., 2007).

While the literature documents key inequities in STEM graduates' postgraduate experiences and outcomes, less research has examined the mechanisms contributing to disparities. One potential contributing factor is inequality affecting how individuals are able to build social networks that support educational and/or career advancement. However, existing research does not generally distinguish between weak versus strong social ties in STEM or address variations that exist based on social identity. Thus, in this study we ask: What roles do more casual acquaintances (weak ties) versus closer relationships (strong ties) play in how individuals working in STEM access (or have accessed) information and opportunities around academic or career advancement? How do patterns vary by race/ethnicity and gender?

2.2 Theoretical Influence

In this study, we utilize the theoretical concept of social ties to examine how such ties influence access to information about opportunities and corresponding inequality (Granovetter, 1973; Murray et al., 1981). We are interested in how the connections that individuals develop during their education or the workplace facilitate access to information and opportunities in STEM. Conversely, we seek to document whether and how women and people of color face unique challenges to forming and/or fostering social ties, and implications for their ability to access certain social networks and information. Social ties are critical because they make up the foundation of social capital—the resources and information exchanged within networks of social relationships (Bourdieu, 1986; Martin, 2015). Such networks are critical to educational and professional advancement, but are not accessible to all populations (Mondisa, 2020; Park, 2012).

A key characteristic of social ties is *tie strength*, which refers to the nature or strength of a relationship or contact, with weak ties being characterized by more casual contacts and acquaintanceships and strong ties referring to closer, more sustained relationships (Granovetter, 1973; Murray et al., 1981). The concept of tie strength is important because different types of social ties may lead to divergent outcomes for individuals, and over-reliance on one type of social tie can limit opportunity for mobility (Lin et al., 1981; McCabe, 2016). Despite the negative connotation of the word "weak," having a high amount of weak ties can help individuals access a greater amount of non-redundant information, which is helpful to those seeking multiple perspectives on a topic or potential job referrals (Granovetter, 1973). Racially diverse networks are often primarily composed of weak ties (Clarke and Antonio, 2012), and diverse professional networks are advantageous for encountering different and non-redundant sources of information and advice related to career advancement (Niehaus and O'Meara, 2015). These networks are especially critical for people of color and women (Martin, 2015; Martin et al., 2013). The benefits linked with cross-racial interaction in campus settings also reflects the gains derived from weak ties (Bowman and Park, 2014; Clarke and Antonio, 2012).

However, multiple challenges exist to encouraging positive cross-racial relationships and social ties, strong or weak, within STEM, given the negative racial climate in academia and the workplace (Beasley and Fischer, 2012; Hurtado et al., 2011; Ong et al., 2011). For instance, a student of color could have close relationships with friends and family (strong ties), but have difficulty forming a broader academic and professional network of weak ties (McCabe, 2016). During college, studies indicate that students of color—and, in particular, Black students—have difficulty joining study groups and forming positive peer relationships given their extreme minority status (Johnson, 2012). Thus, an individual could become boxed-in by a lack of weak social ties, having less access to social capital and information that could lead to professional advancement. Maintaining a network of weak social ties related to one's professional field may be easier for majority-status students, who are less likely to be excluded from informal socializing or venues such as study groups.

Furthermore, research indicates that Black students, in particular, do not reap the same benefits from student–faculty interactions in STEM, an important manifestation of social ties, as do their majority-status peers (Park et al., 2020a). Similar trends exist for gender in certain sub-environments of STEM (Carlone and Johnson, 2007; Ong et al., 2011). Thus, numerous threats exist to positive social ties and the formation of social capital for people of color and women of different races. While previous studies have documented the challenges that these populations experience within STEM, we do so with the specific intent of analyzing the implications for academic and career advancement, a focus generally not addressed in previous studies. We anticipate that, while individuals of different backgrounds are able to access a certain level of both strong and weak social ties, people of color and women will experience unique challenges to forming positive social ties in either professional or educational environments. By focusing on these dynamics, we seek to illuminate processes and mechanisms that facilitate or hinder social mobility for diverse populations within the STEM context.

3. METHODOLOGY

We used qualitative methodology to guide our inquiry, seeking to capture the nuanced dynamic of participants' experiences (Glesne, 2016). Specifically, we used a multiple case studies research design (Yin, 2014) to probe the nature of social ties among 40 STEM graduates during and after their college years. Case study research seeks to deeply examine and describe a complex issue and its context (Creswell, 2013). The case is a bounded system that is examined and understood as a whole entity, including both the unit of analysis and its environment (Merriam, 2001; Stake, 1995; Yin, 2014). In this study, the units of analysis were the participants, who engaged in in-depth interviews, and also answered an online demographic questionnaire addressing their educational and professional background. The questionnaire also gave participants the option to share their résumés and LinkedIn profiles. Consistent with case study research, this survey form afforded us the opportunity to understand more about each participant's distinctive context (Merriam, 2001). Accordingly, as part of this study, we considered each participant a bounded and unique case (Yin, 2014), experiencing and representing the phenomena under study—how participants accessed information about career advancement and the role of social ties in educational and professional settings. In doing so, we were able to delve deeply into a rich sample of participants, highlighting individual experiences while also engaging in cross-case analysis to highlight the unique experiences of subsets of the sample (e.g., women and people of color). Given the focus of our research questions, we did not conduct cross-case analysis by other facets of participants' experiences that could explain variation (e.g., level of graduate degree), choosing to focus primarily on differences in experiences due to race and/or gender.

We used a purposeful sampling method to identify information-rich cases that could address the focus of the study (Merriam, 2001). Eligible participants needed to: (1) have worked in STEM for at least five years; (2) live in the District of Columbia, Maryland, and Northern Virginia (DMV) area; and (3) have graduated from college no less than five years before the study was conducted. The DMV area was chosen due to geographic proximity to the research team. Working professionals were recruited in order to examine the linkage between college experiences and post-collegiate outcomes. Recruitment notices were sent to local chapters of national organizations, such as the NSBE, Society of Women Engineers, and the American Mathematical Society. We also used snowball sampling techniques, asking participants to forward information about the study to their social networks (Glesne, 2016). Interested participants filled out an online survey that gathered extended details about their background, which was used to gain a deeper understanding of participants' experiences and to confirm eligibility.

4. THE SAMPLE

The sample consisted of 12 Black/African American, nine Latinx, nine Asian/Asian American, and 10 White participants, for a total of 40 participants. Our initial goal was to recruit 8–12 participants from each of the dominant four racial groups in the geographic

region. With 40 participants, we achieved data saturation within the total sample, meaning that toward the end of data collection, the information being collected in interviews was highly consistent (and somewhat redundant) with that collected in previous interviews (Yin, 2014). Twenty-three participants were women and 17 were men, with a minimum of five women being represented in each racial/ethnic group. One-half of the sample had a degree from an engineering background; 10 had degrees in the sciences, such as in biology and physics; four had technology-related degrees; and three had a mathematics background. Three participants had college degrees outside of traditional STEM majors but were working in STEM-related careers (e.g., a participant who had a bachelor's in construction management and was working as an environmental engineer). Most participants had graduate degrees ($n = 29$). Out of the 40 participants, 16 had earned a master's degree in STEM; nine had a doctoral degree in STEM; and four had earned graduate degrees in a non-STEM field (e.g., education policy). All participants met the criteria of having completed their undergraduate degrees at least five years prior to data collection, which started in October 2017 and ended in April 2018. Most participants ($n = 31$) graduated from college between 2000 and 2012. The majority of the sample ($n = 28$) worked in STEM fields for over nine years; the rest ($n = 12$) had between five and nine years of work experience. In Appendix A, the information gathered on the participants in the sample is summarized, detailing each participant's race, gender, and STEM discipline. In Appendix B, the participants' educational and professional backgrounds are described.

5. DATA COLLECTION AND DATA ANALYSIS

All 40 interviews were conducted in person, lasting an average of 60 minutes each. All but one participant consented to have the interview audio recorded, and handwritten notes were taken instead. During the interview, we asked open-ended questions and referred to the questionnaire that participants had submitted to probe deeper when needed. Some of the questions asked included the following:

- Can you share about how you got your first job in STEM after you graduated from college?
- Who has provided you information about jobs, graduate schools, etc., over the years?
- Could you name the five most influential people in your professional development?

Overall, the interview questions centered on relationships and social ties that participants developed as they navigated their careers in STEM.

All of the interviews were transcribed verbatim by an independent service provider and reviewed for accuracy (Poland, 1995). Inductive and deductive coding techniques were used to analyze the data. Inductive techniques enabled us to gather emergent codes within each case and identify patterns in the data across cases (Creswell, 2013; Yin, 2014). Deductive coding techniques utilized *a priori* codes that were generated from the theoretical influences and/or relevant literature (Creswell, 2013). Consistent with case study research design, each case was first coded independently before we coded across cases to

identify categories and themes related to the phenomenon under investigation (Merriam, 2001; Yin, 2014). We engaged in some cross-case analysis by race/ethnicity, but also chose to highlight both minoritized and majority-status participants in two of the three main themes, given that participants within both categories relied on both strong and weak ties. However, cross-case analysis indicated that the third theme of negative experiences with social ties was primarily experienced by those from minoritized backgrounds. To enhance the trustworthiness of the study, peer-debriefing techniques were utilized, as well as member-checking processes (Jones et al., 2014). All of the quoted participants were given the opportunity to review a draft version of the manuscript and several offered follow-up comments or clarifications, which we then added to the manuscript.

6. POSITIONALITY STATEMENT

We are a team of researchers from minoritized racial backgrounds. As scholars of color, we have experienced interpersonal and systemic marginalization in professional settings, as well as in our personal lives. As educators, we strive to promote equity and inclusion in higher education settings and have worked with numerous students to support their college and postgraduate success. As qualitative researchers, we are aware that our positionalities and multiple roles and identities have the potential to influence our interpretations of the data (Glesne, 2016). We know that, being the instruments of the data collection and analysis, we cannot ignore how our lived experiences as well as prior research engagement impact our assumptions and understandings of participants' experiences (Merriam, 2001). Thus, to interrupt our biases, we engaged in constant reflexivity both personally and as a team throughout the entire research process (Glesne, 2016). For example, we engaged in memo writing to enhance the trustworthiness of the study as we coded and analyzed each case (Glesne, 2016). While our positionalities helped us understand issues related to systemic inequality in higher education and professional settings, we challenged each other's assumptions about participants' experiences throughout the data analysis process and constantly sought to forefront participants' own meaning-making of events.

6.1 Protection of Vulnerable Populations

As part of the ethical considerations for this study, we reflected on the impact that the interview questions and storytelling process could have on participants. Our interview protocol encouraged participants to retrospectively think about their college years and early career experiences. Engaging in this kind of reflection can sometimes be a sensitive process, with some potential for emotional harm (Glesne, 2016). While the participants we interviewed are not officially considered vulnerable populations based on research ethical standards, we could not ignore that asking them to share experiences related to their social identities (e.g., race/ethnicity and gender) could have caused them distress. For example, when asking participants to elaborate on the people who had been influential in their careers, some felt joy recalling positive experiences of support, while others felt frustrated remembering how they felt alone navigating their STEM careers. Throughout the interview process, we

reminded participants that they did not have to respond to any questions they did not feel comfortable answering and could stop the interview at any time. In addition, to alleviate some of the risks of causing emotional harm, our interview protocol started with more general questions. This protocol design allowed us to build trust and rapport with participants as the interview unfolded, helping us move from general to more sensitive questions. We also used pseudonyms, selected by the research team, to preserve confidentiality.

6.2 Limitations

Like all studies, we faced certain limitations. Our purposeful sampling within the greater Washington, DC, area means that the sample does not necessarily reflect the dynamics of social networks and social ties that exist in other cities or contexts. Additionally, by sampling working professionals employed in STEM careers, we lacked the narratives of those who were not retained within STEM majors or professions. These individuals may have particularly compelling narratives about being excluded from social ties or social networks, which is a rich area for future research. However, in choosing to focus on individuals who completed STEM degrees and were working in STEM careers, we were able to investigate whether individuals who have made it in STEM in some respects still experienced discrimination or negative experiences. There is an additional issue related to our sampling: since we conducted some recruitment through STEM professional organizations that foster social ties, we may have oversampled individuals with stronger social networks. However, not all of the participants were recruited through that method, and the findings showcase a wide variety of experiences between participants.

7. FINDINGS

In documenting how participants accessed information about opportunities, we first address the roles of strong social ties and then the relevance of weak ties. We conclude by documenting participants' accounts of barriers to weak tie formation.

7.1 Strong Social Ties and Career Information

Three sources of strong social ties leading to career information or opportunities included a cultural center staff member who played a mentoring role, a friend from a participant's engineering coursework, and faculty. Regarding the first, communities such as ethnic student organizations or multicultural centers on campus played a surrogate family role for numerous participants. Some participants were part of programs with a specific STEM focus, while others benefited from cultural centers that catered more generally to the ethnic community, as Andrea, of Latinx heritage who majored in math and economics, described the Latino student center from her college days:

> *[W]hen I look back on my college years, she was definitely a wonderful support person and had a big impact on me. So, it was called [the Latino Cultural Cen-*

ter], I hope I got the name right. It was, basically, like a – I almost think of it like a safe space, so a cultural center. It was catered towards helping the Latinos on campus to just have a space to go to talk about stuff. She was the assistant director or something. There was like the director director, and I never really spoke to her. But she was like the second person. And you could tell her life was that place. That was her life. That was what she was dedicated to. And she always had advice for all of us. And with me, she said that she got the impression that working for the federal government would be a good fit for me.

Andrea went on to work for the federal government and mentioned that the associate director at the Latino Cultural Center was the first person to suggest the government as a career option for her. Her case is one where a cultural center facilitated the flow of social capital via the associate director's mentoring of students.

Camila, a Latinx project engineer, spoke of the tight bonds she developed with a group of friends with which she had took all of her engineering courses. Later on, one friendship facilitated the acquisition of a job:

One of my friends that I went through engineering with said that they were looking for someone at her company, and that's a construction management company. She's been there since she graduated. So, I met with her boss and he was interested in my background because it's very similar to hers but a little different because I had already moved. I interviewed with them and it was maybe six months after that he contacted me again and said, 'Hey, are you still interested?'

Her story is an experience of social ties from the undergraduate years paying dividends for professional advancement. Camila noted elsewhere in her interview that she sometimes had difficult interactions with male peers in her STEM courses, and notably, the job lead came from a female friend from her engineering days.

Generally, participants who reported closer relationships with faculty were either White or Asian American, although such relationships were less common within the sample. For instance, Midori, a female Asian biomedical engineer, commented on the positive role that her undergraduate faculty advisor (who later became her PhD advisor) played: "He showed that he cared a lot about us. We wanted to do a good job for him because he cared." Ted, a White male faculty member at a School of Medicine, mentioned being mentored throughout his masters and PhD. He described his master's program mentor: "My mentor there was fantastic, in the sense, that he says I just want you to hang on my coattails, and I want you to learn everything that you can. And he did allow me to do that." Later on, Ted received a job offer to stay at the institution where he did his PhD as a post-doc and eventually, faculty member:

Well, I did my PhD at the [State University] School of Medicine. And lo and behold, I'm still there. The issue was that, 'hey, we really like you; we'd like to keep you around here.' So, I had options to go elsewhere for post-docs, but I didn't want to really pick up and move every two to three years, if I could help it.

In this case, faculty relationships paid off ("hey, we really like you; we'd like to keep you around here") and opened the door for a major career opportunity, allowing Ted the luxury of staying in one location versus the potential itinerant life of having to move for a post-doctoral fellowship and then later for another position. During the member-checking process, Ted ultimately attributed his career success to hard work and ability to make key contributions to the research program at that institution. At the same time, he did not identify any barriers to social tie formation.

7.2 Sources of Weak Ties and Career Information

Career fairs were often mentioned as a source of information for the first job out of college, and casual acquaintanceships also opened the door for career opportunities for select individuals. As noted, close faculty relationships such as those mentioned by Midori and Ted were rare. Mark, a White male fire protection engineer, noted how his academic department connected students with possible job opportunities, but downplayed the rest of the department:

> *For the next step for careers, the department was really good in bringing in – We had our own career fair. In our department's office they had a conference room. They'd have different companies coming in interviewing students for jobs. So, they were really good about having people come and do interviews to make sure that you'd have a chance at least of discussing potential career with people at these companies. And so I'll give them credit for that. But I didn't get a whole lot of mentoring for the next step from within the department.*

As he noted, the department set up an infrastructure to expose students to job opportunities, fostering weak social ties. While helpful, it was less adept at closer mentoring.

Student organizations supporting students of color and women also played an important role by hosting career fairs and other professional development opportunities. Kennedy, a materials research engineer, noted:

> *Every year, there would be a big career fair, and the National Society of Black Engineers [NSBE], they were one of the sponsors of it, but they would have a resume workshop. And so I can remember my freshman year, first year, they all sat us down and was like 'Okay, these are examples of resumes, and you need to check yours, change yours up, write your resume and change it up, so you have that.' And so then a lot of times they were like 'Go to the career fair and shop your resume around that way.'*

She noted how she got her internship through the fair. Interestingly, the head of the Office of Minority Education, who was the advisor for the NSBE group, had encouraged the recruiter from the organization to recruit Black students, who were already friends, in pairs, "so that when they go to this job opportunity they at least have somebody there

that they know." While the career fair was a repository of weak social ties, behind the scenes, a stronger tie (the NSBE advisor) facilitated opportunities for students.

Participants also highlighted the role of chance acquaintanceships in securing professional opportunities. Kim, a female Asian American biomedical engineer, built close relationships within her laboratory. However, in the end, a key opportunity came from a more casual relationship:

> *My last summer, so between my junior and senior year, I found an internship at a pharmaceutical company. And that was mainly through one woman who used to work in the labs that I was working in, she left and went to work for the pharmaceutical company and then I guess, they were looking for interns, so she contacted my post-doc I was working for and was like 'do you know anybody?' And so, I … talked with her and she got me an interview to go, and so that summer I worked full-time, I didn't work at school, I guess I worked at that company for that summer.*

Kim explained how she did not have a close pre-existing relationship with the woman:

> *I did know her because she was kinda like a lab manager person, but I didn't have a direct relationship with her but knew of her while she was around, and she knew who I was. But more of like a friendly acquaintance not like a real developed relationship. Basically, it jump started my career because after I finished I got a job there. Directly in the same group because they were like, what are you gonna do next year and I was like, I'll probably find a job, I don't know … so, they offered me a job in that same group after I graduated.*

In this case, the internship came through a "friendly acquaintance," and ended up opening up doors for Kim's first postgraduate job. It should be noted that the internship referral was somewhat mediated through the post-doc who referred Kim to the acquaintance (the former laboratory manager) for the job, showing how weak ties may be facilitated by other closer ties (e.g., a friend's friend).

Another example of a job opportunity being secured through weak social ties was Greg, a White male aerospace engineer. He had applied for a position at an aerospace company through their website but had not heard back. Then, coincidentally, that week he had dinner with a family that his wife knew through her synagogue:

> *We were just talking about 'Hey, I want to go into aerospace' and all this, and then the, the mom of the other family, she said 'You know, I know some space people.' She's like 'Maybe I can get you in contact.' And I'm thinking 'Well, everybody knows some space person. So what – how – what level are they in their organization?' … So, turns out the two people she's talking about, one of them is in charge of the space department at [Local University Affiliated Research Center]. He's actually the boss. And then the other one was a senior project manager for*

[aerospace company]. So these are actually people that could give you a job. … So then I talked to the other person, and she said 'Oh yeah, [aerospace company] is hiring, so why don't you put your resume in and I'll make sure it gets to the right people.' So she did, and I interviewed, and I got the job offer the next day.

Greg was originally skeptical about his wife's friend knowing "some space people" but it turned out that both were influential in his field. He had already applied through the company's website, but did not hear back until the friend of his wife's friend made sure that his resume got to the right people, and then he immediately got the job.

7.3 Barriers to Weak (and Subsequently to Strong) Tie Formation

In addressing the question of how experiences varied by race and/or gender, we found that while both strong and weak ties helped participants, women and people of color experienced key barriers to forming weak (and, correspondingly, strong) ties in three areas: higher education, the workplace, and social networks. In some cases, weak ties themselves were a source of negative experiences.

As noted previously, forming close or even positive casual relationships with faculty was less common in the sample, especially among underrepresented groups. When asked whether and where she felt support in college, Felicia, a Black female mechanical engineer, said:

We didn't really have much support from the institution, per se … I mean, my class came in with 1300 [in STEM majors] and only 600 graduated. They dropped like flies and [faculty are] okay with that because they feel as if they're weeding out those who can or cannot make it, but they're also not supporting you to make it, you know. Professors will have office hours and you show up and they're not there, and you're like, 'Well, what do I do now?' And they're like, 'well, I had research to do.' And you're like, 'Well, I have homework that I'm trying to finish.' 'That's your problem. You should have paid attention in class.'

Felicia identified the sink or swim climate as a key impediment to forming positive relationships in college. Others echoed her sentiment. When asked about sources of support, Emma, a White female project manager in the field of civil engineering, stated "not the professors." Becky, a White female software engineer recounted: "I think in school [peers and professors]* just kind of looked down on us, but they would never say anything to us." She clarified that the feeling came "probably even more so our peers. I think there was the stereotypes." The sense that male peers were skeptical of her ability to succeed naturally made it harder to form positive social ties.

* The wording in the brackets represents clarified phrasing requested by the participant during the member-checking process.

Courtney, a Black female emergency medicine physician, addressed how the general climate of racial isolation in STEM higher education was a barrier to positive relationships:

> *I think the STEM fields get a lot of attention because I think they're so traditionally saturated with people that are not of color. And I think we often feel as if we just don't belong, like we don't belong doing basic science, being in a lab and things like that. … And we often don't see any [familiar]† faces. It's usually some foreigner, which I'm not [opposed to] – my parents are foreigners. But it's usually some foreign-born person or a White person is usually what you see in the labs. And so I just think that we feel as if we don't belong.*

The lack of a sense of belonging was a key impediment for participants of color's ability to form positive relationships, functioning as both a symptom and cause of the problem.

Negative climate also extended to the workforce, influencing weak social ties that spurred negative experiences as Amanda, a White female structural engineer, noted:

> *I would say since I graduated … it's difficult. Like, the firm I worked at designing bridges there was definitely a boys club. They would go out. They would play golf. They would go to football games. And to be fair, not all the men were invited. They were very cliquish. But the women were definitely never invited. I think since joining the government – I mean I've run into some. It's hard – it's different too – and I don't know what field you're in, if you're doing grad work – I think sexism is a lot more subtle so you never know quite for sure if someone's treating you a certain way because they're sexist or they're just an asshole. My last boss was a jerk and he just used to make comments that start to grate on you about promotions happening because they have to fulfill quotas and things like that.*

Amanda noted the presence of the "boys club" where women were "never invited" to informal social events, which presumably were a place where networking and relationship building occurred. She also referenced a difficult boss who made problematic comments.

In another case, Andrea, a Latinx who majored in math and worked as an economist, spoke about an acquaintance that was not her direct supervisor but still affected her experience:

> *There was this one, he was like the boss of a different group, and I always got like bad vibes from him. I don't know if you feel that way. I always feel like, when you're a minority, you just kind of know. You get this energy and vibe, and he was one of those where I got that energy and vibe. But he wasn't my boss. But still, there are definitely people where you're like 'okay, that person might be*

† The wording in the brackets represents clarified phrasing requested by the participant during the member-checking process.

like racist or prejudice.' And it's definitely something that, obviously, if you're White, or especially if you're a White male, you're not paranoid of that the same way. So, yeah, I definitely always was like that paranoia of what if this person is not, and they're judging me because of this.

She noted that she felt a certain paranoia that the supervisor was racist, and felt that a White peer, or "especially" a White male peer, would not feel the same way, reflecting how the discriminatory climate affected her ability to form and experience relationships in ways that others were not subject to.

Adrian, a Black male mechanical engineer, discussed negative experiences with weak ties at work, and how the difficult climate affected his ability to form positive social ties:

At the job, it was – a lot of guys didn't wanna talk to me at either of those jobs and stuff, just general stuff that happens to every Black professional. I think every Black professional has had at least one job where no one would talk to them. That's kinda just something you expect. But it was really getting to me. No one said anything blatant to me, but it was just little soft things like that.

In this case, Adrian's ability to form social ties at work was literally impeded by the sense that others avoided him due to race. Eventually, a class-action lawsuit was filed against that company. At the time of interview, Adrian was working at a company that was about 20% African American and described the environment as much more comfortable.

Finally, participants noted ways where social networks themselves felt closed off from those with minority status (e.g., women and/or people of color), an obvious impediment to forming social ties. They also described broader tensions around race and/or gender that raised impediments to forming social ties. For people of color, such feelings were exacerbated by the fact that there were so few people of color in STEM, which affected the composition of social networks. Ebony, a Black innovation laboratory manager, addressed her awareness of the "camaraderie" that she was excluded from during college:

The majority of my classes I was the only female or the only Black female there, all the time. There was no support, absolutely none … it was just a matter of my own passion and my own drive for this topic that kind of pushed me through but there was zero support. I definitely recognized the camaraderie outside of myself in those classes and I was like, it's fine. … I was okay with being just a number in the class and making sure that I was doing what I needed to do.

While she did not express bitterness at being excluded from the relationships formed in academic settings, she noted how that isolation continued as she transitioned into the workforce:

I feel like had there been a better representation of – okay, let me rephrase that. So, early on there was a lack of network that I felt like I would be comfortable in. And so, what I chose to do was I chose not to bother and I kind of was very much a solo person working. I feel like earlier on I would've have loved to gain the perspectives of different people earlier on. And I feel like it would've been great had a network been more receptive to diversity. I didn't feel like a lot of the networks were. And so, I just decided whatever, I'm not gonna fight that battle and fight this at the same time. But I feel like the networking earlier on just to get the perspectives of others that were also in the field, I feel like I missed that. And that would've been a good thing.

Ebony had a difficult time locating networks where she would feel comfortable and desired a network "more receptive to diversity." As a result, she functioned more like a "solo person working" and endured, not feeling like the "battle" was worth fighting but noted that she wished she could have had access to diverse networks earlier in her career.

Another example of challenges to building networks in the workplace came from Gloria, a Latinx female neuroscientist involved in STEM policy, who noted how communication dynamics related to gender expectations raised tensions that could impede future relationships:

So, it doesn't happen one time, it happens many times. I've been in national meetings where you're put in rooms to kind of surface issues and problem solve around these big issues affecting STEM education. And I might be one of three women in the room. And men will dominate a conversation more often than not. And women, we're expected to bide our time, and be polite about how we introduce our views, and then apologize for them afterwards. ... I've come out of meetings where I've asserted my opinion or had an active role in the conversation and I've been deemed a bitch, or I'm a social pariah, or something afterwards; like I'm too aggressive. And I've had colleagues actually approach me, female colleagues, and say you know, 'you were pretty aggressive in there;' not assertive, but aggressive. And that language is very – or, 'you need to let other people have a voice' or something like that. ... I think this is an experience, I would say, for a number of women. It's like when you jump in wholeheartedly, and you're passionate, and you wanna have a voice. You have to balance that with looking and gauging people's reactions to what you're saying and tempering what you say. And it's exhausting to be in meetings all the time or to be in these situations where you have to temper your response to everything because you don't wanna burden these relationships in the future. You wanna be invited to these conversations. And so you have to dumb yourself down, still, to this day, or even more so today; dumb yourself down to make it seem like you're approachable or you're a team player and all this. And I'm getting frustrated because we don't have time for this.

Gloria described how women were held to a different standard than men, where women's participation, unless more tempered, was generally deemed as "aggressive." Elsewhere she explained that "if I were a man, I wouldn't be deemed that way. I'd be a leader, an influencer." Gloria expressed frustration at how, in order to not seem threatening, one would have to "dumb yourself down." She was sensitive to how being perceived as aggressive could threaten the formation of relationships, or being invited to critical conversations on reform, showing how the ability of women and women of color, in particular, to form weak social ties was precarious and subject to a sort of policing by those who had certain ideas about how women (and, presumably, women of color) were supposed to act.

8. DISCUSSION

Overall, we identified how weak and strong ties influenced participants' access to career-related information. Strong ties included information that came from campus educators, friends, and faculty mentors. Weak ties included information accessed through academic units, career fairs run by student organizations, and acquaintances. The few participants who noted close faculty relationships were White or Asian American, as were both participants who benefited from opportunities facilitated through acquaintanceships. Furthermore, in answering the question of how experiences varied by race and gender, we documented how people of color—and, on occasion, White women—experienced unique challenges to developing social ties due to racism and sexism experienced in the classroom and/or workplace, which in turn limited access to career-related information and opportunities.

In lieu of faculty relationships, numerous individuals leaned on student organizations and ethnic student centers to provide both a combination of strong and weak ties. Such venues provided participants access to career fairs—a repository of weak ties, where individuals could quickly accumulate acquaintanceships that led to job opportunities—and may have been especially helpful to underrepresented populations given limited access to peer networks. As individuals advanced in their careers, we documented how job contacts and opportunities could come from weak ties—happenstance conversations at a dinner party, an acquaintance from a former laboratory, and the like. This finding supports the Granovetter (1973) finding that weak ties play an important role in facilitating employment among social networks. While not featured in our analysis, participants noted that resources they relied on earlier in their careers (e.g., career fairs) played less of a supporting role as they advanced, given that these resources generally catered toward entry level positions. This dynamic reflects the importance of cultivating a broader social network, especially for women and people of color.

Minority-status participants noted ways that they were excluded from certain networks within the workforce—such as Amanda's observation of the "boys club" and Adrian experiencing racial hostility at work—which, in turn, limited their ability to access certain information and possibly opportunities for advancement. While it is possible that they were able to compensate through accessing other networks, the fact

remains that they were simply blocked from forming certain positive social ties due to negative climate, racism, sexism, and/or combined forms of oppression that they experienced. A poignant finding was Gloria's account of how she felt like she could not speak honestly in gatherings on STEM reform without threatening possible relationships due to how harshly women were judged as being "aggressive" or a "bitch." This double standard is deeply troubling evidence of how women and women of color, in particular, face distinct challenges to forming social ties and networks—which, in turn, will likely limit career advancement and access to social capital. It is not that they are unable to form any social ties, but that they are being asked to choose between changing their demeanor (something not asked of White men), or risk being seen as difficult to work with.

Diverse social networks are a critical source of non-redundant information (Bowman and Park, 2014). While not all people of color and female participants felt excluded from networks, they were much more likely to have experienced marginalization than male and White participants. Given that important opportunities for career advancement were embedded in such networks, as the testimonies of Ted and Greg (two White males) showcased, participants of color and women were likely cut off from certain opportunities for advancement. While support organizations for women and minorities have played an important compensatory role in helping people of color and women network among themselves, it is men, Whites, and to some extent, East/South Asian Americans who have the greatest representation in the STEM workforce. Given that participants of color faced significant barriers to forming positive social ties, both strong and weak, in contrast to majority-status individuals, our research points to how inequality in social networks is a key driver of inequality in STEM. Furthermore, the findings suggest that the marginalization that begins in the undergraduate years can extend into the postgraduate years. This marginalization may be more overt—such as the direct racism experienced by Adrian or the exclusion felt by Ebony—or more subtle, as in the gender policing experienced by Gloria. Notably, no White males reported similar experiences.

Interesting, we found that many, if not most, of the identified ties came from people who shared some demographic similarity with participants, either race and/or gender—three of the four examples of strong social ties, and at least two of the four examples of weak ties (with a possible, unverified third example). This finding reflects the power of homophily (McPherson et al., 2001) or likes attract likes, and speaks to the importance of fostering racial diversity within STEM. People of color and women of all races are automatically at some disadvantage if they have fewer opportunities to connect with peers of the same race and/or gender due to the demographic composition of STEM graduates. Given that people of color and women of all races with STEM degrees are less likely to work in STEM than their majority-status peers (Xie and Shauman, 2003; Melguizo and Wolniak, 2012) this inequality is only compounded in the workforce, underscoring the need for greater diversity. Simultaneously, campuses and workforces also need to create opportunities for individuals to build positive social ties across demographic lines, both to connect people to information and also because diverse teams

are linked with innovation in the workplace (McGee, 2013; Park et al., 2013; Strayhorn et al., 2013).

9. IMPLICATIONS AND CONCLUSIONS

Overall, the findings illuminate both the significance of social ties in accessing career information and the barriers that women and people of color face to forming positive social ties and social networks. In general, while the majority of participants were satisfied in their careers, numerous participants commented on the continued pervasiveness of racism and sexism and its impact on social tie formation. Altogether, the findings point to the importance of both strong and weak ties in advancing educational and occupational success for diverse populations in STEM. Regardless of race, people benefited from whatever type of social tie they were able to access. However, we found that only participants from marginalized populations reported impediments to accessing social networks specifically related to race/ethnicity and/or gender, highlighting key inequities in being able to access certain social networks.

Our work adds to the understanding of how mechanisms of inequality work to privilege some in STEM while concurrently isolating others. A key contribution of the study is the ability to compare and contrast experiences within a racially diverse sample. Numerous studies highlight the inequities faced by people of color and women in STEM, but do so within samples made up of all people of color, women, or women of color. These studies are critical to our understanding of the negative experiences of different populations, but studies rarely showcase both narratives of privilege alongside narratives of disadvantage, showing the contrast and inequality between different groups. Additionally, our study included the experiences of some people of color who were able to still form positive social ties, showing how people of color and women may simultaneously experience both positive and negative experiences in STEM. However, the findings still illuminate how the most negative experiences with social ties—either being cut off from networks or experiencing isolation and pressures within them—were experienced exclusively by women and people of color.

Future research may utilize different methodological approaches, such as social network analysis (SNA), to deepen the understanding of STEM individuals' social ties (McCabe, 2016). The use of SNA could further illuminate the dynamics of individuals' social ties, their interconnections, and access to key resources. Additionally, the use of other qualitative methods, such as narrative inquiry, could more deeply shed light on individuals' experiences. While our coding approach identified key themes and patterns within the data, detailing out individual portraits or narratives of participants would shed light on how social ties and networks influenced the trajectory of their educational experiences and careers.

While our participants reflect a racially diverse sample of people who were able to make it in STEM, attrition rates in STEM—both in higher education and the workforce—are disturbingly high (Graf et al., 2018). The findings signal the need for continued interventions to prevent isolation and marginalization in STEM. Multicultural

centers and STEM programs/organizations catering to people of color were listed as pivotal resources by our participants; however, some participants noted that these programs had been defunded since their graduation. This is of particular concern because such groups often host and/or broker introductions within career fairs, which are important resources, especially in relation to entry-level positions for marginalized populations. Continuing and increasing institutional support for these centers, programs, and initiatives is critical both for the broader campus racial climate (Patton, 2016) and the academic departments where people of color experience particular isolation. Parallel support structures in the workforce are also critical to persistence in STEM.

An additional issue is simply the need for greater critical mass of, especially, people of color in STEM majors, and in some cases, women. As numerous studies document (Carlone and Johnson, 2007; Chang et al., 2011; Cole and Espinoza, 2008; Strayhorn et al., 2013), the experience of being the only one is a huge detriment to persistence in STEM. Our findings highlight how even people of color and women who persisted through STEM experienced isolation from social networks in both academic and professional spaces; discouragingly, this finding shows how even the diversity that does exist within STEM exists on a precarious foundation. While institutional commitment and reform is necessary, defending legal precedent that affirms the ability to consider race in college admissions as one of many factors is essential. In the affirmative action lawsuit, *Fisher v. University of Texas, Austin*, the University of Texas at Austin defended its continued use of race-conscious admissions due to the lack of a critical mass of students of color in STEM fields, among other reasons. The *Fisher* case illuminates how even when an institution may attract compositional diversity at a broader, institution-wide level, additional attention is needed to support a positive climate in disciplines where people of color have been traditionally excluded.

The findings also signal the need for STEM environments to have frank conversations about how women and people of color are often held to double standards in ways that men—and, in particular, White men—are not. This dynamic, recounted by Gloria in the sample, is one of the most troubling ways that women and people of color are policed in environments, both academic and professional. There is no clear-cut way to remedy these phenomena; however, STEM educators and professionals need to be cognizant of how these dynamics have major negative repercussions for retention and the ability of underrepresented populations to form positive social ties and social networks. Clearly, the status quo of colorblindness, and to some extent the so-called gender blindness (which, in reality, is asking women and people of color to conform to expectations set by the majority population), is not working.

The need for the United States to expand and diversify its STEM workforce is one of the most compelling needs of the 21st century. Furthermore, the marginalization of minorities in STEM presents a compelling social justice concern, raising questions around equity and fairness in the field. Building positive social ties is rarely an area that is intentionally taught in educational spaces. Instead, it is part of the unspoken rules that operate to privilege some populations and disenfranchise others. Breaking the silence and critiquing dominant norms is necessary in order for greater diversification and a

more positive climate to prevail, but at potential deep cost to women and people of color. It is a burden and responsibility that needs to be shared across populations as part of a continued commitment to reform.

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APPENDIX A: PARTICIPANTS' RACE/ETHNICITY, GENDER, AND STEM FIELD

Tables A1 and A2 provide summaries of the racially diverse sample of 40 STEM working professionals who participated in this study.

TABLE A1: Summary of the participants' race, gender, and major discipline ($n = 40$)

Race, Gender, and Major Discipline	Number of Participants
Race	$n = 40$
Black or African American	12
Asian or Asian American	9
Latina/o/x or Hispanic	9
White	10
Gender	$n = 40$
Female	23
Male	17
Major Discipline	$n = 40$
Science	10
Technology	4
Engineering	20
Mathematics	3
Other	3

TABLE A2: Summary of the participants' gender in relation to their race and major discipline ($n = 40$)

Major Discipline	Black or African American		Asian or Asian American		Latina/o/x or Hispanic		White	
	Female	Male	Female	Male	Female	Male	Female	Male
Science	3	2	1	0	1	0	1	2
Technology	1	0	0	1	1	0	1	0
Engineering	1	3	4	2	3	2	3	2
Mathematics	0	0	0	1	1	0	1	0
Other	1	1	0	0	0	1	0	0

APPENDIX B: PARTICIPANTS' TABLE

Table B1 gives details on the participants' educational and professional backgrounds.

TABLE B1: Details of the participants' educational and professional backgrounds (n = 40)

Participant Number	Pseudonym	Gender	Race	Undergraduate Degree(s)	Graduation Year	Graduate Degree	Number of Years in STEM Field
1	Emma	Female	White	Geology and Economics	1980	No	Over 12 years
2	Becky	Female	White	Computer Science and Sociology	1982	No	Over 12 years
3	Keisha	Female	Black or African American	Physics and Electrical Engineering	1985	No	Over 12 years
4	Ted	Male	White	Bachelor of Science	1986	Doctorate degree in STEM field	Over 12 years
5	Steven	Male	White	Environmental Science and Geography	1989	No	Over 12 years
6	Janae	Female	Black or African American	Liberal Arts	1990	Doctorate degree in STEM field	Over 12 years
7	Michael	Male	Black or African American	Chemical Engineering and Black American Studies	1992	Master's degree in STEM field	Over 12 years
8	Kenji	Male	Asian or Asian American	Electrical Engineering	1992	Doctorate degree in STEM field	Over 12 years
9	Kennedy	Female	Black or African American	Materials Science	1994	Doctorate degree in STEM field	Over 12 years
10	Kevin	Male	Asian or Asian American	Mathematics and Physics	1999	Doctorate degree in STEM field	Over 12 years
11	Sonya	Female	Asian or Asian American	International Development Studies and Environmental Science	2000	Doctorate degree in STEM field	9–12 years
12	Ebony	Female	Black or African American	Computer Information Systems	2000	Master's degree in STEM field	Over 12 years
13	Emily	Female	White	Mathematics	2002	No	Over 12 years

TABLE B1: (*continued*)

14	Jamal	Male	Black or African American	Physics	2002	No	Over 12 years
15	Amanda	Female	White	Civil Engineering	2003	Master's degree in STEM field	Over 12 years
16	Kim	Female	Asian or Asian American	Chemical Engineering and Biotechnology	2003	Doctorate degree in STEM field	Over 12 years
17	Reyna	Female	Hispanic, Latina/o, or Latinx	Computer Telecommunications Engineering and English	2003	Master's degree in STEM field	Over 12 years
18	Milagros	Female	Hispanic, Latina/o, or Latinx	Computer Engineering	2005	Master's or doctorate degree in a non-STEM field	4–6 years
19	Felicia	Female	Black or African American	Mechanical Engineering	2005	Other: Industrial Design	9–12 years
20	Adrian	Male	Black or African American	Mechanical Engineering	2005	Master's or doctorate degree in a non-STEM field	9–12 years
21	Tony	Male	Asian or Asian American	Electrical and Computer Engineering	2005	Master's degree in STEM field	9–12 years
22	Lynn	Female	Asian or Asian American	Civil Engineer	2005	Master's degree in STEM field	7–9 years
23	Gloria	Female	Latina/o, or Latinx	Neuroscience	2005	Master's or doctorate degree in a non-STEM field	Over 12 years
24	Kristen	Female	White	Engineering Science and Mechanics	2006	Master's degree in STEM field	9–12 years

TABLE B1: (*continued*)

Participant Number	Pseudonym	Gender	Race	Undergraduate Degree(s)	Graduation Year	Graduate Degree	Number of Years in STEM Field
25	Jenny	Female	Asian or Asian American	Electrical Engineering	2006	Master's degree in STEM field	9–12 years
26	Andrea	Female	Hispanic, Latina/o, or Latinx	Economics and Mathematics	2007	Master's degree in STEM field	9–12 years
27	Samuel	Male	Asian or Asian American	Computer Science and Economics	2007	No	9–12 years
28	Mark	Male	White	Fire Protection Engineering	2008	No	9–12 years
29	Midori	Female	Asian or Asian American	Biomedical Engineering	2008	Doctorate degree in STEM field	4–6 years
30	Troy	Male	Black or African American	Civil Engineering	2009	No	7–9 years
31	Courtney	Female	Black or African American	Biochemistry and Africana Studies	2009	No	4–6 years
32	Malcolm	Male	Black or African American	Biology and Chemistry	2009	Master's degree in STEM field	9–12 years
33	Renato	Male	Hispanic, Latina/o, or Latinx	Electrical engineering	2010	Master's degree in STEM field	7–9 years
34	Camila	Female	Hispanic, Latina/o, or Latinx	Civil Engineering	2010	Master's degree in STEM field	7–9 years
35	Cathy	Female	White	Architectural Engineering and Architectural Studies	2011	No	7–9 years

TABLE B1: (*continued*)

36	Natalia	Female	Hispanic, Latina/o, or Latinx	Electrical Engineering	2011	Master's degree in STEM field	4–6 years
37	Malik	Male	Black or African American	Elementary Education	2011	No	7–9 years
38	Antonio	Male	Hispanic, Latina/o, or Latinx	Construction Management	2012	No	9–12 years
39	Greg	Male	White	Aerospace Engineering	2013	Master's degree in STEM field	7–9 years
40	Pedro	Male	Hispanic, Latina/o, or Latinx	Biomedical Engineering	2013	No	4–6 years