Skewed SySTEM: The Double Bind for Women of Color in STEM

by

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Term Paper

Engineering Management 52
Tufts University
Medford, Massachusetts

December 28, 2017

EXECUTIVE SUMMARY

The purpose of this paper is to raise awareness of the double bind experienced by women of color in the fields of science, technology, engineering, and mathematics (STEM). After reading this paper, readers should be able to take effective action towards supporting women of color in STEM, thus mitigating the negative effects of the double bind.

My research includes (1) the history of inequity in education in the United States, (2) obstacles for women of color in higher education and the workforce, (3) the persistence of women of color in STEM, and (4) ways to mitigate the negative effects of the double bind. The scope of my paper is limited to the experiences of women of color in the United States who have already declared interest in post–high school STEM careers. Of the experiences of women of color in college, I focus on the experiences of women of color in predominantly White institutions (PWIs). My paper does not cover the systemic and societal factors that affect women and people of color since childhood and affect their choices to pursue STEM fields in college or to even attend college at all.

Diversity in the workforce directly benefits diverse companies and businesses, and it also leads to better experiences and achievement levels for women and people of color. Yet there is a lack of true diversity in STEM, which is a direct result of the history or inequity in education in the United States and the obstacles that women and people of color face in education and the workforce. Only true demographic diversity, not superficial tokenism, will allow organizations to achieve the desired benefits. Although positive interactions with women of color in STEM can help, organizational changes that directly address diversity issues in STEM are more effective at improving the overall system.

Persistence is the ability of women and minorities to stay in STEM even though the system is biased in various ways that exclude them. Many women and people of color drop out of STEM before reaching the highest levels of achievement, and the ones that stay develop adaptations and defense mechanisms, some of which are unhealthy. The STEM environment should be inclusive so that all people can participate throughout their intended career trajectory without negatively altering their sense of self.

Despite the indisputable effects of the double bind on women of color and the STEM workforce, dominant (White and male) culture in the United States tries to deny the very existence of the double bind, hindering societal progress. When women of color can fully participate in STEM, their scientific discoveries can help more people live their best life, and women of color can freely pursue their interests. Due to these benefits, improving experiences of women of color in STEM is not only a societal duty but a moral obligation.

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LIST OF ACRONYMS AND INITIALISMS

HBCUs	Historically Black Colleges and Universities
HSI	Hispanic-Serving Institution: a college or university with a full-time undergraduate student population that is at least 25% Hispanic (Title III of the Higher Education Act of 1965, as cited in Aspray, 2016, pp. 65–66)
PWI	Predominantly White Institution
STEM	Science, Technology, Engineering, Mathematics: fields of study and work
TCUs	Tribal Colleges and Universities

LIST OF DEFINITIONS

Assimilation	the process of adapting or adjusting to the culture of a group
Disproportionality	disproportionate representation; the over- or under-representation of a given population group (defined by race, gender, and more) in a specific population category
Gender	behavioral, cultural, or psychological traits typically associated with masculinity or femininity
Marginalize	to treat a person, group, or concept as insignificant; to put in a powerless or unimportant position within a society or group
Parity	the state or condition of being equal
Race	a socially constructed human classification system that is used to establish power and to benefit the dominant group
Stereotype	an oversimplified image or idea about a group of people
Tokenism	the practice of recruiting a small number of people from underrepresented groups to give the appearance of sexual or racial equality within a group

1.0 INTRODUCTION

1.1 Purpose

The purpose of this paper is to raise awareness of the double bind that affects women of color in the fields of science, technology, engineering, and mathematics (STEM). After reading this paper, readers should be able to take effective action towards supporting women of color in STEM. By actively and collectively supporting women of color in STEM, readers will be able to mitigate the negative effects of the double bind.

1.2 Scope

My research includes (1) the history of inequity in education in the United States, (2) obstacles for women of color in higher education and the workforce, (3) the persistence of women of color in STEM, and (4) ways to mitigate the negative effects of the double bind.

The scope of my paper is limited to the experiences of women of color in the United States who have already declared interest in post–high school STEM careers. Of the experiences of women of color in college, I focus on the experiences of women of color in predominantly White institutions (PWIs).

My paper does not cover the systemic and societal factors that affect women and people of color since childhood and affect their choices to pursue STEM fields in college or to even attend college at all. Other topics outside of my scope are the experiences of women of color in historically Black colleges and universities (HBCUs), Hispanic-serving institutions (HSIs), tribal colleges and universities (TCUs), and women's colleges. Many of the sources I found in my research either include information on the experiences of women in STEM or the experience of people of color in STEM; this dearth of research on the specific experiences on women of color in STEM limits the scope of my paper.

1.3 A Note on Terminology: Gender and Race

Gender and race are heavily nuanced social constructs that tangibly affect people's lives. In order to simplify discussion and analysis, we will make a series of assumptions.

For the purposes of this paper, gender will be treated as a binary. That is, although gender is a spectrum on which people can choose to identify and express themselves, we will assume that the people mentioned in this paper identify and express themselves as either male or female.

Gender self-identity, biological sex, and social gender assignment are separate from one another, but for the purposes of this paper, we will assume that gender self-identity and social gender assignment are consistent. In other words, we are assuming that the gender with which people self-identify matches the gender that others assign to them. Only women can experience sexism, but anyone can experience gender-based prejudice.

At this time, the most frequently used racial categories in the United States are: Asian American/Pacific Islander, Black/African American, Indigenous/Native American, Hispanic/Latino, and White. These are the racial categories commonly used by data collection agencies, such as the U.S. Census Bureau. Scholars writing about race often choose to capitalize racial categories in order to emphasize that they are referring to a social construct and not biological skin color (e.g., "White" instead of "white"). The term "people of color" is used interchangeably with "minorities," and it encompasses every racial category except White. It is important to note that many people are mixed-race and choose to identify with more than one race. However, we will assume that people mentioned in this paper identify as either White or non-White and that this self-identified race is consistent with the race that others assign to them. Only people of color can experience racism, but anyone can experience race-based prejudice.

1.4 The Double Bind for Women of Color in STEM

In the United States, dominant culture prioritizes the interests and experiences of White men and marginalizes those of women and people of color. Historically, the demographic of STEM fields has been predominantly White and male, and this historical standard creates an environment where women and people of color experience obstacles that White men do not.

Women of color in STEM simultaneously experience gendered and racial bias, unlike White women and men of color; this distinct experience is called the double bind (Ong, Wright, Espinosa, & Orfield, 2011, p. 181). The obstacles accumulated from being both female and a person of color in STEM produce tangible effects: The achievement levels of women of color are lower than those of White women and of men of color, especially at the most specialized levels of STEM ("Unraveling the Double Bind," 2011, p. 158).

The concept of a double bind for women of color in STEM was first introduced in 1976 when Malcom, Hall, and Brown published *The Double Bind: The Problem of Being a Minority Woman in Science*, but since then, no one has made any sustained efforts to support women of color in STEM (Ong et. al, 2011, pp. 175–176). Ong et. al (2011) attribute this lack of support to

the “misguided idea” that institutional efforts to serve women or minorities would also serve minority women; this assumption is harmful because these institutional efforts disproportionately benefit White women and minority men (p. 176).

1.5 Benefits of Diversity in STEM

Fewer women and people of color pursue STEM due to obstacles that disproportionately affect them, especially at the higher levels. Poor people of any gender and race face additional obstacles that limit their participation in STEM (Drew, 2011, pp. 48–49). This lack of representation is especially harmful in these fields, as the goal is often to create solutions that may benefit large populations of people. Removal of the barriers that limit participation in STEM will increase the diversity of knowledge and technical skills available in the American workplace, allowing STEM specialists to transform more lives (Drew, 2011, p. 48).

Diversity in education and the workplace leads to more-informed decisions, enhanced performance, more creative innovations, and increased possibility of serving a broader population (Klawe, Whitney, & Simard, as cited in Drew, 2011, p. 34; Ong et. al, 2011, p. 176). The achievement of female students and students of color in science is directly related to the demographics of the teaching faculty: Female students perform better in male-dominated disciplines when taught by female teachers, and students of color perform better when taught by instructors of their same race (Carrell et. al, Fairlie et. al, and U.S. Department of Health and Human Services, as cited in Ginther, Kahn, & Schaffer, 2016, p. 1098). Although more diverse workplaces and schools with better-performing students are at an economic advantage, economic motivations should not overshadow the moral obligation to seek justice for women and people of color (“Unraveling the Double Bind,” 2011, p. 158).

1.6 Equality and Equity

The benefits of diversity in STEM cannot be produced by simply recruiting an increased number of marginalized people. This practice, known as tokenism, does not improve the experiences of the marginalized people, who are being used to improve the reputation of an organization. Parity, or equal representation in the workplace, can artificially be created through strategic recruitment, but parity does not guarantee equality or equity. Through policy changes, people often seek equality, or the practice of giving the same rights, expectations, and opportunities to everyone, but in doing so, policy-makers assume that all people have the same experiences and abilities.

Equality does not account for the historic marginalization of women, people of color, and people of lower socioeconomic class. Proponents of equality argue that the past should not affect equal treatment in the present.

Equity, in contrast, takes into account that everyone starts out in life with different disadvantages and needs. Equity-based policies are goal-oriented and focused on justice: By compensating for the disadvantages that people experience and tailoring treatment to needs, equity-based policies can ensure that everyone can achieve goals and maintain well-being. STEM fields have historically lacked both equality and equity, and this history continues to affect the lives of women, people of color, and women of color.

2.0 HISTORY OF INEQUITY IN EDUCATION AND THE WORKFORCE IN THE UNITED STATES

2.1 Significant Laws, Events, and Court Cases

For inequity and inequality to exist, a dominant group must claim superiority over others. To justify oppression of other groups, dominant culture asserts that these groups are mentally inferior (Drew, 2011, p. 51). Oppression can take the form of policies, laws, and cultural norms that are bolstered by unspoken biases. Since education provides an opportunity for citizens to gain skills and knowledge with which to contribute to society, policies that provide equitable access to education are essential for uplifting oppressed groups (Noltemeyer, Mujic, & McLoughlin, 2012, p. 3).

When European colonial powers first came to North America, the Europeans stole land from the Native Americans and forced them to assimilate to White culture (Loring, as cited in Noltemeyer et. al, 2012, p. 4). These events set the precedent for treatment of other racial and ethnic groups, including Black Americans and Asian Americans. While societal standards forced people of color to assimilate to White culture, school boards prevented people of color from receiving the same education as that of White students or from receiving an education at all (Noltemeyer et. al, 2012, pp. 4–5). Many of these discriminatory policies applied to public primary and secondary schools and thus indirectly excluded people of color from participating in higher education and certain fields in the workforce.

The Civil Rights Act of 1964 forced White colleges and universities to admit Black students, and the Higher Education Act of 1965 provided funds to historically Black colleges and universities (HBCUs), which lacked the resources to provide the same education as that of White colleges (Aspray, 2016, pp. 35–38). Since then, predominantly White institutions (PWIs) have been required by law to implement affirmative action, a policy that aims to diversify student bodies by giving traditionally marginalized groups a fair opportunity to be admitted (Aspray, 2016, p. 41).

White women could attend college starting in 1836, with the charter of Georgia Female College, now Wesleyan College (Noltemeyer et. al, 2012, p. 16). Between 1836 and 1930, other women's colleges were established, and some men's colleges began to admit women; between 1900 and 1930, enrollments of men and women in college were approximately equal (Aspray, 2016, p. 18). In the 1930s, school policies started to bar married women from teaching; these

"marriage bar rules" made college degrees less valuable to women, who often majored in education (Aspray, 2016, p. 18). Between 1968 and 1985, approximately 40 major men's colleges and universities began admitting women; although these institutions had strong programs in STEM, few women pursued majors in them (Aspray, 2016, p. 25). According to Aspray (2016), female college students were often channeled towards majors in "female-intensive disciplines" such as education and literature; this changed in the 1970s and 1980s, when newly popularized contraceptive technology allowed women to delay having children to focus on math- and science-intensive careers (p. 18).

Policies restricting women's and minorities' access to education were effective at preventing them from entering certain fields in the workforce, but additional policies specifically excluded women and people of color from the STEM workforce. During the two World Wars, women took on traditionally male occupations, but they were treated as replacements for men at war and were forced to surrender the jobs once the men returned (Aspray, 2016, p. 27). After World War II, women in scientific careers were paid less than men and were forced out if they got married (Aspray, 2016, p. 18).

The 1964 Civil Rights Act prohibited federally funded programs from discriminating on the basis of race or gender, allowing women and minorities to work in more occupations than before (Noltemeyer et. al, 2012, p. 7). In 1972, the Equal Employment Opportunity Act and the Educational Adjustments Act (including Title IX) passed, allowing women and minorities to file lawsuits against unlawful and exclusionary practices (Aspray, 2016, pp. 23–24). These two acts were important because women and people of color were finally protected by the law, and they set the precedent for legislature that explicitly requires inclusivity. However, there is still much progress to be made, especially considering that the existence of laws does not guarantee cooperation from everyone.

2.2 Residual and Ongoing Effects of Inequity

Although women and minorities have the same rights as White men on paper, obstacles that they encounter in education and the workforce limit their participation and achievement in STEM. Women of color in particular are consistently underrepresented in advanced education and career stages relative to White women and men of color (Ong et. al, 2011, p. 173); in STEM fields, the achievement levels of women of color are consistently lower than those of White women and men of color ("Unraveling the Double Bind," 2011, p. 158). Minority women earn more

bachelor's degrees than minority men in almost every STEM discipline, but they earn fewer STEM Ph.D.s than minority men, White women, and White men; of the women of color who earn Ph.D.s in STEM, a smaller proportion of them are chosen as STEM faculty (NSF, Nelson & Rogers, as cited in Ong et. al, 2011, p. 173). Although Asian American/Pacific Islander women are often considered the exception because they earn bachelor's degrees and Ph.D.s in STEM at a disproportionately higher rate relative to their representation in the general US population (Ong et. al, 2011, p. 174), they still do not advance to higher-level leadership positions at the same pace as White women and men of color (Burrelli, Wu & Jing, as cited in Ong et. al, 2011, p. 175). Additionally, it is important to note that the racial group "Asian American/Pacific Islander" encompasses ethnic groups from over 50 countries, and some of these Asian ethnic groups are overrepresented in STEM while others are severely underrepresented (Aspray, 2016, p. 2).

In addition to being underrepresented in higher education and the workforce, women and women of color are often paid less than their male counterparts. Female engineers earned more than their male counterparts at the start of their careers, but after ten years, they earned only 93 percent of their male counterparts' salaries (Dey & Hill, as cited in Gamm, 2014, p. 3). Women faculty in computer science earn 81 percent of what their equally qualified male counterparts earn (Klawe, Whitney, and Simard, as cited in Drew, 2011, p. 34).

3.0 OBSTACLES FOR WOMEN OF COLOR IN HIGHER EDUCATION AND THE WORKFORCE

3.1 Stereotypes and Biases of Educators, Supervisors, and Peers

While pursuing STEM degrees and careers, women and people of color often experience negative biases from educators, supervisors, and peers. Biases can either be explicit or implicit: Explicit biases are declared, such as policies that discriminate, while implicit biases are attitudes and assumptions that subconsciously affect behavior (Gamm, 2014, p. 119).

When educators and supervisors hold negative biases against women and people of color, they often evaluate women and people of color as less competent. These biased evaluations often result in lower grades and fewer opportunities for hire and promotion. At every level of education, from grade school through graduate school, teachers more frequently interact with male students and give them more helpful and precise feedback (Sadker & Sadker, as cited in Gamm, 2014, p. 13). According to a Native American woman transferring to a university from a community college, the instructors would place the Native American students in the back of the classroom, and they "wouldn't worry whether or not we were understanding the material" (Reyes, 2011, p. 251). Teachers will also consider male students to be more competent: Liu found that female students are less likely to receive meaningful and critical praise than male students (as cited in Gamm, 2014, p. 14), and girls are referred to programs for gifted students half as often as boys (Orenstein, as cited in Gamm, 2014, p. 15). When rating National Science Foundation (NSF) fellowship applicants, faculty systematically give lower ratings to minority women than they do to minority men, White women, and White men, even when undergraduate GPA and degree field majors are considered (Brown, as cited in Ong et. al, 2011, p. 194).

This discrimination extends beyond the classroom and is perpetuated even by mentors who are meant to guide students, directly impacting the path that they take in life. Advisers and administrators in community colleges commonly channel Hispanic students into vocational paths instead of preparing them to transfer into STEM; this channeling practice is often done independently of students' wishes and academic abilities (Ornelas & Sóloranzo, as cited in Reyes, 2011, p. 251; Aspray, 2016, p. 63).

Even in professional STEM fields, women of color find themselves being unfairly treated simply due to their race and gender. Ben Barres, a transgendered neurobiologist who used to go by Barbara, shares an anecdote highlighting the assumption that women are innately less capable

than men: Soon after Ben changed sex, a faculty member praised Ben's work as better than that of his "sister's," not realizing that Ben's "sister's" work was indeed Ben's own work (Drew, 2012, p. 34). According to Brush, when a woman makes a scientific discovery, she is often not credited in discussions; this type of omission perpetuates "the belief that science has been created almost entirely by men" (as cited in Drew, 2011, p. 37).

When educators, supervisors, and peers are constantly questioning the abilities of women and people of color in STEM, these individuals will internalize the biases and begin to question themselves. In a study exploring the relationship between math achievement and self-assessment, male students and female students of the same math ability (based on previous performance) rated their own abilities differently: Female students assessed themselves lower than their male counterparts, and this lower self-assessment decreased the likelihood of these female students choosing to pursue math in higher education (Correll, as cited in Gamm, 2014, p. 24). In another study, Shain found that self-confidence in math ability led to academic success for African American female engineering majors (as cited in Ong et. al, 2011, p. 188).

Researchers have investigated the effect of stereotypes on people who have internalized racism and sexism. The term stereotype threat refers to a measured drop in performance that occurs when people think about a negative stereotype that applies to them (Steele, as cited in Drew, 2011, p. 43), and stereotype boost is the opposite: People do better when they think about a positive stereotype that applies to them. Questioning the validity of stereotype boost, Cheryan and Bodenhausen investigated whether positive stereotypes could actually threaten performance in math: The Asian American women in the study did not respond to the negative stereotype that women were bad at math, but they did significantly worse when exposed to the positive stereotype that Asians are good at math (as cited in Ong et. al, 2011, p. 188). Cheryan and Bodenhausen attributed this unexpected result to the pressure to live up to expectations and the fear that positive stereotypes did not apply to them (as cited in Ong et al, 2011, p. 188).

3.2 Unjust Methods of Evaluation

STEM fields are notorious for recruiting only White males of a particular personality profile (Drew, 2011, p. 38): Objectivity is valued while emotions and secondary speculations are viewed as wastes of time. Because White men are the default, evaluations of everyone else in the field are biased.

First, we must question how women and people of color learn the material on which they are tested. According to Brotman and Moore, teaching styles in science often exclude the interests and learning styles of girls (as cited in Gamm, 2014, p. 20).

Minority students often perform worse on standardized tests like the SAT and IQ tests, but this performance reflects less about these students' intelligence and more about concepts that are assumed to be common knowledge but are not readily available to all test-takers (Freedle, as cited in Drew, 2011, p. 41). Kahle attributes gender-based test bias in science to the fact that tests are tailored to cover areas in science where boys have been encouraged to take more courses and show more interest (as cited in Gamm, 2014, p. 18).

Additionally, people are expected to take standardized tests at the same points in life. Drew (2011) asserts that most STEM students gradually accumulate knowledge and experience rather than peaking early in life (pp. 47–48), and when women and people of color are expected to assimilate to the expectations of White male culture, they must learn additional information at the same rate at which their White male peers can focus on learning just what they need for the exam.

3.3 The Unwelcoming Culture of STEM

Due to the objective nature of STEM work, STEM culture is often considered to be meritocratic and free of racism and sexism; however, this viewpoint is at odds with the experiences of women and minorities, who often feel that they are not recognized as legitimate members of the STEM community (Carlone & Johnson, as cited in Ong et. al, 2011, pp. 182–183). To gain acceptance from male peers and faculty, women of color in science must perform extra, invisible labor relating to the unspoken rules of science culture (Ong, as cited in Ong et. al, 2011, p. 183). Additionally, in order to maintain the illusion that success in STEM is based purely on talent, many professors actively avoid discussing issues related to race and gender, unintentionally perpetuating racism and sexism and making women of color feel silenced or ignored (Johnson, 2007, p. 816).

In large research universities, STEM culture is often competitive and individualized (Valenzuela, as cited in Ong et. al, 2011, p. 184), creating an unwelcoming atmosphere for women, who tend to avoid competition, and minority women, many of whom thrive in collaborative environments (Niederle & Vesterlund, as cited in Ginther et. al, 2016, p. 1105; Ong et. al, 2011, p. 191).

3.4 Lack of Communities of Support in STEM

Women and minorities in STEM encounter disproportionately more obstacles than their White male peers, but they do not have access to enough support in STEM to help them cope with these hardships.

Peer support networks, especially peer study groups, are important for long-term student success, but women of color often have trouble joining peer study groups that do not include other minority women (Justin-Johnson, as cited in Ong et. al, 2011, p. 186). On the other hand, women of color often look within their racial community for peer support but still feel alienated because their peers do not completely understand the experience of being a woman of color in STEM (Shain, as cited in Ong et. al, 2011, p. 186).

Women of color also believe that the lack of female, minority faculty role models in STEM is a disadvantage that their minority male, White female, and White male peers do not experience (Brown, as cited in Ong et. al, 2011, p. 194). Additionally, female minority students lack role models at home who can help navigate the STEM environment (Teo, 2014, p. 49).

4.0 PERSISTENCE OF WOMEN OF COLOR IN STEM

4.1 Definition of Persistence

For the purposes of this paper, persistence is the ability of women and minorities to stay in STEM even though the system is biased in ways that exclude them. Women and people of color working in academia are more likely than White men to report dissatisfaction with the workplace and are more likely to leave (AAUW, as cited in Gamm, 2014, p. 26), but this trend reveals more about the STEM environment than it does about these groups' commitment to staying in STEM. By modeling persistence in STEM, policymakers hope to increase participation in STEM from underserved groups.

4.2 The STEM Pipeline

The STEM Pipeline is a metaphor that models the path people take from high school to specialized STEM occupations, with the intermediate steps being receiving undergraduate and graduate degrees (Aspray, 2012, p. 8). This metaphor can be extended: the STEM Pipeline is "leaky" when the percentage of women and minorities declines as the pipeline reaches higher levels of achievement (Teo, 2014, p. 49).

Although the pipeline model has become popular among policymakers, many people believe that the pipeline model is limited in the extent to which it can benefit women and people of color. One criticism is that the pipeline model only focuses on adding more marginalized people to the workforce, treating them as "passive resources to be harnessed" (Mendick, Berge, & Danielsson, 2017, p. 482). Mendick et. al (2017) believe that this focus on diversification does nothing to democratize science, i.e. encourage equal participation from all STEM community members (p. 494). Additionally, the leaky pipeline metaphor leads to the stigmatization of the people who choose to use their skills outside of STEM and accepts as lost the individuals who did not complete each step as expected (Aspray, 2016, p. 10). The linear nature of the model does not leave room for gaining skills outside of formal education or for skipping certain steps.

4.3 STEM Career Pathways

The multiple pathways model has become increasingly popular to model the STEM careers of women and people of color. The Committee on Equal Opportunity in Science and Engineering (CEOSE), an advisory body created by Congress in 1980, renounced the pipeline in 2004 and

advocated for the pathways metaphor (Aspray, 2016, p. 10). According to Reyes (2011), women of color often take a more circuitous route through higher education (p. 248). Gamm (2014) attributes this circuitous route to women's tendency to explore opportunities in order to prevent regret later: Women wanted to satisfy both their work and personal goals (p. 106).

4.4 Social Adaptations of Women of Color Who Remain in STEM

In order to survive in the STEM environment, women of color adopt a series of coping behaviors. According to Ong et. al (2011), female STEM majors of color seek out academic and personal support vigorously and with serious intent: They cultivate strong social networks consisting of family members, faculty members, university administrators, and peers, both within and outside of STEM fields (p. 185). Although women of color have found that support networks help them succeed (Fuller & Meiners, as cited in Ong et. al, 2011, p. 185), they must often "fragment" their identities, or reveal only certain aspects of themselves in certain interactions (Joseph, as cited in Ong et. al, 2011, p. 193). For example, women of color in STEM will only focus on topics related to academics when interacting with classmates or faculty within the department, and they will only discuss topics relevant to their racial or gender identity to their peers who also share these identities. White women, men of color, and White men in STEM are more likely to share non-academic experiences with other people in the department, so they do not have to perform this fragmentation of identities as often. According to Tate and Linn (2005), engineering students' non-academic identities are equally important in ensuring academic and professional success: The intersections of identities creates a sense of belonging, which increases the likelihood of persistence in the field (p. 491).

In addition to directly adjusting their social interactions, women of color also take on certain behaviors after internalizing racism and sexism. Internalized oppression occurs when people of oppressed groups believe that people of their own identities are inferior to people who belong to the dominant group. One behavior stemming from internalized oppression is dissociating oneself from the devalued groups: Women of color in STEM might play down their racial or gender identities, or they might act hostile towards the few other women of color in the class (Reyes, 2011, p. 252). Because the rules of tokenism state that there is limited space for traditionally marginalized individuals, these individuals must pretend their racial and gender identities do not matter to them, compete with and assert dominance over peers who share their same identities, or both. Another behavior caused by internalized sexism is the adaptation of

male behavior: In order to be taken seriously and viewed as competent workers, women who had worked in STEM for long enough learned to project confidence by bragging about achievements and by speaking more loudly (Gamm, 2014, p. 115). Women would also cut their hair short and act more brusque (Kim, as cited in Gamm, 2014, p. 116).

5.0 METHODS OF MITIGATING THE NEGATIVE EFFECTS OF THE DOUBLE BIND

5.1 Interpersonal Interactions with Women of Color

The most cost-effective and most easily implementable strategy for supporting women of color is improving interpersonal interactions with women of color. This strategy is accessible because anyone, regardless of occupation and relationship with women of color, can participate.

The first step to improving interactions with women of color is to develop civic literacy, or knowledge of how to actively initiate change in your community and greater society (Teo, 2014, p. 53). Civic literacy includes awareness of other cultures and sensitivity in communication: Individuals should avoid imposing the views of the dominant culture onto others (Teo, 2014, p. 53). Developing civic literacy can be as simple as learning about the history of oppression and the specific obstacles that marginalized people face. When developing civic literacy, you must not expect women of color to educate you; women of color are often expected to explain themselves to their White and male peers and supervisors.

The next step is to have positive human interactions with women of color. According to Gamm (2014), women who have received explicit messages of support from professors and institutions in the form of professional networking and scholarships, respectively, felt more encouraged to continue in their STEM career path (p. 90). A subcategory of support is showing appreciation, and the best way to show appreciation in the workforce is to give people flexibility (Gamm, 2014, p. 93). According to the women interviewed in Gamm's study (2014), women offered flexibility in choosing schedules or assigned tasks felt that the quality of their work and their satisfaction doing the work were valued more than the hours they spent working (p. 94). Small acts of kindness and support can significantly improve women of color's outlook towards their academic and professional life: If you have the power to make someone's life more bearable, you should do so.

5.2 Structural Improvements in Higher Education and the Workforce

5.2.1 Fixing the people versus fixing the system

People that have more power in institutions and companies should strive to help women and people of color with larger, structural changes. Structural improvements that attempt to bring equity into STEM can be split into two categories with different goals: fixing the people and

fixing the system. Fixing the people entails creating interventions for the groups that have been traditionally excluded from STEM; interventions may include minority-only financial aid programs, summer-before-college bridging programs, and mentoring programs (Aspray, 2016, p. 11). According to Aspray (2016), these interventions can stigmatize the underrepresented groups and reinforce stereotypes: People might think that minorities do not belong in STEM because they need extra help and attention (p. 11).

Because the double bind for women of color in STEM is rooted in systemic inequity, the best solutions directly change the system. Fixing the people should be regarded as a temporary fix until the system itself can be fixed. Fixing the system is a much more difficult feat, so companies prefer to focus on fixing the people: According to Aspray (2016), technology companies spent years recruiting new women and minority hires before even considering changing their organizations' practices and environments (p. 11). Fixing the system is much more effective in improving retention and advancement of women of color in STEM: According to the participants in Gamm's study (2014), employers' intentional efforts to address diversity and to create an inclusive environment made a noticeably positive change in workers' attitudes (p. 136).

5.2.2 Facilitating access to support groups and role models

When fixing the people seems to be the best or only option, facilitating access to support groups and role models is the most effective strategy. Peer support networks are crucial in ensuring long-term student success, especially when peers share similar academic experiences and social identities (Ong et. al, 2011, p. 186). According to Johnson, the cohesive peer community fostered by retention programs greatly supports student persistence (as cited in Ong et. al, 2011, p. 184). Peer support groups are successful because they create inclusive, informal environments where students feel that they belong (Gamm, 2014, p. 133).

Increasing the number of role models and facilitating access to these role models is also important for the success of women of color in STEM. Exposure to female role models in STEM is shown to improve female students' self-concepts, attitude towards STEM, and motivation towards continuing in STEM (Stout et. al, as cited in Gamm, 2014, p. 132). According to Richard Tapia, a Latino professor at Rice University, minority faculty serve two important roles: They demonstrate feasibility of success to minority students, reducing the effect of stereotype threat, and they are a living example for non-minority students and faculty that the stereotypes are untrue (as cited in Drew, 2011, p. 31).

5.2.3 Adjusting community standards to support women of color

Adjusting community standards is a good starting step towards changing the system. After Carnegie Mellon University noticed that the culture of its computer science department deterred female students from enrolling and persisting, it worked to change the curriculum, culture, and available support in the department. According to Gamm (2014), the computer science department's main goal in making the changes was to remove the expectation that women were to model themselves after the stereotypical male student (p. 25). Margolis and Fisher observed that after the institutional changes were complete, the women's enrollment in computer science rose by 42 percent (as cited in Gamm, 2014, p. 25).

Companies can change their work culture as well: Gamm (2014) believes that decentralized, more collaborative workspaces are more successful (p. 95). By respecting the different perspectives of employees and giving everyone an equal chance to contribute, managers can create a work atmosphere that is conducive to community building (Gamm, 2014, p. 96). Positive work environments may also offer more flexibility in expectations for employees. Women of color in particular thrive in more democratic and collaborative environments, but positive work environments benefit employees of all identities (Gamm, 2014, p. 96).

Requiring workshops for faculty and staff is a concrete way to change the culture of the STEM community. Workshops could cover topics such as the best practices for teaching and working with multicultural populations, social justice concepts such as gender equity, and specific familial and cultural responsibilities of women and people of color (Reyes, 2011, p. 258). Reyes (2011) believes that workshops like these could convince many to finally reject misconceptions and biases about female students of color (p. 259).

5.2.4 Interrupting bias

One specific and effective strategy to changing the work environment is to implement Metrics-Driven Bias Interrupters. This approach, created by Williams, is an iterative four-step process designed to interrupt subtle bias in real time (as cited in Williams, Phillips, & Hall, 2016, p. 15). Rather than relying on people's retention of material from workshops and their ability to self-monitor, Bias Interrupters allow departments to address the direct effects of bias (Williams et. al, 2016, p. 64). Examples of Bias Interrupters include establishing specific rules about employees' responsibilities, questioning people's thought processes when making decisions, and establishing standards about treatment of other employees (Williams et. al, 2016, p. 64).

6.0 CONCLUSIONS

The double bind is widely experienced by women of color pursuing the fields of science, technology, engineering, and math. Despite the indisputable effects of the double bind on women of color and the STEM workforce, dominant (White and male) culture in the United States tries to deny the very existence of the double bind. The history of the United States is deeply rooted in racism and sexism, and the only way to improve the experiences of women of color in STEM is to directly challenge and change practices that were established when the vast majority of people in STEM were White and male. Improving the experiences of women of color in STEM is a moral obligation: When women of color can fully participate in STEM, their scientific discoveries can help more people live their best life, and women of color can freely pursue their interests. Life, liberty, and the pursuit of happiness might finally be available to a significant portion of the United States population.

7.0 RECOMMENDATIONS

As stated in the scope, there was a noticeable lack of sources that covered the experiences of women of color in STEM, despite the numerous sources covering the experiences of just women or just people of color in STEM. Thus, researchers must further investigate the experiences of women of color in STEM and make their findings widely accessible. Raising more awareness of the double bind makes it harder for the dominant culture to deny its existence.

Even without widespread awareness of the double bind, people of all careers and positions should take steps toward mitigating its negative effects. All people should aim to develop civic literacy so that they can have positive interpersonal interactions with women of color. People who have the power to make organizational decisions should do whatever is in their power to make the STEM environment more welcoming, and they should do so in a way that prioritizes the experiences of women of color over their organization's image. All people should abide by the expectations and responsibilities resulting from organizational change, such as attending workshops and following through with rules established during Bias Interrupters. Collective action is necessary for changing the system.

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