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How US Women in STEM Feel in Male-Dominated Study and Work Cultures

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ABSTRACT

Women in STEM study and work in male-dominated environments with cultures based on masculine values and white male primacy. STEM women strain to conform to these cultures, and any failure to properly advance is often blamed on them. The struggles these women face and the impact on their psychological well-being and professional STEM lives remain mostly untold. The Global Women in STEM Leadership Summit (GWiS) is a multigenerational, multi-sector conference that, among other things, empowers women in STEM to explore and articulate their struggles in male-dominated study and work cultures, to discuss how these experiences hinder their progress and affect their well-being, and to recognize their unique contributions. This paper leverages data collected at the 2019 GWiS to (1) expose, amplify, validate and elevate the severely underrepresented female identity and perspective in STEM, (2) reveal struggles women in STEM face and uncover underlying root causes in male practices that hinder women in STEM, and (3) illustrate the value of counterspaces, such as GWiS, in validating women's identities and perspectives, creating empowering experiences, and countering negative feelings. If widely implemented, this shift in perspective is the first step toward dismantling one-sided systems and co-creating more balanced work environments that benefit all.

KEYWORDS

United States, equity, identity, obstacles, struggles, gender, retention, inclusivity, validation, counterspaces

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INTRODUCTION

As the founder and chairwoman of the Global Women in STEM Leadership Summit (GWiS), Dr. Takoi Hamrita receives numerous emails and LinkedIn messages from women concerning the challenges they face in STEM. The excerpts below show a few of these unsolicited candid statements from junior and senior women in STEM:

> As a young female who is still trying to get her career rolling, I face a lot of insecurities in my abilities and have little confidence in myself (Junior Scientist, personal communication, November 2016).
>
> I was completely unaware of the difficulties about being a woman in science until I started my postdoc … it is really sad…. I have had some unpleasant experiences, which have been hindering my progress…. I will have to change my job soon. (Postdoctoral student, personal communication, September 2019).
>
> I've spent my career working to be taken seriously as a scientist (Senior Scientist, personal communication, September 2019).

We have a problem. STEM school and work cultures are unwelcoming to, unsupportive of, and ill-suited for women - all issues that are still not fully recognized, understood, or addressed. Obstacles to the success of women in STEM often go unnoticed and unaddressed because they have long been embedded in workplace culture (Steinke, 2013), and denial of their existence, in general, persists (Swafford & Anderson, 2020). Research is urgently needed to understand how women from all paths of STEM and at all career stages feel about and are influenced by the struggles they face in male-dominated cultures.

This paper examines the study and workplace experiences of a multigenerational group of 35 U.S. women in STEM. Participants consisted of speakers and attendees of the 2019 GWiS and came from various sectors, career paths, and stages. Data consisted of participants' personal and professional reflections and was collected throughout the conference by means of session video recordings, post-presentation self-reflection sessions, interviews, and responses via a polling application. The resulting powerful narrative reveals the struggles with which women wrestle in all levels of male-dominated STEM study and work environments: The struggle to be one's authentic self, difficulty finding one's voice and being heard, dealing with bias and discrimination and not being taken seriously, the intimidation and erosion of confidence and self-esteem, difficulties of dealing with sexism and racism as the only woman in the room, difficulty taking advantage of professional opportunities, that men do not necessarily understand. Study and work environments that support women must begin with an increased awareness and understanding of these struggles, their root causes, and the influence they have on women. These

beginning steps will equip STEM for greater inclusivity and position these fields to contribute to a more equitable future for STEM.

This paper is part of a larger project that, like the GWiS, aims to elevate the conversation from a focus on women's "shortcomings" and how to overcome them to better fit into a man's world to one that tunes into women and invites them to discuss the impact of the status quo on their personal and professional well-being, their motivations, and their unique contributions. This important work promotes an understanding of women, elevates their identities and perspectives, and uncovers the root causes of the struggles they face in STEM study and work cultures. An understanding is imperative as the first step toward dismantling one-sided systems and co-creating balanced work environments whose values and perspectives benefit all.

Related Literature

Women Still Severely Underrepresented in STEM Majors and Careers

Women are severely underrepresented in STEM majors and careers in most industrialized countries around the world (Blickenstaff, 2005), and their lack of advancement continues to be a problem (Mavriplis et al., 2010). Moore et al. (2021) found that, globally, only 30% of research and development scientists are women. Women in the United States are no exception. In fact, in one year, U.S. women working in science, engineering, and technology are 45% more likely than men to leave their field, and that nearly one third of senior STEM leaders—both women and men—believed that a woman would never reach the top position in their companies (McGregor, 2014; Hewlett, 2014). Researchers at Cornell University and the University of Texas at Austin found that 50% of STEM women are likely to leave their careers for another occupation within the first 12 years, compared to only 20% of professional women in non-STEM fields (Glass et al., 2013). In 2017, women made up only 27% of those employed in Science and Technology in the U.S. (National Science Board, 2020). In 2020, women in the largest 500 US public companies occupied 26.5% of executive- and senior-level positions and 21.2% of board seats, while only 11% were top earners and 5% were CEOs (Catalyst, 2020).

Male-Dominated STEM Cultures' Detrimental Impact on Women

Male-dominated university and workforce STEM environments have been described as having a chilly climate (Blickenstaff, 2005; Morganson et al., 2010), are highly sexist, biased toward men, isolating, and unsupportive, with extreme work schedules and ambiguous rules about advancement and success (Swafford & Anderson, 2020); highly impersonal and individualistic (Morganson et al., 2010); and overly competitive and hostile, with threatening "good old boy" cultures (Wentling & Thomas, 2009). These intimidating environments can erode women's self-confidence (Morganson et al., 2010) and increase impostor feelings (Chakravarty, 2019). Van Veelen et al. (2019) showed that the more women were outnumbered by men, the higher their gender identity threat, the experience of feeling devalued or stigmatized individually or as a group. As both men and women unconsciously relate maleness to power and perceive men as having higher status

across a wide array of situations (Kish-Gephart et al., 2009), lack of support in traditional STEM environments could be particularly harmful to women. These issues often negatively influence women's pursuit of and interest in STEM careers.

Contributions to the Literature

Many studies attribute the low number of women in STEM to factors such as work-life balance, social conditioning, an absence of female role models, cultural pressures on women (Blickenstaff, 2005), women's lack of interest in STEM, and family responsibilities (Swafford & Anderson, 2020). Women themselves are often blamed for their underrepresentation (Tyson & Borman, 2010). The underlying tone in many of these studies, as well as many capacity-building programs designed for women, is that women must learn to better cope with and fit into male-dominated STEM cultures. The work embodied by GWiS and highlighted in this paper confirms that engaging women is vital to an improved understanding of their struggles of working in male-dominated environments, as these struggles impact their personal and professional well-being. Understanding facilitates equity by amplifying, validating, and elevating the severely underrepresented female identity and perspective in STEM and uncovering the root causes of women's struggles, providing a much-needed female perspective on male practices that hinder women in STEM. This paper also illustrates the value of counterspaces in validating female identities and perspectives, creating empowering experiences, and countering the negative feelings that arise when women are disempowered by white male-biased study and work environments. If widely implemented by researchers and practitioners, this shift in perspective from how to improve women so they can better fit within the status quo to a better understanding of women, their struggles, values, motivation, and unique contributions have the potential to build a new balanced reality that benefits all.

Balance requires diversity. This study's rich qualitative data is due to the diverse backgrounds of the participants, and the unique atmosphere in which data was collected. As study after study shows, the literature is often focused on a subset group from a certain sector such as engineering, or a certain age group such as students, but rarely do we have access to a multi-sector, multigenerational group of women from all paths of STEM and all career stages under one roof, reflecting on their work experiences and weighing in on the issues they face. The atmosphere of the 2019 GWiS is, then, unique and meaningful, as participants were surveyed in a vulnerable environment where they were highly inspired and engaged.

METHODOLOGY

2.1 GWiS

In 2016, Dr. Takoi Hamrita founded GWiS as a two-day program consisting of keynote speeches, informal question-based panels, practical workshops, and most importantly, group and self-reflection sessions. GWiS was designed as a multigenerational, multi-sector conference in which women in STEM are empowered to explore and articulate the struggles they face in male-dominated study and work cultures, how these hinder their progress and affect their well-being, and their

unique contributions. The program aims to expose, amplify, validate and elevate the severely underrepresented female identity and perspective in STEM; reveal struggles women in STEM face and uncover underlying root causes in male practices that hinder women in STEM; and provide a counterspace that validates female identities and perspectives, creates empowering experiences, and counters negative feelings resulting from male-biased study and work environments. The participants come from all career paths and stages, from high school to the C-suite. Leaders share insights, wisdom, hard-earned lessons, and actionable tools and strategies in a transparent, intimate, compelling, and authentic way, leading participants to productive self-reflection. In these sessions, attendees experience moments of validation when they realize that the struggles they face are not entirely their fault, that there are systemic issues that need to be addressed. All of this happens in an intimate, supportive, and fun atmosphere where the participants build real and meaningful relationships.

GWiS is organized around the following themes:

- Exploring, understanding and articulating female values and gifts
- Navigating underrepresentation and gender challenges and working with men to change perceptions and break down barriers
- Overcoming inner and outer hindrances to success
- Leadership philosophies
- Entrepreneurship
- Career and personal development strategies

2.2 GWiS Participants

Each year, GWiS's participants include approximately 300 women and a few men, all of whom come from a wide range of backgrounds, paths, and career stages:

- High school students and their teachers
- College students, professors, and administrators
- Industry professionals and senior leaders
- Entrepreneurs
- Nonprofit and government employees and officials

While the conference attracts attendees from several countries, most attendees come from the Southeastern United States. Figures 1 and 2 show attendees' distribution by sector and career stage.

Figure 1. Distribution of Attendees by Sector.

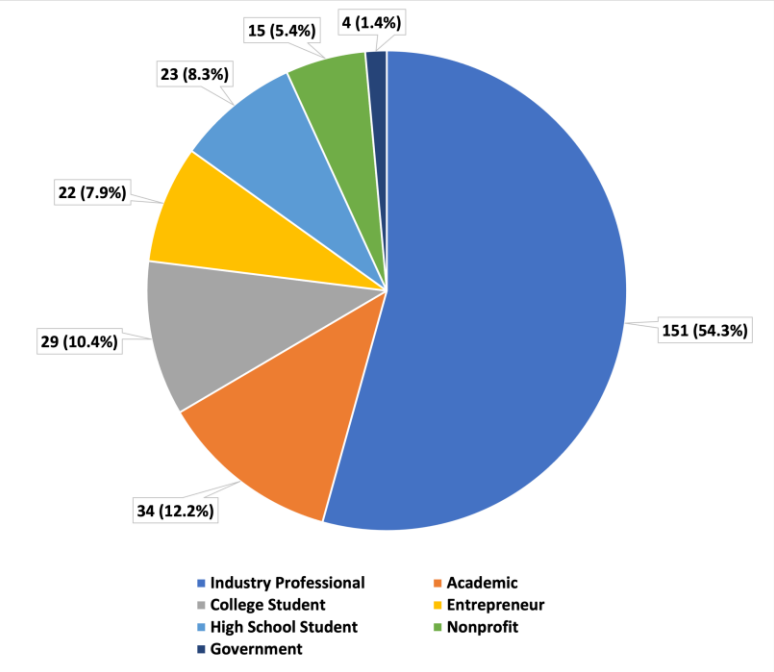
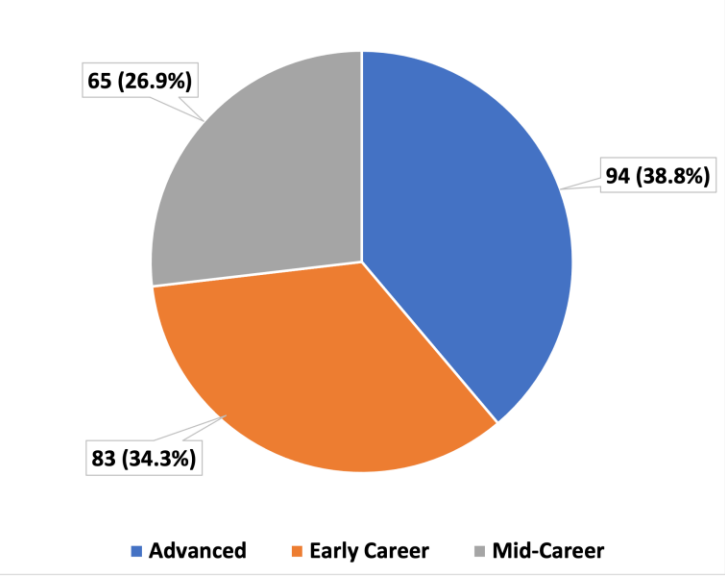


Figure 2. Distribution of Attendees by Career Stage.



2.3 Data Collection

Data collection was employed using a combination of instruments with the unique context of GWiS in mind. Our data collection protocol was reviewed and approved by the University of Georgia's Institutional Review Board (IRB protocol 00001133) ensuring consent and anonymity of study participants. All data collection activities were conducted during both days of the 2019 GWiS, November 4-5, 2019. Notes from self and group reflection sessions were transcribed. A total of 50 program sessions were recorded on video, and the content was transcribed. Eight interviews were conducted during which women were asked a series of questions, with the one relevant to this study being "What is the biggest challenge you face as a woman in STEM fields?" To gain additional insights on participants' thoughts and feelings about the issues being discussed, attendees were polled using an application (e.g., Slido). The polling application was downloaded by attendees to their mobile phones or tablets. Attendees were asked to respond to a series of questions via the polling application after select conference sessions. The question relevant to this study was "What is your biggest insight or takeaway gained?" All questions posed to the participants were open ended, capturing a wide and diverse range of insights, feelings, and concerns.

The data collection team consisted of an intern, a community ambassador, and the assistant to the chair of GWiS, all of whom were vetted for experience in collecting social science data and trained before the conference. Team members were strategically stationed around the conference site, facilitating data collection during the conference, encouraging participation during sessions, recruiting potential respondents for interviews, and assisting attendees with the polling application, as needed.

A total of 27 data points were selected for this study representing a diverse group of participants from various ethnicities, age groups, career stages, academia, and industries. To keep participants' identities confidential in accordance with the IRB, participants were given pseudonyms. Table 1 lists participants' pseudonyms, backgrounds, and career stages. Data on participants' ethnicities was not recorded.

Table 1. List of Study Participants and their Backgrounds.

Pseudonym	Data Collection Source	Affiliation	Career Stage
Joan	Interview	School	High School Student
Jennifer	Interview	School	High School Student
Jocelyn	Interview	School	High School Student
Lacy	Interview	School	Graduate Student
Rachel	Interview	Academia	Advanced
Cameron	Slido	Academia	Advanced
Veronica	Interview	Industry	Early Career
Sierra	Interview	Industry	Early Career
Mandy	Session	Industry	Mid-Career
Melissa	Interview	Industry	Mid-Career
Taylor	Interview	Industry	Advanced
Carla	Interview	Industry	Advanced
Rita	Session	Industry	Advanced
Lola	Session	Industry	Advanced
Kevin	Session	Industry	Advanced
Attendee	Session	Unknown	Unknown

2.4 Thematic Analysis

In this study, we, like Braun and Clarke (2006), used an inductive thematic analysis approach. This approach focuses on identifying codes and themes related to the data, rather than using an a priori theoretical approach. This approach was selected to allow for capturing the struggles women in STEM face and how they feel about them, potentially beyond what is identified in the literature. The analysis involved first reading through all the data, crafting memos, and developing a coding scheme

related to challenges women face in STEM. The coding scheme was continuously refined by comparing codes and developing descriptions of coded text. Then, codes were combined into descriptive themes. To ensure coherence, these initial descriptive themes were reviewed and reorganized. This analytical process resulted in the various themes discussed in the results section.

3. RESULTS AND DISCUSSION

The themes identified through the previously described analysis of session recordings, interviews, self-reflection sessions, and polling questions, in some way or another, all point to one fact: Male-dominated cultures do not positively support women, as these cultures present them with various conflicts and obstacles. In particular, the following themes and obstacles emerged from the data:

- The struggle to be one's authentic self
- Difficulty finding one's voice, being heard
- Dealing with bias and discrimination, not being taken seriously
- The intimidation and erosion of confidence and self-esteem experienced in male-dominated culture
- Difficulties of dealing with sexism and racism as the only woman in the room
- Difficulty taking advantage of professional opportunities
- The men do not necessarily understand

Although workplace environments are increasingly becoming more diverse in the United States (Hall et al., 2019), women remain significantly underrepresented in some STEM fields (physics, engineering). As a result of women being underrepresented in these fields, they work in male-dominated environments. The women in this study, like those Steinke (2013) studied, noted struggles in these male-dominated settings. For instance, the women in this study described the men in these scientific contexts as combative, adversarial, and unsupportive. In the discussions that follow, quotations from the data sources provide evidence of these findings.

3.1 Struggling to be One's Authentic Self

Authenticity, or being true to oneself, is a common concern in women's work life (August, 2011). For the women in this study, like those in the August's (2011) study, the struggle of being one's authentic self was evident. Specifically, the participants described this struggle as an internal fight with oneself concerning whether to behave how they wanted or as others expected. "Carla's" statement during her interview exemplified this point:

> I would say the biggest challenge that I face being a woman in STEM is ensuring that I'm always authentic to myself and not trying to adapt to how I think folks want me to behave and be, but ensuring that my true self always comes out.

Carla's determination to be herself might seem fundamental, but a woman's rejection of conventions requires courage and strength since women are often taught to conform to others' expectations. "Joan's" interview response also revealed the struggle young women face when they are expected to force themselves into ill-fitting boxes to meet conventional expectations:

> As young students, people push you to do what they think you should do or what they think would be best for you, and it can be kind of hard to figure out what actually makes you feel fulfilled, what you actually want to do with your life.

Indeed, women are often brought up to please others, so it requires more energy to win the internal battle, to be true to oneself, than to conform. If women are constantly forced to endure internal battles, how can they find the energy to be productive much less to compete for promotions? How can a woman in STEM be the best version of her authentic self when that version must fracture to fit the expectations of a male-centered environment? For "Rachel," this inability to meet others' expectations while also being herself is frustrating: "When I was not myself, when I was emulating someone else and was trying to fit into someone else's version, that's not me" (Interview).

The "someone else's version" to which Rachel refers is based on gendered expectations that are rooted in men's socialization. Such socialization draws artificial boundaries between boys and girls, and these lines extend into adulthood, where they create "boys' clubs" and "good old boy" cultures. These spaces then become associated with the sort of expectations "Lacy" faces:

> Probably the biggest challenge one faces as a woman in STEM is just trying to navigate both with your own personal skills, as well as having to conform to what is seen as a typical successful person in that field, which is not always something that is supported by a non-dominated women field. (Interview)

Conforming to gendered expectations while performing career requirements leaves little time to be true to oneself. In "Mandy's" interview, she described struggling to be one's authentic self as the challenge of trying not "to extract the core pieces of ourselves" in the workplace. This challenge is consistent with findings in Fenwick's (1998) study in which women described a version of themselves or a true self that needed to be protected and preserved.

In the current study, women discussed the importance of not losing one's own sense of self when developing professional relationships, particularly with men. For these women, being or protecting their true selves refers to not being overly agreeable, concerned if everyone likes them, or willing to put up a front just to maintain workplace relationships. While recognizing the importance of protecting one's true self, women acknowledged the difficulties of being authentic in the context of workplace relationships and openly questioned how it can be done. The following quotes evidence these challenges:

> I think that one [being my true self] is really challenging in the workplace because, like some of the women today said, you want to be amenable; you want to like everyone in the room and have everyone in the room like you, but that's not always the case, and I think people can see through that. ("Veronica," Interview)

> Throughout the day, we hear about being true to ourselves but also creating these relationships with these men. I think I'm pretty true to myself and I don't want to pretend to like something to form a relationship. How do you walk that line? (Attendee, Session)

Overall, the women did not want to, in Rachel's words, "fit into someone else's version" of themselves or to be so amendable in their relationships with others, particularly men, in the workplace to the extent that they lost essential aspects of themselves. As Cameron put it, "I continue to be contradicted about choosing between being myself and standing up for myself and playing 'nice' at times and win men on my side in order to accomplish my goals" (Slido). Cameron's grievance is reminiscent of Fenwick's (1998) study of women who found their work environments to be self-destroying. When women feel that they cannot be themselves, they are unlikely to be as productive or competitive as they might otherwise be. Thus, these women's experiences help to explain why so many women tend to leave STEM fields, if they even enter these fields at all.

3.2 Difficulty Finding One's Voice, Being Heard

Related to the struggle of being one's authentic self is finding one's voice. Finding one's voice is the act of communicating one's inner, true self to the outside world or seeking to be heard (Fenwick, 1998). Consistent with other studies (Hall et al., 2015, 2018a, b; Ven Veelen et al., 2019), the women who participated in the current study reported struggling with finding ways to communicate one's true self. While participants discussed struggling to communicate one's true self in various ways, they frequently considered this topic in the context of workplace meetings. The participants' descriptions of finding voice, like their descriptions of the struggle to be authentic, revealed an internal fight. For instance, during a self-reflection session, Mandy identified the challenge of finding her voice as a continuous struggle occurring in her mind during workplace meetings: "I fight my own brain every single time I walk into one of these meetings, but I don't back down." An important aspect of finding one's voice, then, includes not backing down, even when it is difficult to speak up. Still, such internal fights demand great energy. Energy spent on overcoming challenges depletes the level of energy allocated for other career and personal activities.

Participants, while discussing the challenge of finding one's voice, noted the importance of women learning to raise questions, to voice concerns, and to disagree with their male colleagues during meetings. The women also discussed how not backing down requires feeling assertive and empowered, despite any discomfort or fear. "Melissa's" interview response highlights some of these findings:

> From observations and the fact that I work with a lot of women and men that work in the STEM fields, I think the biggest challenge is learning to find your own voice in many respects. Oftentimes, women walk into a room filled with male colleagues and even the most empowered women will still get the knot in the middle of their stomach, where they have to take a deep breath and really understand that they do have to speak up and feel empowered to speak up. So, I think that's just a more day-to-day challenge, which not only in STEM fields, but really any field asserted is male dominated.

Melissa's determination to stand her ground relates to the notion of "voice efficacy," when one believes in their own ability to effectively use their voice, even in challenging circumstances (Kish-Gephart et al., 2009). The women in this study discussed having voice efficacy, specifically in mixed-gendered STEM work contexts, and made clear that the capacity to speak up develops over time but remains challenging. As Mandy noted, "I speak up and I even interrupt when I have something to say. Getting there wasn't easy and it's not easy" (Session). Many women are taught early in life that interrupting someone else is rude. But men are socialized to be assertive; thus, they are often excused from adhering to the same social rules that women are expected to follow. While a couple of participants noted that they did not feel comfortable speaking up and questioned how they can be more assertive when they are interrupted by colleagues or find themselves "not able to speak" in work settings, other women offered suggestions to facilitate voice efficacy when participating in workplace meetings. Some of these suggestions emphasized the importance of reviewing the meeting agenda and researching unfamiliar topics, as well as establishing connections between the agenda topics and one's experiences or the experiences of others. In short, this study revealed a range of voice efficacy experiences. Some women in the study were empowered to speak up, despite internal conflicts, and identified strategies to speak up or were encouraged by others to do so. Other women struggled to achieve voice efficacy and questioned how to find their voice without losing central aspects of themselves.

These findings suggest that learning to be one's true self is a continuous developmental process that includes building the capacity to speak up or assert oneself, despite feelings of fear or discomfort. This process occurs in male-dominated workspaces that are adversarial and make it difficult for women to take advantage of professional opportunities.

3.3 Dealing with Bias and Discrimination, Not Being Taken Seriously

External factors such as bias and discrimination have the greatest negative impact on women's careers (Smith & Swamy, 2016; Wentling & Thomas, 2009). Challenges related to bias and discrimination in the workplace are based on long-held gender stereotypes and assumptions about women's competencies, which, in turn, decrease opportunities for women to move up the career ladder (Steinke, 2013). Mandy's realization that "despite the success, the external barriers still exist" (Session), showed that her experience with bias and discrimination in the workforce was like that described by women in other studies (Smith & Swamy

2016). Mandy went on to include a telling example: "My lipstick choice often will garner more of a comment than what I have to say. But my internal dialogue has changed. It wasn't overnight, and I didn't do it alone" (Mandy, Session). Mandy's example points to a form of sexism that stems from the gendered mind-body dualism in which men associate themselves with the mind and women with the body. This dualism can become widespread in male-dominated environments where one man's comment on a woman's lipstick or other aspect of her physical appearance, such as her age, can embolden other men to make similar comments.

In Wentling and Thomas's (2009) study, men intimidated their female coworkers and made degrading comments toward them. The men's behavior, as they found, was a competitive strategy to procure projects and assignments. Several women in our study revealed that they, too, had experienced discriminatory remarks from men in their work contexts. The women further expressed that these remarks made them feel uncomfortable and noted that they did not know how to respond to negative comments in professional settings. For example, one woman stated, "We've all experienced the discriminatory language of, 'Are you qualified to do this? Is there somebody more senior?' What are some responses to those comments to defuse those situations?" (Attendee, Session). Another woman explained it this way:

> I work with a lot of men that are much, much older than me. Since that's the case, oftentimes my age is a joke and it's used to break the ice. How do I work around that because it makes me uncomfortable even though I've confronted them? (Attendee, Session)

Comments that men might perceive as paternalistic teasing or admiration can sound quite alarming to women due to their own or others' previous experiences.

3.4 Male-Dominated Culture Intimidating and Eroding Confidence and Self-Esteem

Men's comments about their female colleagues' bodies are inherently harmful because they discount women's minds and create an exclusionary environment through division. Women are excluded from workplace boys' clubs and "good old boy" cultures because membership in such groups is often defined by demographics such as sex and race but also by one's willingness to conform to their peers' behavior. Thus, to gain membership, even young men who do value women's contributions to the workplace might fail to show respect toward their female colleagues. One of the participants in this study explicitly asked, "How do you deal with young male mentees who are very combative and think they know more than you and you start doubting yourself?" (Attendee, Session). To fit into the workplace culture, young male mentees often take their cues from older males, even when their mentor or supervisor is a woman. Unfortunately, the "good old boy" culture is often the more dominant and thus visible group, particularly in male-dominated fields.

"Good old boy" culture is an open sore that festers and contaminates an entire work environment, thus creating a negative experience for those who do not belong to the "club." Our participants indicated how these negative experiences in male-dominated STEM work environments can lead to self-doubt or a lack of confidence in one's professional competence, contributions, or accomplishments. High school participant "Jocelyn," recalling her and a friend's experience in a physics class, revealed that the "good old boy" culture is present even in secondary educational environments:

> One of the hardest things … currently is that … we both take physics at the highest level that's offered to our school. There's … roughly 40 students taking physics, and only 5 of us are female, and that's really intimidating, especially in class, if you ask a question or you don't know the right answer to something, that can be really intimidating to talk about … and to speak out or maybe have some of the guys in class laugh at you for asking, so it can be really difficult sometimes to overcome that and push through and keep doing what you're interested in and what you want to do when you're in such a male-dominated field. (Interview)

Jocelyn and her friend's experience points to the persistence of gendered stereotypes in STEM fields and shows that even when girls are interested in STEM, stereotypes drive boys to behave in ways that exclude girls and discourage them from taking advantage of opportunities to advance. Wentling and Thomas (2009) found that the "good old boy" culture affected their participants' self-confidence, as they felt that they were interlopers, always on the periphery, preventing them from feeling accepted or advancing. Van Veelen et al. (2019) went even further, claiming that women's negative experiences in male-dominated work environments impact not only their self-confidence but also their career-confidence, as they come to perceive themselves and their abilities through a "good old boys" ideology. Even these groups' language is a barrier to inclusion: The terms "good old boy" and "boys' club" indicate that sex is the most important membership requirement. This privileging of sex based on stereotypes increases women's likelihood of perceiving themselves as outsiders who do not belong in the workplace culture (Treft, 2019) and triggers their concern that others will call them out for being imposters (Badawy et al., 2018). Thus, Jocelyn's experience is one that she might expect to follow her from the male-dominated classroom to the male-dominated workplace.

3.5 Difficulties Being the Only Woman in The Room, Dealing with Sexism and Racism

A male-dominated work context often involves men in competition with both themselves and one another, resulting in silencing or overlooking women (Konrad & Kramer, 2008). This issue is exacerbated when an excluded woman is the first or the only woman in a setting. Participants in this study, including "Sierra," discussed the challenges of being the only woman or the first woman to work in a particular male-dominated context:

> I think it's difficult to be the only woman in a room or in a meeting, and I definitely had that experience in my company, and I think the key is silencing your inner critic or that imposter syndrome and understanding that you have a seat at the table, and there is a reason why you're there, and you have something to contribute to the team and add value. (Interview)

Concerns about being the only woman in the room were further compounded by the intersection of race and gender, as the women who discussed these issues were persons of color, thus evoking Kimberlé Crenshaw's (1989) famous argument about intersectionality, in which she found that White women and Black men often ignore Black women's experiences. Although this study did not track participants' race and ethnicity, some of the women identified themselves as women of color and connected this aspect of their identity to their feelings of being undervalued and unwelcomed in their respective STEM work settings.

"Taylor," for example, who self-identified as African American, noted that people in the workplace are initially prejudiced against her:

> Being African American in STEM, oftentimes, not only being a woman but a woman of color, sometimes is a challenge because sometimes you are the only woman of color in the room and people have their unconscious biases, so people don't really see me for my value initially until they get to know me. (Interview)

Of course, African American women are not the only ones who experience intersectional discrimination. All women of color are at risk, as shown by another participant, who shared her experience with prejudice as a self-identified Hispanic woman. She provided examples of the obstacles she has faced due to sexism and racism, despite advocating for herself:

> As a Hispanic female, I have faced a lot of adversity. I would say I completely understand the need to advocate for yourself. I have been in a situation where I have been passed up for an opportunity even though I voiced it for a year. I said, "I know this opportunity is coming; I want to be considered, these are my reasons why, and if you don't think I meet them what can I do in the meantime?" I was looked over a lot, and the reason why was, "We didn't know you." What I found was, I can't find mentors or sponsors that can speak for me in those rooms. I've been met with three things: 1) I can't be your mentor or sponsor because it'll look like we're having an affair; 2) I'm a Hispanic and I've worked very hard to get here so you need to figure it out on your own; or 3) they're willing but they're very, very overwhelmed dealing with people in my situation. So how do I go about those instances to find the right mentors and sponsors? (Attendee, Session)

As these women's experiences show, race and gender cannot be treated as mutually exclusive. Discrimination against women of color cannot be understood as separate layers of racial and sexual oppression. The intersectional discrimination that affects women of color is unique from the racism that Black men face and the sexism that White women encounter (Crenshaw, 1989). Differences exist even among women of color, as sexual orientation, age, and other aspects of identity shape every woman of color's experience with discrimination.

While the STEM experiences of women of color are unique, they do share some common challenges. Due to negative stereotypes associated with their gender and race, both African American and Hispanic women in STEM fields experience intersectional discrimination, or what Pietri et al. (2019) label "double jeopardy" (p. 1). Given women of color scientists' dual marginalized identifies, they have a higher risk of experiencing adversity and a lack of belonging in STEM fields relative to their white counterparts (Pietri et al., 2019). Yet, this finding also reveals that both women of color and White women who work in STEM fields perceive these male-dominated environments as contexts that limit opportunities for professional advancement, the topic of the next theme.

3.6 Difficulty Taking Advantage of Professional Opportunities

Most women in the study reported challenges concerning professional opportunities in STEM fields; however, they held different views about the difficulties of taking advantage of such opportunities. Some women, for example, discussed frustrations concerning how to recognize the right time to explore a new career. As one woman noted:

> I'm at a crossroads in my life, either staying at my job where I'm 18 years in this industry or going into still that path but completely different to what I'm doing. How do you identify those opportunities that you should take rather than bumps in the road that are in the way of where you should be going? How do you identify which are the nuggets you should go towards? (Attendee, Session)

The answers to these questions can be particularly elusive for women who lack the support of family members or mentors who fully understand their situation. As Cameron noted via Slido, women often have difficulty taking advantage of professional opportunities because they do not have a "support system in place," such as a spouse, parents, or savings to financially assist them when changing careers. During another session, "Lola" reflected on the time she was told that knowing what sparks her interest will help her to identify appropriate professional opportunities. However, Lola perceived this advice as unhelpful because she did not know what she was passionate about at that point in her life: "Everyone always said to me, 'You have to do what you're passionate about.' I know that was meant to inspire, but it frustrated me because I didn't know what I was passionate about. There were a lot of things I liked" (Session). Cameron's and Lola's experiences reflect Fenwick's (1998) study, in which women described struggles with deciding when to leave a job and trying to define (or redefine) work priorities.

Other participants believed that women themselves created barriers to professional advancement. For example, one participant suggested that women do not get professional opportunities because they neither seek them nor are willing to move beyond their comfort zone and try something new. Others claimed that underlying reasons why women do not take advantage of professional opportunities include being overly concerned about what others may think, fearing negative outcomes, lacking self-confidence (self-doubt), possessing perfectionist ideals, and an unwillingness to ask for help. The following quote from Taylor exemplifies many of these points:

> The other challenge is ourselves. Sometimes we talk ourselves out of opportunities. We have self-doubt, we don't push forward and don't do things that are uncomfortable or unnatural for us. We feel like we have to be perfect, and the reality is that you don't have to be. You just have to show up and be willing to take a chance on ourselves, and when we do it, other people are willing to follow. (Interview)

Taylor's argument that women need to "take a chance" on themselves might be easier said than done because women are seldom trained to believe in themselves. We must do better for women. We must normalize women's self-assertive behavior by teaching girls to stand their ground. As "Jennifer's" story about her and a friend's determination showed, when girls are persistent and believe in their own abilities, they can find the success they deserve:

> When we first joined the robotics team at our school, we were small freshman girls, and we join a team that was 100% men, or males, and this was incredibly difficult because we weren't able to pursue but … were really, really passionate about … design and fabrication, and, instead, we were pushed towards marketing and operations and organizing the team. While this is all really, really important, it wasn't really what we wanted to do. We were constantly told that we weren't meant to do fabrication, and that wasn't where we were supposed to be, and so we had to be really persistent, and we really had to push our way into the space and what we were interested in, and now I'm the design captain of my team, and she's on my group, so it's really an amazing situation now. (Interview)

Jennifer and her friend, unlike Lola, knew exactly what they were most interested in pursuing. Jennifer's drive to pursue her passion called into question the reasons for women's exodus from STEM fields. By the time these women leave, have they lost their passion or are they simply unable to sustain the energy to pursue it in male-dominated environments?

Though women perceived the challenges associated with taking advantage of professional opportunities as linked to a lack of knowledge (not knowing when to take advantage of an opportunity) or insufficient resources to support taking professional risks. In contrast, other women perceived this challenge to be more

related to negative mental attitudes or unproductive mindsets that hinder their ability to explore professional opportunities. These findings are aligned with Fenwick's (1998) claim that not all challenges to women's professional advancement in STEM fields are external. Some issues are internally imposed, thus increasing the chances that others will understand and be able to help them break through the barriers.

3.7 Men Do Not Necessarily Understand

Recent studies have shown that women engineers' conversations with male colleagues can trigger feelings of incompetence and a lack of acceptance, as on the days when the studied conversations took place, women's levels of self-reported gender identity threat were higher than on other days (Hall et al., 2015, 2018a, b; Van Veelen et al., 2019). Despite these findings, men do not necessarily understand the issues women face in male-dominated STEM environments nor know how to help. They can even become defensive when their female co-workers attempt to initiate conversations on the subject. For example, one participant recounted her male colleagues' reaction to her interest in attending GWiS:

> Even when bringing up the opportunity to come to this summit with some coworkers, we were met with this "where we went wrong" attitude. I wanted to ask, how I should phrase criticism in a way that doesn't immediately put my partners in the defense? (Attendee, Session)

As men are socialized to be competitive, it can be difficult for them to understand why women hold themselves back and have trouble taking advantage of opportunities. It might seem as if women see men as culprits. But gendered expectations, not men, are to blame. Western society expects men to forge the way while women obey the rules that confine them. When women do the unexpected—entering a male-dominated STEM field, for example—they flip these expectations and forge the way for other women. Still, women instinctively know that they must conform to some expectations, such as appearance, to get a pass in other areas. "Kevin," one of the men who participated in the 2019 GWiS, noticed the differences between men's and women's appearances in both college and workplace settings:

> If I'm growing up as a woman, I have to wonder if I fit into this place. At the workplace, women dress really nice. Men wear crappy jeans and crappy shirts. Every woman has to worry about perception, and I wonder where that thought comes from. I went to visit my son at his college, and I saw the same thing, guys wearing crappy jeans and women dressed to go to the nines. So somewhere early in life, they're getting the message that they have to present themselves differently than men. So, it makes me wonder how much else is happening that those men don't understand that is putting stress, taking energy away from doing your work, not letting you be yourself, not letting you speak up when you want to speak up. (Session)

As Kevin's realization shows, gendered expectations create more work for women. Women put extra energy into their appearance to gain acceptance in male-dominated fields and, in doing so, fight internal battles against their own fears and emotions. As men do not need to make additional effort to present themselves as capable and successful, they do not understand.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 The Inner and Outer Struggles are Many and Real

The climates and cultures of STEM environments are dictated predominantly by men. Analysis of data collected through a combination of self-reflection instruments from 35 diverse female participants during the 2019 GWiS uncovered inner and outer struggles that hinder women's success and retention in intimidating male-dominated cultures. In these cultures, women struggle to be authentic and find it hard to speak up and be heard, especially when they are the only woman in the room. They wrestle with discrimination and are not taken seriously, leading to self-doubt and difficulties taking advantage of professional opportunities and advancing their careers.

If a woman's work environment sends her the message that she is not good enough, that what she has to say is not important enough, that her male colleagues are more valuable to the organization, and if she is surrounded by what she perceives as a closed network, then she is likely to experience self-doubt and lack confidence for taking risks and moving forward. As the participants' responses showed, some women believe that men's behavior further agitates the obstacles they face while others perceive women themselves as barriers to their own professional advancement. The fault lies with neither men nor women but with gendered expectations. These expectations shape behaviors and mindsets, both of which shape the environments in which we work and live. Women hold themselves back because they were taught, not born, to do so. To overcome these lessons, some participants fought internal battles and devised their own resistance strategies.

4.2 Struggles Exist Across Generations, Sectors, and Career Stages

Though our findings were in line with some of the studies referenced in this paper, this study offers a unique, important contribution to the literature due to the participants' diversity. The participants in this study consisted of a multigenerational group of women from various sectors, career paths, and stages. The diversity of this group and the frequent consistency of responses signify that the issues women in STEM face are not localized but present across sectors and persist as women progress through their careers.

4.3 Validating Women's Experiences of Struggle is an Essential Steppingstone Toward Equity

Validating women's experiences and creating healthier, more supportive environments could make a significant difference in their trajectories. Since female perspectives are often overlooked (Swafford & Anderson, 2020), so are their challenges. Without validation, women are at risk of feeling isolated, discouraged,

and inferior. In counterbalancing what women see as a lack of competence, they can become trapped in unhealthy workaholic patterns, compromise their authentic identities to fit in, or even leave the profession, taking their unique contributions with them. With validation, however, women are more likely to realize that the challenges they face are not unique and that their struggles and burdens are real, often due to male-dominated cultures and external factors outside of their control. Through validation, women can come to understand that they already possess what is necessary for their success and that there are potential solutions to their challenges.

4.4 Counterspaces Are Essential for Women in STEM

Traditional STEM spaces often discount women's knowledge and experience; within these spaces, women are not perceived as able and knowledgeable. Counterspaces, safe spaces that exist outside of traditional spaces, can provide solutions as well as validation (Solórzano et al., 2000). Counterspaces are necessary in STEM, where norms center on White men (Ong et al., 2018). GWiS is an example of a female counterspace in which women's abilities and knowledge matter. Research has emphasized the importance of relationships and interpersonal connections to women's psychological development and well-being (Morganson et al., 2010), and counterspaces offer access to role models and mentors. Thus, counterspaces can help women to persist in male-dominated STEM fields by validating their identities and perspectives, allowing them opportunities to take agency over their struggles, creating empowering experiences, and countering negative feelings that emerge from disempowering white male-biased study and work environments. By resisting patterns of oppression, like sexism and racism, counterspaces can provide neutral spaces for mediation for STEM men and women to engage in conversations about these issues. Of course, mediation requires the participation of more men, and, if not carefully controlled, could destabilize the countereffects of the space.

4.5 Women Must be Heard to Change the World

Engaging women in discussions about male-dominated environments increases equity by providing a better understanding of how they feel about the struggles of working in these environments and how these struggles impact their personal and professional well-being. Their engagement in these discussions amplifies, validates and elevates women's underrepresented identities and perspectives in STEM and uncovers the root causes of their struggles, providing a much-needed female perspective on the male practices that hinder women in STEM. If widely implemented, this shift in perspective from how to improve women so they can better fit within the status quo to a better understanding of women and their struggles, values, motivations, and unique gifts has the potential to build a new balanced STEM reality that benefits all, not only in the U.S. but also around the world.

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