BARRIERS AND RECOMMENDED STRATEGIES FOR RECRUITING, RETAINING, AND UPSKILLING BLACK AND LATINA WOMEN IN STEM

Abstract

Employers and potential employees face the same barriers to effective and sustainable recruitment, retention, and upskilling of Black/African American and Hispanic/Latina women in STEM. Social inequality, organizational culture and policies, interpersonal interactions, and intrapersonal factors create barriers. By building an inclusive organizational culture committed to diversity, equity, and inclusion, and providing support and leadership development for minoritized employees, employers can work towards a sustainably diverse workforce in STEM.

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Authors

Jessica MacDonald, Instructor, Social Sciences Department

Jessica MacDonald received her M.A. in Public Sociology from UNC Wilmington in 2010, with a focus on education inequality. She has been working at Wake Technical Community College since 2011, where she has worked in both College and Career Readiness and Degree Programs. She joined the Social Sciences Department as a full-time sociology instructor in 2021. She is involved in research, writing, data collection and analysis on projects for the Research and Evaluation team.

Rachel Madsen, Sr. Director of Assessment, Research, and Evaluation, Institutional Effectiveness and Research

Rachel Madsen received her Ph.D. in Social Policy and Sociology from Brandeis University in 2018, with a focus on economic and racial equity. She joined Wake Technical Community College in 2018 as the Director of Assessment, College Initiatives and Assessment. Rachel formed the Research and Evaluation team in Spring 2022 and leads projects involving qualitative and quantitative data collection, data analysis, and report writing.

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Introduction

The paucity of minoritized women in STEM and its causes have been well documented since the seminal 1976 report "The Double Bind: The Price of Being a Minority Woman in Science" (Malcom, Hall, Brown, 1976; Weisgram & Diekman, 2014). In 2022, we are still failing to effectively recruit and retain women in STEM at all points of the so-called leaky pipeline and beyond, from elementary school through post-secondary education and the workplace (Hall et al., 2018, National Science Foundation, 2021; Walsh & Simon, 2022) and "this pattern of significant underrepresentation has not changed in the past 20 years of the National Science Foundation's reporting of indicators" (Yamaguchi & Burge, 2019, p. 220). While this underrepresentation exists for white women, the disparity is especially pronounced for Black/African American and Hispanic/Latina women (Rice & Alfred, 2014; Cantor, 2014; Hall et al., 2018; Illumoka et al. 2017; Mattheis et al. 2022, National Science Foundation, 2021; Swafford & Anderson, 2020; UNESCO, 2018; William & Ceci, 2015; Wynn & Correll, 2018; Yamaguchi & Burge, 2019).

Barriers that Black/African American and Hispanic/Latina women face in STEM mirror those faced in society: [1] social forces like gender inequality, racial inequality, ethnic inequality, and their intersections form the societal backdrop upon which interactions among individuals and institutions in STEM occur. Black/African American and Hispanic/Latina women are pursuing STEM (Alfred et al., 2019; National Science Foundation, 2021; Walsh & Simon, 2022) and increasingly, businesses want to hire them. However, because of the social context, individual women in STEM and businesses are limited by the same barriers when attempting to improve recruitment, retention, and upskilling. While the business's concern is their "chilly" organizational culture, so too is it the concern of the isolated woman trying to navigate it. While the African American girl is struggling to thrive in STEM education, the employer waits impatiently for an inclusive and diverse candidate pool.

Barriers to improving the representation of Black/African American and Hispanic/Latina women exist from the societal to the individual level and do not exist in isolation; individual and interactional factors impact organizational cultures and vice-versa, and all the above will vary based on institutional and governmental policies and social context. This literature review identifies the leaky pipeline from education to industry (Glass et al., 2013; Makarova et al., 2016; Mattheis et al., 2022; Weisgram & Diekman, 2014), feeble organizational policies or their enforcement (Mattheis et al. 2022; Alfred et al., 2019; Yamaguchi & Burge, 2019), a "chilly climate" or organizational culture towards women and racial/ethnic minorities in STEM (Cech, Blari-Loy & Rogers, 2018; Wynn & Correll, 2018), and

[1] See WIIW Gender Equity Gaps in Wake County: Representation and Wages in STEM Fields (2020)

interpersonal & intrapersonal barriers among both employees from majority groups and Black/African American and Hispanic/Latina women (Alfred et al., 2019; Charleston et al., 2014; Floyd, 2021; Hall et al., 2019; Krivkovich et al., 2022; Makarova et al., 2016; Sterling, 2020; Walsh & Simon, 2022; Williams et al., 2016; Yamaguchi & Burge 2019).

Employing strategies to address these barriers and effectively recruit, retain, and upskill Black/African American and Hispanic/Latina women into STEM has benefits for employees as well as employers. Increasing the *sustained* representation of these women in STEM can improve individuals' financial health, lower the gender-wage gap (Ashton et al. 2020; Floyd, 2021; Moss-Racusin et al., 2021), and increase the likelihood of participation from the next generation of diverse women and girls (Alfred et al., 2019; Floyd, 2021). Groups with more member diversity generate more objective and accurate responses to subjective questions when compared to homogenous groups responding to the same questions (Apfelbaum et al., 2014), more diverse workforces build more "innovative products that avoid biases and exclusions of groups of people not represented" (Floyd, 2021, p. 2). In one study of over 20,000 companies world-wide, those with more women in leadership showed a better financial performance compared to those who did not (Noland et al., 2016). Employee resource groups have proven beneficial not just to participants but to organizations (Alfred et al., 2019; Casey, 2021). Reducing flexibility stigma[2] can improve job satisfaction and persistence for all employees, not just women and parents who are more susceptible to it (Cech & Blair-Loy, 2014). Ellemers and Rink (2016) discuss the assortment of benefits to companies in their literature review on diversity at work, highlighting that research shows diversity is related to more creativity and innovation, the ability to meet the needs of a more diverse set of clients, and a positive impact on market performance. Society-wide, addressing these gaps can help the United States remain competitive globally in STEM and ensure that there is a robust skilled workforce in the future (Ilumoka et al., 2017). As Cantor et al. explain, "the United States cannot continue its global leadership in STEM without an acceleration in its production of women in general and women of color in particular for the STEM workforce" (Cantor et al., 2014, p.2). In addition to proven benefits, effectively addressing gaps in representation and retention can help employers avoid the negative impact of a homogenous workforce like costly turnover of talented employees and burnout (Hall et al., 2018) and decreased work performance due to psychological stressors caused by racial and gender inequality (Dickens & Chavez, 2018; Travis & Thorpe-Moscon, 2018).

[2] See Barriers: Organizational Policy and Organizational Culture for more details.

Successful interventions aimed at addressing the problem must consider the unique experiences of women of color and Black/African American and Latina/Hispanic women specifically, rather than focusing solely on addressing gender or racial inequality. While white women experience many of the same disadvantages as Black/African American and Latina/Hispanic women, the latter groups experience them at higher rates. Efforts must be made to dispel the impression "that women's initiatives are seen as 'white women's initiatives'" (Williams et al. 2016; Yamaguchi & Burge, 2019) and interventions should be designed to address the unique, documented intersection of race/ethnicity and gender that Black/African American and Latina/Hispanic women experience (Alfred et al., 2019; Cantor et al., 2014; Charleston et al., 2014; Krivkovich et al., 2022; Linnabery et al., 2014; Mattheis et al., 2022; Yamaguchi & Burge, 2019). Implementing strategies that acknowledge the structural, organizational, interpersonal and intrapersonal causes of Black/African American and Latina/Hispanic women's underrepresentation in STEM have the potential to boost both recruitment and retention of a talented and diverse workforce in the 21st century.

Barriers

Structural and Social Barriers

The underrepresentation of Black/African American and Latina/Hispanic women in STEM occurs within the historical and social context of a society beset by racism, sexism and the "double dose" (Linnaberry et al., 2014, p.541) of discrimination at their intersection (Dickens & Chavez, 2018; Floyd, 2021; Hall et al., 2019; Makarova et al., 2016; Mattheis et al., 2022; Swafford & Anderson, 2020.) Institutional discrimination is built into the day-to-day functions of our social institutions like the education system and workplace and result in disparate outcomes for Black/African American and Latina/Hispanic women across society, not just in STEM (Alfred et al., 2019, Floyd, 2021).

Gender and Racial-Ethnic Stereotypes

Interpersonally, these society-wide systems of inequality lead to stereotypes that can influence behavior and gender-based expectations at work for all employees (Dickens & Chavez, 2018; Krivkovich et al., 2022; Travis & Thorpe-Moscon, 2018). Gender stereotypes are also linked to traditional gender roles in society that signal to both men and women who they should and should not be, and often these roles are perceived as opposite each other (Makarova et al., 2016). These stereotypes and roles, which are both descriptive and prescriptive, create a cascade of impacts on women and men, including girls' lower self-efficacy in math and science (Weisgram & Diekman, 2014), STEM education and toys geared towards boys (Makarova et al., 2016; Swafford & Anderson, 2020), and the influence on women's choice to pursue STEM careers (Low et al., 2005; Pajares, 2005) and who is perceived to have leadership potential

in the workplace (Krivkovich et al., 2022). If women perceive a career as not being "family-friendly" they may opt-out of pursuing that career (Weisgram & Diekman, 2014), especially if it includes math, succumbing to the stereotype threat that suggests they have less aptitude in the discipline and thus see it negatively (McCarthy, 2009; Shapiro & Williams, 2012). In addition to facing gender stereotypes, Black/African American and Hispanic/Latina women face the additional burden of the stereotypes at the intersection of race, ethnicity, and gender in society (Charleston et al., 2014; Walsh & Simon, 2022; Williams et al., 2016). These stereotypes exist society wide, but trickle down into our institutions, organizations, and interactions.

> *Of course, workplace dynamics that are out of African American women's control exist because such undercurrents are threaded within the context of institutional racism and are thus meted out unchecked. Behaviors projected from (un)conscious racial biases, microaggressions expressed in response to one's skin color, hair texture, or any other erroneous perceived notions, are too often sanctioned by the established influence of institutional racism. In those cases, African American women's experiences vastly differ from what white women experience." (Floyd, 2021, p.60).*

Leaky Pipeline

Gender stereotypes are a byproduct of sexism and racism, and contribute to salient outcomes society-wide, including organizational cultures and the leaky pipeline in STEM that disproportionately leaves Black/African American and Latina/Hispanic girls and women behind.

> *"The pipeline metaphor is a reoccurring analytical frame used in the literature to explore and explain the stages to a STEM profession (Cannady, Greenwald, & Harris, 2014; Rice & Alfred, 2014). Scholars have advanced different perspectives regarding the STEM talent pool deficit to include poor quality public school education, the small number of students majoring in STEM disciplines at undergraduate and graduate levels, the high rate of attrition among undergraduate STEM majors, and poor-quality programs that inadequately prepare students to perform successfully in business and industry" (Alfred et.al, 2019, p.116).*

As the United States struggles to patch the pipeline for all students, calls for concerted efforts are being made to address the underrepresentation of Black/African American and Latina/Hispanic women and girls (Cantor et al., 2014; Charleston et al., 2014). The disparate rates of interest and participation in STEM for girls can be observed as early as elementary or middle school, and while girls are closing the gap in math aptitude testing, boys and men outpace girls and women in SAT and ACT scores, number of Advanced Placement (AP) courses, and pursuit of STEM degrees in post-secondary education (National Science Foundation, 2021; Swafford & Anderson, 2020). When women do obtain STEM degrees, they are less likely to be working in the field (Beede et al., 2011), and more likely to leave. Hill, Corbett, & St. Rose

found that in 2010, of women working in engineering, 40% leave within the first five years (2010). Fouad et al. (2016) reports that for twenty years, women have been 20% of engineering graduates but only 11% of the workforce, indicating that half of women engineers leave the workforce at some point during their career. At each phase of the pipeline, more girls and women are left behind. If Black/African American and Latina/Hispanic women are not pursing and earning STEM credentials, it becomes even more difficult for employers to recruit them. To address the problem, stakeholders should address all phases of the pipeline, from K-12 to postsecondary education (Ilumoka, 2017), including investigating barriers and solutions within industry and the workplace.

Organizational Policies & Organizational Culture

Against the backdrop of gender and racial inequality, businesses and organizations may unintentionally create policies and cultures that mirror the problems of society overall and make women feel unwelcome (Mattheis et al.,2022; Wynn & Correll, 2018). Screening and hiring processes can alienate women, especially when credentials are questioned (Shein, 2018). When organizations show passive efforts to be more inclusive (Yamaguchi & Burge, 2019), weak responses to incidents of discrimination, lackluster policies against harassment (Mattheis et al.,2022), do not offer family leave, and/or do not provide employee flexibility, women notice. These conditions can impact both recruitment and retention. Women in STEM have reported dissatisfaction with "extreme work schedules" (Swafford & Anderson, 2015, p.64), the lack of flexibility, and the lack of opportunities for advanced training, pay, and promotion (Glass et al., 2013; Hunt, 2010; Fouad & Singh, 2011; Mattheis et al., 2022; Weisgram & Diekman, 2014). Women's experiences in STEM are not all unique to their field. McKinsey's most recent *Women in the Workplace* Report indicate that two-thirds of young women of all racial and ethnic groups in the workplace have ambitions of advancement, and that flexibility and commitment to diversity, equity, and inclusion (DEI) is increasingly important to them. "Companies that don't take action may struggle to recruit and retain the next generation of women leaders—and for companies that already have a 'broken rung' in their leadership pipeline, this has especially worrisome implications" (Krivkovich et al., 2022, p.16).

Chilly Climates

Organizational policies influence culture, which both influence how employees interact with each other and see themselves within the organization. That self-identity then influences further interactions amongst members of the organization. In turn, both interactions and intrapersonal factors can influence organizational culture (Hall et al., 2018). If an organizational culture is "chilly" to women and people of color, women feel more isolated and excluded (Alfred et al., 2019; Cech, Blair-Loy & Rogers, 2018; Floyd, 2021; Travis & Thorpe-Moscon, 2018). Citing Carr et al. (2003) and Ostroff et al.(2003) Cech, Blair-Loy & Rogers (2018) explain that "existing literature typically defines 'chilly climates' as

marginalizing and intolerant interactional environments that disadvantage non-dominant groups" (p.133). This could manifest as the underrepresentation of women, men's references to specific cultural knowledge or reliance on stereotypical behavior, and the objectification and dismissal of women at work or during the hiring process.

> *Based on past research identifying factors that dampen women's interest or sense of belonging, we define an environment as 'chilly' if, through numerical representation and gendered roles, it conveys a sense that men are more prevalent or more important. An environment can also be chilly if it is permeated with references to cultural knowledge, hobbies, or behaviors that are more commonly associated with men than women, or if women are referred to in sexualized or other gendered ways. If tech recruiting sessions are chilly environments, they potentially dampen the movement of women into tech work (Wynn & Correll, p.152, 2018).*

In their study of recruiting presentations by tech companies to matriculating college seniors, Wynn & Correll (2018) found that men were more likely to speak and spoke longer, and, when women were present, they were more likely to serve in supporting roles, be described using stereotypical feminine language, and were often interrupted when speaking.

> *"through their presentations, interactional styles, and the images they project, [tech companies] convey a gendered sense of who will fit best in their company culture. By emphasizing geeky masculinity, they risk appealing only to a narrow range of men and virtually no women. Smaller companies, in particular, compound this problem through the use of gendered swag, frequent references to geeky movies and TV-shows, and masculine cultural icons. The result is an environment that often feels like a fraternity house." (p.161).*

When women make it through recruiting and into an organization, that same chilly climate can lead to exclusion, isolation, and lack of persistence for all women, but especially women of color (Mattheis et al., 2022, Floyd, 2021; Williams et al., 2016). Fouad and Singh (2011) found that one in three women in engineering left because of "the workplace climate, their boss, or the culture" (p.6).

Flexibility Stigma and Maternal Wall

Flexibility stigma also contributes to chilly climates for women in the workplace. Even when companies have flexible work and leave policies on the books, if the company culture emphasizes the ideal worker as one who prioritizes work over everything else, and management interprets working flexible hours to perform care work as a lower commitment to career, employees who need to use these benefits are stigmatized (Cech & Blair-Loy, 2014). "Research shows that employees who work flexibly face more doubts about their productivity and commitment, even when they produce the same results as their colleagues" (Krivkovich et al., 2022, p.33). Because of societal gender norms that still expect women to be primary caregivers to children, the flexibility stigma that impacts all parents (Cech & Blair-Loy, 2014)

is especially pronounced for women. Williams et al. (2016) found that two-thirds of all women in STEM reported facing a "maternal wall" and flexibility stigma when taking leave or pausing the tenure track, which was consistent across white, Asian, Black/African American, and Latina participants. "Motherhood appears to be a no-win proposition for many women in STEM" (Williams et al., 2016, p.17).

Absence of Support Networks

An absence of intentional support networks for Black/African American and Hispanic/Latino women or a lackluster commitment to mentoring programs and leadership development of these women can lead to feelings of isolation and to problems with employee job satisfaction and retention. Black/African American and Hispanic/Latina women in STEM often mention mentorship and peer support as critical parts of their academic success and notice the lack of those intentional networks in the workplace (Alfred et al., 2019; Dickens & Chavez, 2018; Johnston et al., 2021; Rice & Alfred, 2014, Rockinson-Szapkiw et al., 2021). Seventy-five percent of Black/African American female engineers indicated having a mentor was critical to their success (Rice & Alfred, 2014). When mentorship is unimpactful, unstructured, or leads to burdening existing minoritized employees, it is disenchanting and does not contribute to a positive workplace culture or retention (Buzzanell, 2015; Moss-Racusin et al., 2021).

Lack of Leadership Development

Mentorship can be an important part of leadership development, and women in all workplaces are less likely to be promoted to manager. McKinsey's 2022 *Women in the Workplace* report found that "For every 100 men promoted from entry-level to manager, only 87 women are promoted,…only 82 women of color are promoted…and only 75 Latinas" (p. 9). Furthermore, fewer Hispanic/Latina and Black/African American report having managers that show interest in their career compared to white women (Krivkovich et al., 2022). Of male and female Black/African American employees in STEM jobs, just 37% believe their racial group is treated fairly in opportunities for promotion and advancement, and of male and female Hispanic employees in STEM, 59% believe the same for their ethnic group (Funk & Parker, 2018). Women made up less than 4% of information technology industry CEOs in 2021, down from around 5% in 2016 (Kersley et al., 2021), and, while Black women in the workforce are more likely than other women to have ambitions of reaching executive levels, they are also more likely to have received cues that it will be difficult for them to reach that goal (Krivkovich, 2022).

Interpersonal Barriers: Interactions Amongst Diverse Employees

Interactions at work contribute to and are influenced by the organizational culture. Furthermore, these interactions can be influenced by stereotypes, and can impact the intrapersonal experiences of employees.

Identity Shifting

In their qualitative study of college-educated Black women in white dominated workplaces, Dickens & Chavez (2018) found through interviews that women report having to identity shift, or change their speech, interaction, or appearance, to assimilate into the workplace or interact successfully with colleagues. "Collectively, many participants believed that shifting their identities in order to create and sustain professional relationships is critical to the career development of early professional Black women, and those who resisted assimilation to the dominant culture were aware that it stifled their professional relationships" (Dickens & Chavez, 2018, p.765). While this identity shifting has career benefits, it can also have intrapersonal consequences. [3]

Microaggressions

All women in the workplace reported experiencing microaggressions like being interrupted, dismissed, doubted, mistaken for a junior, and unsupported by supervisors; with Black/African American and Hispanic/Latina reporting microaggressions at the same or higher rates as white women (Krivkovich et al., 2022). Qualitative research on Black/African American women in STEM in general and computer science in particular has documented the microaggressions Black women experience that are unique to their racial and gender statuses (Charleston et al., 2014, Yamaguchi & Burge, 2019). Williams et al. (2016) found that Black/African American and Hispanic/Latina women in STEM both faced more backlash for being assertive in the workplace and experienced comments related to negative stereotypes and greater rates than white women. Black/African American women In STEM are also most likely to report having to prove themselves to colleagues, and Hispanic/Latina women reported being tasked with more office housework and care work than other women of different racial/ethnic groups (Williams et al., 2016). One Hispanic/Latina woman recalled an experience of being mistaken for a janitor while wearing her white lab coat (p. 61), and a Black/African American female biologist was casually asked by her post-doctoral advisor if she has "family on drugs or in jail" (p. 59).

Harassment

Beyond microaggressions, women in STEM are experiencing harassment at high rates (Mattheis et al., 2022), and research indicates harassment is higher when women are also racial or ethnic minorities (Alfred et al., 2019). In one study, Pew Research found that half of women in STEM jobs had experienced discrimination at work, and over one-third indicated sexual harassment was a problem in their workplace (Funk & Parker, 2018). In the Survey of Academic Field Experiences (SAFE), two thirds of field scientists who responded reported that they had experienced sexual harassment, and one-fifth had experienced sexual assault (Gewin, 2015).

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[3] See Intrapersonal Barriers: Internalizing Interactional Cues & Biases

These interpersonal barriers- the need to identity shift, experiencing microaggressions, hostile interactions and harassment- are certainly barriers for women who try to persist in these chilly climates, but they are also a problem for employers who seek to retain these women, benefit from a diverse workforce, and foster an inclusive culture (Hall et al., 2018).

Intrapersonal Barriers: Internalizing Interactional Cues & Biases

Girls have lower math and science self-efficacy than boys (Weisgram & Diekman, 2014), women STEM graduates report lower self-efficacy than men (Sterling et al., 2020), and self-efficacy is related to positive outcomes in STEM (Rockinson-Szapkiw et al., 2021). While some literature indicates that faculty hiring committees rate resumes from male candidates higher than identical resumes with female names (Moss-Racusin et al., 2012), another analysis suggests a supply-side problem in which women are less likely to apply because of the perception that STEM is male dominated (William & Ceci,2015). "The perception that STEM fields continue to be inhospitable male bastions can become self-reinforcing by discouraging female applicants, thus contributing to continued underrepresentation, which in turn may obscure underlying attitudinal changes" (Williams and Ceci, 2015, p.5365).

In the workplace, lack of gender inclusive policy, chilly organizational climates, underrepresentation, inability to advance, bias from colleagues, and alienating interactions all have negative intrapersonal consequences for women (Hall et al.,2018) and for Black/African American and Hispanic/Latina women in particular (Dickens & Chavez, 2018; Krivkovich et al., 2022; Travis & Thorpe-Moscon, 2018; Yamaguchi & Burge, 2019). These negative consequences include less job satisfaction, burnout, isolation, and the prevention of marginalized members of groups from meeting their full potential (Travis & Thorpe-Moscone, 2018; Hall et al., 2018, Hall et al., 2019). Research also indicates that that day-to-day experiences at work have a significant influence on overall psychological wellbeing (Hall et al., 2019).

Psychological Safety and Social Identity Threat

According to Dickens & Chavez (2018) having to identity shift to assimilate at work leads to negative outcomes for Black/African American women, like becoming psychologically paralyzed and remaining silent, feelings of inauthenticity, doing mental labor to be sure actions do not confirm stereotypes of Black women, feeling pressure to be a "model black citizen", and experiencing cognitive dissonance about identity shifting (p. 766). Similarly, Travis & Thorpe-Moscon's (2018) study of women and men of color at work identify the emotional tax on those employees, who must be on guard and actively prepare to be exposed to racial and gender bias. Compared to White and Asian women, Hispanic/Latina and Black/African American women report less psychological safety at work, reporting that they are more likely to worry about being penalized for mistakes, less likely to be comfortable arguing with coworkers, and less likely to say they are rarely excluded (Krivkovich, p. 22, 2022). Though the terminology varies,

this is consistent with the literature on social-identity threat, or "the threat that people experience in situations where they feel devalued on the basis of a social identity" (Hall et al.,2019, p. 542; Steele, Spencer, & Aronson, 2002).

Social Isolation

Social identity threat and isolation caused by interactions and underrepresentation are common experiences for all women in STEM and is one possible explanation for poor retention in the field (Hall et al., 2018). "32% of women in technical and engineering roles are often the only woman in the room at work" (Krivkovich, 2022, p. 11). Black/African American women in computing also expressed feelings of self-doubt, imposter-syndrome, and isolation from being the only one (Yamaguchi & Burge, 2019) and from acclimating to the workplace environment (Charleston et al., 2014). Black/African American female engineers indicated they felt isolation especially when prompted by stigma, microaggressions, and harassment (Floyd, 2021). It is important to note that while there is an immense intrapersonal burden that falls on Black/African American and Hispanic/Latina women in the workplace, employers are also impeded. In addition to the impact on work outcomes and retention for women, employers must reconcile with the fact that managers and employees belonging to dominant groups hold racial and gender biases that manifest as microaggressions and harassment and perpetuate these outcomes (Krivkovich et al., 2022).

Effective Strategies for Employers

Despite the extensive barriers to representative participation in STEM for Black/African American and Hispanic/Latina women, best practices are emerging for employers who seek to address the STEM workforce gaps at the intersection of race and gender.

Upskilling

The literature is robust with best practices for recruitment and retention but is lacking in terms of upskilling. Some case studies provide emerging practices for upskilling, like the Intuit Apprenticeship Pathway Program and the "Intuit Again" return to work program, detailed in the McKinsey Women in the Workplace study (Krivkovich et al., 2022, p.48). The Apprenticeship Pathway Program is available to all people, but the corporation makes intentional effort to recruit underrepresented minorities. The program includes training, work-based learning on company projects, and mentorship, and has resulted in over 80% of participants being hired full time. Intuit Again targets employees in technical fields that have exited the workforce and provides them with 16 weeks of training to update their skills and a dedicated mentor. Because women are more likely to enter and exit the workforce, they make up most candidates for the program, which has 70% full-time hiring rate for graduates. As a result of these interventions,

Intuit has increased the number of women in tech roles to 33% from 27% in 3 years (Krivkovich et al., 2022, p.48).

Most notably, N Power and the Command Shift coalition is leading the charge in upskilling and recruiting women of color and aim to double the number of women of color in tech in the next decade. The coalition provides tools for market benchmarking to identify current diversity in the sector compared to who should be reasonably eligible for jobs, including people who just need "bridge skills and last-mile skills" for their future roles (Walsh & Simon, 2022, p.14). They also identify "skill adjacencies" that translate well to tech roles, and similar job pairs that connect a non-tech job to a relevant tech-sector equivalent. While African American/Black, Hispanic/Latina, and American Indian women make up 5% of the tech workforce, they make up 10% of the "skill similar workforce" (p. 26). N Power trains women of color on how to advertise their relevant skills and provides them with wraparound services and the "last mile" skills they need to qualify for more lucrative tech jobs using workforce development (Walsh & Simon, 2022).

> *There are many forms of workforce development programs that connect incumbent workers to the tech sector. For instance, there are numerous bootcamps for coding, web development, user experience design, digital marketing, and other tech skills (for example, Coding Dogo, Resilient Coders, Fullstack Academy, and others), as well as short IT certificate courses such as those that NPower offers in tech fundamentals, IT support, cybersecurity, and cloud computing. There are also paid apprenticeship and co-op programs that enable incumbent workers to leave underemployment without weathering a drought in pay (for example, Apprenti and Per Scholas, as well as others)* (Walsh & Simon, 2022, p.9).

The Command Shift report, *The Equation for Equality: Women of Color in Tech* provides detailed tables enumerating the various skills and job pairs and is an invaluable tool to employers who are looking for guidance on who and how to upskill (Walsh & Simon, 2022, p. 16-17, p. 28-29, p. 31).

Though the literature on upskilling is limited, because potential students and employees must be recruited before upskilled, and quality employees are ideal candidates for upskilling, insights on recruitment and retention may be informative in considering how to best upskill Black/African American and Hispanic/Latina women in STEM.

Recruitment and Hiring

Addressing the Leaky Pipeline & Building Social Capital

In order to meet long-term goals for representative recruitment, employers should recognize the positive impact of K-12 school programs, pre-college summer programs, human resource and workforce development, gender balanced promotional materials, financial aid, structured and intentional mentorship, and the importance of like-role models on girls' and women's interest, participation, persistence in STEM

(Illumoka et al., 2017; Johnston et al., 2021; Kamm et al., 2020; Moss-Rascusin et al., 2021; Rice & Alfred, 2014; Swafford & Anderson, 2020; Weisgram & Diekman, 2014; Yamaguchi & Burge, 2019). For example, the STEM UP! pre-college program targeting women and underrepresented minorities that featured industry mentoring raised interest in STEM careers from 29% to 55% and decreased the number of students who did not want to pursue STEM (Ilumoka et al., 2017). In post-secondary and graduate settings, advisors who recruited and mentored a small group of black women created a "built-in peer support system" that was integral to mentee success (Yamaguchi & Burge, 2019).

Visible role models in STEM should be inspiring, relatable, and look like the people employers aim to recruit (Johnston et al., 2021; Moss-Racusin et al.,2021; Rice & Alfred, 2014; Rockinson-Szapkiw et al., 2021). Role models and mentors may be more effective if they communicate that they are able to maintain work-life balance and a family life (Weisgram & Diekman, 2014) and can serve their community. Hispanic female/Latina students identify the importance of family support and giving back to their families and communities when making their career choices (Johnston et al., 2021). Beginning recruitment efforts early by investing in girls' awareness and exposure to STEM can contribute to "patching the pipeline" and ensuring more Black/African American and Hispanic/Latina women pursue STEM credentials and careers.

Data-Informed Recruitment

Employers wishing to expand their workforce's representation of Black/African American and Hispanic/Latina women must first collect data on representation and attrition by race and gender, leadership representation by women of color to set data-based goals (Krivkovich et al., 2022), and disparities in start-up packages for new hires (Williams et al., 2016). NPower and the Command Shift Coalition recommends that employers use a data-based approach to cast a wider net in recruiting non-traditional candidates. Using their analytical tools, employers can conduct benchmark analyses on current disparities and potential recruits in like-skilled occupations in the region and set data-based goals accordingly (Walsh & Simon, 2022). Comcast monitors representation through each phase of the hiring process to identify where racial, ethnic, and gender minorities fall out of the pipeline, as a means of identifying which parts of the hiring process need intervention (Walsh & Simon, 2022). This is consistent with "Metrics-Based Bias Interrupters" model proposed by Williams et al. (2016) to assess, implement a bias interrupter, measure, and rachet up if necessary (p. 64). Workforce leaders in DEI efforts not only review diversity metrics quarterly, but make the information public, and innovators provide incentives for senior leaders who make progress on diversity goals (Krivkovich et al., 2022).

Intentional and Targeted Recruitment

STEM employers should purposefully and explicitly recruit Black/African American and Hispanic/Latina women to their organizations and communicate their commitment to diversity, equity, and inclusion.

Institutionalizing this goal and building in specific accountability measures that target intersectional groups is most effective. Advertising towards an aggregate group like "underrepresented minorities" may be effective in recruiting white women into computer science but will be less so in recruiting Black/African American women (Yamaguchi & Burge, 2019). Shadding et al. (2016) found that there were gender and racial differences in how prospective students responded to recruitment efforts for STEM graduate programs, with women, Black/African Americans, and attendees of HBCUs responding positively to interactions at in-person recruiting events, and women responding positively to email solicitations.

Diverse and Inclusive Advertising

Other methods of communicating that the organization is committed to diversity include posting to targeted job boards like People of Color in Tech, The Hispanic/Latino Professionals Association, and the Black Women's Career Network (Graham, 2022), outreaching to minority communities, avoiding gender stereotypes and geek culture references (Wynn & Correll, 2018), and creating inclusive recruitment materials that feature discussions of DEI efforts (Olund, 2017). Establishing or expanding relationships with workforce development programs and apprenticeships may also prove fruitful to diverse and inclusive recruitment efforts (Walsh & Simon, 2022).

When writing job advertisements, organizations can use trained diversity/equity advocates within the organization to recognize biases in postings, like using male pronouns or language associated with masculinity, for example "assertive" or "competitive" (Moss-Racusin et al., 2021; Williams et al., 2016). Other exclusionary practices that could be reconsidered are the inclusion of degree requirements and background checks, which could be replaced by language that highlights necessary skills and the skill-adjacencies from non-tech fields applicable to the advertised tech position (Walsh & Simon, 2022).

Equitable Candidate Evaluation

Once job postings close, it is a best practice to review applications or resumes as objectively as possible, without information that identifies gender, race, or ethnicity, and with the use of evaluation rubrics (Moss-Racusin et al., 2021; Williams et al., 2016) Services like GapJumpers provide data analysis and blind hiring platforms for employers, but a lower-cost method could explicitly ask applicants not to include gender or name, assign an applicant number, and discard applications that do include the identifying information (Gapjumpers, 2022; Kong et al., 2020). Finally, just reminding people that stereotypes exist during the hiring process decreases their reliance on them, and training hiring committees in academia to understand how implicit bias impacted hiring enabled them to develop strategies to avoid it (Williams et al., 2016; Shein, 2018).

The Impact of Policies and Organizational Culture on Recruiting

While the impact of organizational culture and policy is most pronounced in retention efforts, it can also impact recruitment and whether or not certain candidates see organizations as attractive. Human Resources (HR) policies and departments must make holistic and transformational change to incorporate diversity, equity, and inclusion efforts and move away from the one-size-fits all model of HR management (Olund, 2017). When women can see multiple paths to success in the field and identify it as family-friendly, they are more attracted to STEM (Wynn & Correll, 2018; Weisgram & Diekman, 2014). However, unsubstantiated perceptions about family friendliness are not enough, as they may increase recruitment but not retention (Weisgram & Diekman, 2014). Providing gender-inclusive policies like holding supervisors accountable and providing paid parental leave can reduce social identity threat and increase STEM engagement and belonging (Moss-Racusin et al., 2021). Low-cost family-friendly policies include scheduling meetings during school hours, providing new hires with information about school and childcare, allowing flexible schedules and encouraging women and men to take advantage of them, and leading by example (Wynn & Correll, 2018).

Retention

Effective strategies for retention of diverse candidates, including Black/African American and Hispanic/Latina women, focus on improving the organizational culture through inclusive policies and benefits, bias training, leading by example, building social capital through mentoring and supportive networks, and leadership development & promotion opportunities for minoritized employees. Strategies for recruitment and retention are not mutually exclusive, as improving the organizational culture will both attract and retain valuable talent.

Inclusive Workplace Policies and Culture

Cultivating *both* inclusive organizational cultures and policies can improve retention of Black/African American and Hispanic/Latina women, decrease burnout and social identity threat, increase job satisfaction, and benefit all employees (Hall et al., 2018; Krivkovich et al.,2022; Mattheis et al., 2022; Travis & Thorpe-Mascon, 2018; Walsh & Simon, 2022). Policies and benefits that are not supported by norms and culture, are not enforced, or are not used are ineffective in creating lasting organizational change (Mattheis et al., 2022; Krivkovich et al., 2022; Walsh & Simon, 2022). A “top-down and system wide” approach is needed to transform organizational cultures (Kong et al., p.5, 2020) and acknowledge that existing systems were “designed for white, abled, men from a narrow socioeconomic background, [and] these systems tend to protect the existing power structure and place additional burdens on individuals outside the dominant groups (Mattheis et al., 2022, p. 12). Research backed policies require holistically transforming human resource management approaches to emphasizing the explicit value of

multi-culturalism and inclusion, a shift from the model that sees all employees as generic (Olund, 2017). While colorblind approaches engender distrust, promoting inclusive workplace policies and making "brief statements advocating for fairness" builds trust and decreases worries of being judged based on race for Black professionals (Purdie-Vaughns et al., 2008). Organizations should create codes of conduct that support inclusion, transparency, and emphasize organizational values and a zero-tolerance attitude towards harassment (Alfred et al., 2019; Kamm et al., p. 103, 2020). These codes of conduct should outline acceptable behavior, procedures for investigation, and enforceable sanctions. When violations occur, procedures should protect complainants from retaliation and strive to protect anonymity. For example, procedures that require mediation and the complainant to confront their harasser can have negative consequences and can decrease retention (Mattheis et al., 2022).

Flexible Schedules and Paid Leave

Additional gender-inclusive policies include providing and promoting flexible work schedules and family leave. Hall et al. (2018) found that these policies had a positive impact on interactions between men and women *and* men and men in the workplace, which led to a decrease in social identity threat for people of all genders. Family-friendly policies attract more women to STEM (Weisgram & Diekman, 2014). While 75% of companies provide paid sick leave, family leave, and bereavement leave, leaders are providing emergency backup childcare for parents, allowing parents to take extended time off and come back to work, providing support for those doing elder care, and offering leave for mental health. The emerging practice of offering childcare subsidies is showing promising early results (Krivkovich et al., 2022, p. 46).

Hybrid and Remote Options

Allowing hybrid and remote work also supports minoritized employees, who experience a decrease in burnout, psychological distress, and microaggressions when they work where they want. Women of color, LGBTQ+ women, and disabled women experienced the most notable increase in psychological safety when working remotely compared to other women (Krivkovich et al., 2022, p. 36).

Family-Friendly Policies and Eliminating Flexibility Stigma

Implementing flexible work models will also address structural inequalities that disproportionately impact women of color (Walsh & Simon, 2022). The presence of family-friendly policies, however, does not ensure they will be utilized without stigma (Cech & Blair-Loy, 2014). Organizations should pay attention to see if people are using their benefits and intervene accordingly. When managers set examples and use their flexible work benefits, especially if they communicate that they are caring for family, it decreases flexibility stigma and encourages employees to take advantage of the benefits (Kong et al., 2020; Krivkovich et al., 2022, Alfred et al., 2019).

Engaging Dominant Groups in Equitable Organizational Culture

Impactful, inclusive, and enforced policies set the foundation upon which an equitable organizational culture can be built. By openly stating specific commitments to intersectional groups like Black/African American and Hispanic/Latina women, organizations will build trust and decrease social identity threat. However, these statements and initiatives should also foster the engagement of employees from dominant groups to avoid resistance and feelings of exclusion among male employees (Hall et al., 2018). In fact, members of the dominant group should actively participate in confronting biases, so it is not just perceived as the responsibility of minoritized employees (Mattheis et al., 2022). Discussing "cultural schemas of inequality" which offer different explanations for inequitable outcomes (hard work versus structural barriers) can be beneficial in allowing employees to recognize chilly organizational climates. Belief in meritocracy myths about achievement is an indicator of a chilly climate and dispelling those myths may facilitate buy-in from dominant groups. *"*If the majority of interactional community members do not recognize intolerant and unfair interactional processes in play, they may be particularly unlikely to support efforts that would put money, resources, and time toward altering the climate of that environment" (Cech, Blair-Loy & Rogers, 2018, p. 154).

Support, Affirmation, and Modeling from Managers

Equitable cultures avoid flexibility stigma, which can impact all parents and especially women (Cech, Blair-Loy, 2014), create safe spaces for minoritized employees to be their true selves at work (Alfred et al., 2019) and celebrate diversity and inclusion (Dickens & Chavez, 2018). Rice & Alfred (2014) found that African American female engineers identified supportive organizations as those that supported "their values, career goals, and interests as a person and an employee" (p. 45). Organizational values that impact inclusion and retention include

> *"welcoming and family-friendly working conditions, acknowledgement of the advantages of diversity, zero-tolerance attitude towards harassment or unjust treatment, valuing an international and intercultural environment, the commitment to structured career development for nonpermanent research staff, the transparent publication of research output" (Kamm et al., 2020, p. 103).*

On the interactional level, friendly and affirming interactions with male employees decreases social identity threat and improves morale among female employees (Hall et al., 2018). When managers "give helpful feedback, help manage workload, show interest in career, check-in on wellbeing, ensure credit for work, encourage inclusivity and respect" women of all racial and ethnic groups have improved psychological safety, feel they have opportunities to advance, report a better work culture, have higher job satisfaction, experience less burnout, and are less likely to leave (Krivkovich et al., 2022, p. 42). Leaders can also model appropriate behavior in interactions with diverse staff, take advantage of and encourage

flexible work to decrease flexibility stigma, avoid gender stereotypes in images and references, and ensure that policies are enforced (Alfred et al., 2019; Cech & Blair-Loy, 2014; Mattheis et al., 2022; Weisgram & Diekman, 2014; Wynn & Correll, 2018). Action or lack thereof by leadership is seen to represent the organization's intentions and can influence feelings of belonging (Mattheis et al., 2022).

Quality, Research-Based, and Reinforced Bias Training

To improve interactions and decrease bias, thus improving organizational culture, quality, research-based, and reinforced bias training should be required for employees and managers. Organizations should track participation, effectiveness, and outcomes of bias training and adjust accordingly (Alfred et al., 2019; Krivokvich et al., 2022). Poorly developed or implemented bias training can backfire and be ineffective or have negative consequences for organizational culture (Williams et al., 2016). While one study indicated that at least 75% of companies are providing employees with unconscious bias training, pioneering organizations are also training employees in how to be an ally to underrepresented minority colleagues and developing training specifically for managers. Leading practices for training managers include "how to manage hybrid employees, facilitating team conversations around diversity, combating bias in promotion and/or everyday interactions, minimizing burnout and/or effectively checking on employee wellbeing" (Krivkovich et al., 2022, p. 46). Lean In's programs offer a suite of tools and programs available at no cost and are used by corporations like Adidas, Walmart, and WeWork, and include "50 Ways to Fight Bias" "Allyship at Work" and "Lean in Circles" (Krivkovich et al., 2022, p. 51).

Equitable Distribution of Labor

Finally, organizations would do well to investigate the current gendered distribution of labor on their teams and departments. Identify who is serving on more prestigious committees or teams, and who does more of the "office housework" like party planning, scheduling, ordering supplies, or even actual cleaning. Then, leaders can utilize the "Metrics-Based Bias Interrupters" model proposed by Williams et al. (2016) to redistribute labor more equitably.

Mentoring and Building Social Capital

Quality, Structured Mentorship Programs

"Mentoring is a personal interaction, but when intentionally facilitated and supported in industries, it can serve to disrupt behaviors that lead to inequity in opportunity." (Alfred et al., 2019, p. 127). Building quality, structured, strengths-based mentorship programs and peer network support in the workplace is important to women's professional development in STEM, especially if mentor is a woman (Alfred et al., 2019; Buzzanell et al., 2015, Dickens & Chavez, 2018; Kamm et al., 2020; Rockinson-Szapkiw et al., 2021). While this is true for all women, positive effects on Black/African American and Hispanic/Latina women are documented. Rice & Alfred (2014) found that seventy-five percent of Black/African

American female engineers identified mentorship as critical to their success, and Johnston et al., (2021) identified familial support and mentorship as critical to the success of Latina college students in biology. Formal sponsorship and mentoring programs specifically for women of color are emerging as a leading practice for companies that are committed to diversity and inclusion (Krivkovich et al., 2022).

Like bias training, poor quality mentoring can have not just neutral but negative impacts, and in one study, underrepresented women in STEM had negative experiences with mentoring and associated it with performance evaluation and mentors co-opting their ideas (Buzzanell et al., 2015) Quality, structured mentoring is characterized by intentional support with career planning and advancement, building social capital (Kamm et al., 2020), engendering trust, communicating care, and focusing on a strength-based approaches (Alfred et al., 2019). This type of mentorship has positive impacts on women and women of color in STEM (Alfred et al., 2019; Illumoka et al., 2017). Mentors to Hispanic/Latina biology students allowed students to make mistakes and pushed them to excel (Johnston et al., 2021), and African American mentors tend to use a familial approach, a guidance and resource approach, and empathetic listening (Mondisa, 2018, p. 300). Mentors may also benefit from "training in psychosocial and instrumental competencies and trust building", as psychosocial and instrumental support were identified as some of the major contributions mentors made to racial and ethnic minority women in a virtual STEM mentorship program (Rockinson-Szapkiw et al., 2021, p. 279). Because like-mentors and role models are advantageous, employers should take care to be sure that mentoring efforts are formally acknowledged, compensated, contribute to performance evaluations, and are part of the criteria for promotion or tenure (Moss-Racusin et al., 2021). These conditions will prevent the further burdening of minoritized employees.

Opportunities for Building Social Capital

In addition to building quality mentorship programs, employers can build social capital through organizing social events (Linnaberry et al., 2014) and peer networking. Peer networking can be designed to bring together dominant and minoritized groups like women and men in the workplace (Hall et al., 2019), or to support specific populations. Employee resource groups (ERGs) or affinity groups are a popular best practice to address diversity, equity, and inclusion, with 75% of employers who participated in the Women in the Workplace survey participating (Alfred et al., 2019, Casey 2021, Krivkovich et al., 2022; Olund, 2017; Walsh & Simon, 2022; Yamaguchi & Burge, 2019). While ERGs are beneficial, they must be paired with additional efforts to facilitate organizational change (Krivkovich et al., 2022). ERGs offer support, resource sharing, and opportunities for leadership development to employees, but they also benefit employers. In fact, some organizations are renaming them "business resource groups" to

emphasize those benefits (Casey, 2021[4]). ERGs support companies by aligning employees with organizational goals, improving job satisfaction and retention, expanding talent acquisition through ERG members, building organizational social capital, capitalizing on members' experience for innovation, creating an engaged and inclusive work environment, providing leadership development, increase job satisfaction and retention (Alfred et al., 2019, Casey, 2021; Kong et al., 2020; Walsh & Simon, 2022; Yamaguchi & Burge, 2019).

Intentional Leadership and Career Development Programs

Mentorship is an effective mechanism for leadership and career development, but employers can also create data-based and intentional leadership programs to improve Black/African American and Hispanic/Latina women's advancement within the organization (Dickens & Chavez, 2018; Rice & Alfred, 2014; Krivkovich et al., 2022). Receiving recognition by supervisors and being put on the leadership track was identified as an important mechanism for career success among African American female engineers (Rice & Alfred, 2014). Employers should "invest in continual upskilling and advancement pathways" to improve retention (Walsh & Simon, 2022, p. 48), and when possible, allow women of color to participate in the design of the programs (Dickens & Chavez, 2018). Targeted practices to expand opportunities for minorities are shown to positively impact diversity among managers, especially at small companies (Olund, 2017, p. 82). An example of an effective leadership development program is with Sanofi SA, who used data to identify where women drop out of leadership and developed a woman-focused leadership program that lasted six months and included intentional coaching and a capstone project. Two years later, one third of program participants had been promoted, and women led all of Sanofi SA's North American businesses (Kong et al., 2020, p. 59).

Effective Coping Mechanisms for Minoritized Women in STEM

While interactional and organizational change are the most effective ways of addressing the gap in recruitment and retention for Black/African American and Latina/Hispanic women, coping mechanisms and strategies for success for individual women emerged from the literature. These mechanisms provide insight into what women find helpful when building resilience and persisting in the field.

Building Supportive Networks and Social Capital

Building supportive networks and social capital through peers, professional and social groups, and mentorship was most frequently cited as a success strategy (Alfred et al., 2019; Dickens & Chavez, 2018; Ferguson & Martin-Dunlop, 2021; Floyd, 2021; Linnaberry et al., 2014; Rice & Alfred, 2014; Rockinson-Szapkiw et al., 2021). Ferguson & Martin-Dunlop (2021) found that among African American women

[4] This source provides helpful step-by-step guides for employers seeking to create an ERG

who earned terminal degrees in STEM, extra-curricular participation during their education was common and built connections to a "cultural broker" which built resilience and improved persistence. These "brokers" transmitted important cultural capital and industry knowledge to students who otherwise did not have a network of people with that knowledge. Access to mentors and role models helps racial and ethnic minority women mentees see themselves as capable of having successful and fulfilling STEM careers (Rockinson-Szapkiw et al., 2021). While academic and professional peer networks are critical to support for Black/African American women (Alfred et al., 2019; Floyd, 2021; Rice & Alfred, 2014), research indicates that support from family, friends, and church communities can also be an important source of strength (Linnaberry et al., 2014; Floyd, 2021).

Intra-Personal Strategies

Intra-personally, Makarova et al. (2016) found that women employ adjustment strategies that allow them to function within a male-dominated STEM vocational school. These strategies include resilience, assimilation, avoidance, and excellence. Black/African American women use a variety of tactics to cope and thrive at work, including identifying a positive work identity (Dickens & Chavez, 2018), employing self-help coping strategies (Linnaberry et. al, 2014), drawing on their sense of agency (Hodari et al., 2016), their faith (Shorter-Gooden, 2004; Linnaberry et al., 2014) and spirit of determination, speaking "words of affirmation which nurtured their self-image as aspiring African-American engineers" (Rice & Alfred, 2014, p. 43), demonstrating their abilities to counteract doubt, remembering their passion for science, engaging in activism to support other minorities, identifying safe spaces for their whole selves, and getting out of their department to stay in STEM (Alfred et al., 2019, p. 126). It may be beneficial for employers to be mindful of these documented strategies used to persist and excel in the STEM workplace when designing their interventions.

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