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Patching the "Leaky Pipeline": Interventions for Women of Color Faculty in STEM Academia

Sin-Ning C. Liu, Stephanie E. V. Brown, and Isaac E. Sabat
Texas A&M University

A B S T R A C T

The "leaky pipeline" entails the progressive loss of competent women faculty members in the fields of science, technology, engineering, and mathematics (STEM). These leaks have been identified at various career stages, including selection, promotion, and retention. Efforts to increase female representation in STEM academia have had mixed results: Although the overall percentage of STEM women faculty has increased in recent decades, the percentage of women of color faculty (WOCF) in STEM has decreased. These differential effects may stem from the fact that most existing interventions for increasing female representation in STEM academia have not been intersectional in nature. However, when the intersectionality of race–ethnicity and gender are accounted for, WOCF are more likely to thrive professionally and feel like they matter to the institution. In this article, intersectionality theory is employed to identify the specific barriers in selection, promotion, and retention faced by WOCF within the scope of academic STEM careers and to identify the types of interventions that are likely to be particularly effective at fixing these leaks. In doing so, this article provides a framework for future research in the area of improving diversity and inclusion of WOCF in STEM.

S C I E N T I F I C   A B S T R A C T

There has been a great deal of research on the concept of the "leaky pipeline," which is the progressive loss of competent women faculty in the fields of science, technology, engineering, and mathematics (STEM). Research has shown that women academics are less likely than men to be selected, promoted, and retained in STEM departments. In recent years, there have been programs to increase the representation of women in STEM departments, which have resulted in increasing the overall percentage of STEM women faculty in the United States. However, despite these efforts, the percentage of women of color faculty (WOCF) in STEM has decreased. This simultaneous increase in overall numbers of women faculty in STEM and decrease in numbers of women of color faculty in STEM might be because these programs did not consider intersectional barriers. When the intersectionality of race–ethnicity and gender is accounted for, WOCF are more likely to thrive professionally and feel like they matter to the institution. In this article, we consider the unique challenges faced by WOCF in STEM departments within selection, promotion, and retention. Furthermore, we identify the types of interventions and programs that are likely to be particularly effective at fixing these leaks within the pipeline. Last, we call for more research to be conducted to assess whether these programs are actually helpful in remediating these disparities for women of color in STEM departments.

Keywords: leaky pipeline, STEM, women of color, intersectionality

The "leaky pipeline" entails the progressive loss of competent women in a variety of disciplines, most prevalently in the fields of science, technology, engineering, and mathematics (STEM; Barr, Gonzalez, & Wanat, 2008; Schroeder et al., 2013). These leaks have been identified at various career stages, including the bachelor's-to-PhD pipeline, and at the academic employment stages of selection

(S. L. Morgan, Gelbgiser, & Weeden, 2013), promotion (Ong, Wright, Espinosa, & Orfield, 2011), and retention (Turner, 2002). The "evaporation" of women out of the STEM pipeline has dire impacts on scientific advancement as a whole—investing in the potential of all scientists is crucial in an increasingly globalized and technology-driven society. This underrepresentation of women in STEM has been seen as simultaneously progressive (the proportion of women continues to shrink as one traverses the pipeline) and persistent (the leaky pipeline problem has not been alleviated despite efforts to treat it; Chesler, Barabino, Bhatia, & Richards-Kortum, 2010; Cronin & Roger, 1999).

Efforts to increase female representation in STEM academia in the United States have had mixed effects. There has been an increase in the percentage of women pursuing and obtaining postgraduate STEM degrees in recent decades. According to the National Center for Science and Engineering Statistics (2017), of the PhD degrees awarded to U.S. citizens and permanent residents, 10.19% were awarded to women of color (WOC) in 2004 and 11.96% were awarded to WOC in 2014, which is comparable to the 12.5% of WOC within the U.S (Ginther & Kahn, 2013). In a similar way, 32.39% of these PhD degrees were granted to White women in 2004 and 30.11% were granted to White women in 2014 (National Center for Science and Engineering Statistics, 2017), which is comparable to the 36.2% of White women within the United States (Ginther & Kahn, 2013).

However, despite these advances in postsecondary STEM education, WOC continue to make up only 5.1% of non-tenure-track faculty and merely 2.3% of tenure-track or tenured faculty, whereas White women make up 38.5% of non-tenure-track faculty and 23.4% of tenure-track or tenured faculty (Ginther & Kahn, 2013). Thus, although the number of White women and WOC PhD STEM graduates is proportional to the percentages of White women and WOC in the U.S. population, there is a major underrepresentation of WOC in STEM at the faculty level. Though it is clear that the overall number of women in STEM faculty positions is increasing, not all groups of women are experiencing these same advancements. Indeed, when the numbers of women in STEM fields are parsed out, White women and Asian women are overrepresented in the STEM workforce, whereas Black and Hispanic women are significantly underrepresented (Funk & Parker, 2018; National Science Board, 2012).

Furthermore, women of color faculty (WOCF) in STEM are more likely to be employed in less prestigious settings (i.e., 2-year and non-doctoral-granting 4-year colleges and universities), compared to their White female and minority male counterparts. And they are more likely to be in non-tenure-track positions (Ginther & Kahn, 2013). However, when they do retain a tenure-track position, women of color perform equally well, rising through the ranks at a pace similar to that of White women's (Ginther & Kahn, 2013). Thus, although it seems that interventions to increase the proportion of women in STEM faculty positions have begun to make an impact, they do not appear to be as successful for equalizing the proportion of WOC faculty (National Science Board, 2012). This may be because the vast majority of existing interventions for increasing female representation in STEM are not intersectional in nature (Jovanovic & Armstrong, 2014). Thus, within the current article, we employ intersectionality theory to identify the unique barriers faced by WOCF, as well as potential strategies to overcome those barriers, in U.S. academic institutions.

The Role of Intersectionality in the STEM Academia

In her introduction of intersectionality theory, Crenshaw (1991) posited that the "intersection of racism and sexism factors into [WOC's] lives in ways that cannot be captured wholly by looking at the race or gender dimensions of those experiences separately" (p.

1244). The literature suggests that the combination of different minority identities (e.g., race–ethnicity and gender) has a greater effect on stress than each identity does on its own (Cole, 2008; Kachchaf, Ko, Hodari, & Ong, 2015). Moreover, WOCF perceive that their dual-minority status of being both female and non-White hinders career success in the form of the "double bind"—challenges that WOCF uniquely face in their STEM fields (S. M. Malcom, Hall, & Brown, 1976). To develop effective and equitable intervention strategies, one cannot ignore the unique workplace experiences that are brought about by the intersection of race and gender (Kachchaf et al., 2015; Pittman, 2010; J. W. Smith & Calasanti, 2005). The barriers facing WOCF are unique, and the solutions brought forth by researchers, faculty members, and administrators must intentionally account for intersections of race and gender (Brown & Liu, 2018). Indeed, research has shown that when the intersectionality of race–ethnicity and gender are accounted for in the creation and implementation of interventions, WOCF are more likely to thrive professionally and feel like they are important to the institution (G. D. Thomas & Hollenshead, 2001; Turner, González, & Wong [Lau], 2011).

Thus, in this article, we employ intersectionality theory to identify some of the specific barriers in selection, promotion, and retention faced by WOCF within the scope of academic STEM careers. Then, we examine organization-level interventions that may be particularly effective at fixing these leaks, given the extant literature. Last, we explain how other interventions that have been suggested in the literature may be less effective at addressing each of these barriers. It is important to note that there is a dearth of research regarding strategies for supporting WOCF in STEM at the organizational level and that much of the extant literature has focused on either race *or* gender when addressing the leaky pipeline of the STEM academia. Thus, although we propose that certain strategies may be more effective than others, additional research needs to be conducted to compare the relative effects of these strategies.

Barrier to Selection: Implicit Bias

Commitment to diversity in STEM fields must start at the beginning of the pipeline, with the academic hiring process. This barrier is especially important, given that fixing subsequent leaks in isolation would be minimally productive without equal numbers of WOCF entering academia. Research from social psychology and intersectional feminist literatures inform the specific barriers faced by WOCF within STEM faculty selection. Specifically, this research shows that WOCF face a set of unique stereotypes that are not experienced by White women or men of color, including stereotypes that they are angry, aggressive, irrational, overly assertive, and unstable (Ashley, 2014). These stereotypes likely cause WOCF to experience heightened barriers within academic selection systems, which often rely heavily on subjective perceptions of fit and likability (García, Posthuma, & Colella, 2008). Additionally, Harrison and Thomas (2009) examined biases associated with skin color and found that Black women with lighter skin were favored over Black women with darker skin during the selection process. These manifestations of implicit bias displayed during the evaluation phase are important to identify and remediate, given that they directly translate to fewer WOCF entering the pipeline. Thus, it is critically important for interventions to focus on dismantling these unique and harmful stereotypes.

Interventions to Reduce Barriers to Selection

Given the extant literature on interventions to reduce barriers to selection systems, we suggest that implicit bias training might be the most effective intervention, whereas targeted hiring and increasing

search committee diversity may be less effective strategies. However, because most of the existing interventions target either women faculty or faculty of color—not WOCF specifically—it is difficult to evaluate the costs and benefits of these interventions relative to each other when considering the leaky pipeline for WOCF. Thus, we highlight future research that is needed to compare the relative effectiveness of these strategies for reducing biases against WOCF within STEM faculty selection systems.

Implicit Bias Training

To address the barrier of implicit bias in faculty selection systems, we propose that department chairs and search committee members attend mandatory implicit bias training programs to help search committees realize that their prototypical models of STEM academics may be biasing them against hiring WOCF. All individuals who are involved with search committees should undergo such training, regardless of their gender or race, because all individuals are vulnerable to holding implicit biases (Jackson, Hillard, & Schneider, 2014). These training programs should focus on the unique stereotypes facing each individual and intersectional identity group, as well as the subtle, unintentional ways that these biases manifest within selection systems. The most effective implicit bias training programs focus on empirical research (e.g., providing information that disconfirms commonly held stereotypes) rather than emotional or moral appeals, provide procedures for countering bias, and use local climate indicators; these training programs have been shown to be effective in reducing bias and improving attitudes toward diversity (Jackson et al., 2014). Implicit bias training often includes perspective-taking exercises (Todd, Bodenhausen, Richeson, & Galinsky, 2011), promotes multiculturalism over colorblindness (Wolsko, Park, Judd, & Wittenbrink, 2000), and emphasizes the importance of acknowledging one's own bias in order to effectively reduce implicit bias (Carnes et al., 2012). Indeed, search committee implicit bias training programs have been launched at a number of institutions, resulting in successful improvements in faculty diversity in STEM departments (J. L. Smith, Handley, Zale, Rushing, & Potvin, 2015).

Targeted Hiring

The literature has suggested that targeted hiring—where hires are often sponsored by the university in an effort to more proactively recruit minority faculty—can help with the selection challenges faced by WOCF in STEM academia (Gasman, Kim, & Nguyen, 2011). Indeed, research has shown that these targeted hiring strategies do increase the chance that minority candidates are recruited and ultimately selected into these positions (Bilimoria & Buch, 2010; Gasman et al., 2011) However, this strategy in isolation may not be as effective for hiring WOCF in STEM departments. Targeted hiring can often incur backlash from majority members (Dover, Major, & Kaiser, 2016), especially when there are persistent biases against these groups. Furthermore, such policies do not necessarily address what Sensoy and DiAngelo (2017) refer to as the "fundamental Whiteness of [university] policies and practices" (p. 560). Believing that racial and gender equity will be achieved by simply hiring WOCF neither addresses the need for awareness of and action against the systemic issues facing WOCF in academia nor produces real education on bias awareness and reduction.

Increasing Search Committee Diversity

The literature has also suggested that the diversity of the faculty search committee be maximized along the forms of diversity that are being targeted in order to address the selection challenges faced by WOCF in STEM (Diggs, Garrison-Wade, Estrada, & Galindo, 2009; D. G. Smith, Turner, Osei-Kofi, & Richards, 2004). Thus, it has been suggested that search committees for STEM departments always include diversity along racial–ethnic and gender lines (McNeely & Vlaicu, 2010). This balanced representation on faculty search committees is thought to increase the likelihood of building a rich, diverse candidate pool from which to select and recruit STEM faculty (Diggs et al., 2009; D. G. Smith et al., 2004). Accordingly, this strategy is thought to increase the chances of ultimately selecting WOCF (Bilimoria, Joy, & Liang, 2008).

This intervention is potentially problematic given that it increases service-related burdens for the few existing WOCF in STEM departments (Terosky, O'Meara, & Campbell, 2014). Additionally, these procedures do not ensure a lack of bias within the hiring committee, even if a diverse committee is assembled. According to Kayes (2006), "diverse candidate pools do not necessarily result in diverse hires because institutional, departmental, and search committee cultures can overtly and covertly undermine the goal of faculty/staff diversity" (p. 65). Thus, it is instrumental that search committees undergo implicit bias training to educate them about the "biases, assumptions, and stereotypes that influence their perceptions, judgments and decisions" (Kayes, 2006, p. 69).

Barrier to Retention: Social Isolation

Once they are selected into STEM departments, WOCF are often doubly isolated from social support networks. Specifically, their racial–ethnic and gender identities (which differ from that of the prototypical White, male scientist) cause them to stand apart from others in their academic community, and their scientist–scholar identities may cause them to feel separated from their racial–ethnic community (L. E. Malcom & Malcom, 2011). As a result, many WOCF have reported feeling invisible and isolated in their departments (Constantine, Smith, Redington, & Owens, 2008; Turner & Myers, 2000). Furthermore, the STEM academia has not paid adequate attention to the desire for WOCF to contribute to their racial–ethnic communities, which may serve to further isolate WOCF (Constantine et al., 2008; Turner, 2002). Many of these faculty are forced to navigate the muddy waters of maintaining their personal identities alone, because there are often too few WOCF to provide them with meaningful mentoring relationships (Rankins, Rankins, & Inniss, 2014).

WOCF also experience greater levels of subtle workplace discrimination, including incivility, microaggressions, and ostracism (Carter-Sowell & Zimmerman, 2015). This is problematic given that subtle discrimination can be more harmful than is overt discrimination due to its ambiguity, which causes increased mental rumination (Jones, Peddie, Gilrane, King, & Gray, 2016) and allows perpetrators to justify their actions (Cortina, Kabat-Farr, Leskinen, Huerta, & Magley, 2013; Zimmerman, Carter-Sowell, & Xu, 2016). Academic incivility and bullying have been shown to have lasting personal and professional repercussions for the targets of these behaviors (Frazier, 2011; Keashly & Neuman, 2010). Johnson-Bailey (2015) asserted that

> when you introduce race and gender, bullying and incivility can occur regardless of rank. Therefore, a junior male faculty member can effectively bully a senior woman colleague, or a White colleague of lesser rank can bully a higher ranking faculty member of color. (p. 43)

Put simply—regardless of rank or time spent in the pipeline, WOCF are targeted above and beyond their White male and female counterparts, increasing their chances of leaving, or leaking, from the pipeline.

In addition to experiences of isolation and mistreatment, STEM WOCF often find that their students and colleagues are more likely to challenge their expertise in the classroom and the field (Pittman, 2010). Thus, WOCF may feel pressure to go above and beyond to prove their expertise and garner respect from others (Ford, 2011), which can be cognitively and physically draining. These negative experiences likely contribute to the increased turnover of WOCF in STEM (Turner, 2002).

Even when they are faced with mistreatment, WOCF are expected not to rock the boat of the STEM academia. The cultural norms that socialize girls to "play nice" as children continue to urge women to play nice at their workplaces as adults. Women who break this norm and actively resist incivility or bullying are often treated negatively (Babcock, LaSchever, Gelfand, & Small, 2003; Sandberg, 2013). The cultural call to play nice differentially affects some minority women faculty. Namely, Black women faculty often have to avoid conforming to the "angry Black woman" trope, which becomes an emotional burden when faced with the injustice of workplace incivility or academic bullying (Ashley, 2014; M. Morgan & Bennett, 2006). Alternatively, Asian women (who are often viewed as less out of place in STEM due to so-called model-minority stereotypes) are often stereotyped as submissive and passive, and failure to conform to that pattern by confronting mistreatment can cause others to perceive them as hyperaggressive (Berdahl & Min, 2012).

In sum, isolation experienced by WOCF in STEM may exacerbate the negative outcomes of experienced workplace mistreatment. We posit that interventions providing increased social support can assuage the feelings of isolation for WOCF in STEM departments and serve as a buffer against workplace incivility, ostracism, and bullying. Ultimately, we believe that social support can serve to satisfy WOCF's need to belong (Leary & Baumeister, 2017) and help WOCF remain in the STEM academic pipeline.

Interventions to Reduce Barriers to Retention

We propose that creating social support networks might be the most effective intervention to address the barriers to retention for WOCF in STEM and that mentorship programs are a less effective strategy. However, these interventions have not been specifically examined with WOCF in mind. Thus, more empirical research is needed to test the effectiveness of these two strategies at combating the experiences of chilly climate faced by WOCF in STEM.

Creating Social Support Networks

In many institutions, WOCF are dispersed among many different departments and academic areas, which can cause feelings of alienation and loneliness. Social groups (similar to employee resource groups) can promote networking, facilitate camaraderie, and provide social and emotional support for WOCF (Xu & Martin, 2011). By facilitating opportunities to meet and participate in social and academic activities, institutions can combat the feelings of alienation, isolation, and tokenism that WOCF often feel within their STEM departments (N. Thomas, Bystydzienski, & Desai, 2015; Turner, 2002). These opportunities for social interactions among WOCF across departments could provide the psychosocial support needed to buffer against the negative experiences of incivility and ostracism that often lead to turnover (N. Thomas et al., 2015).

These social support structures can include peer mentoring circles, seed money for collaborative and interdisciplinary research aimed at WOCF, open forums exhibiting research by WOCF, and conferences or symposia for WOCF (Turner, 2002; N. Thomas et al., 2015). WOCF can also benefit from the creation of "noncompetitive, non-judgmental, and relationship based" writing groups that serve to provide support, accountability, and peer reviews for group and individual writing. Results from similarly structured writing groups show increases in collaborative research, strengthened professional networks, and heightened feelings of emotional and professional support (Penny et al., 2015, p. 458).

Additionally, there are support structures for WOCF in STEM beyond the institution level. For example, the STEM Women of Color Conclave and the Minority Women in Science Network are examples of professional organizations for WOC in STEM—as well as their allies—to gather. These organizations are opportunities for networking, mentoring, collaboration, and cooperating on advocacy efforts (L. E. Malcom & Malcom, 2011; Rankins et al., 2014).

Mentorship Programs

There is a host of literature addressing the role of mentorship in retaining minority faculty in the academic pipeline (e.g., Dawson, Bernstein, & Bekki, 2015; N. Thomas et al., 2015; Turner, 2002). It is well established that mentor–mentee relationships can help level the playing field for minority faculty in STEM fields. A mentors serve as guide for mentees and introduce them to the culture, conduct, and traditions of the field (L. E. Malcom & Malcom, 2011). They can also help mentees with professional development and goal setting (Dawson et al., 2015). Additionally, mentorship can serve as a source of psychosocial support, which could serve as a buffer against mentees' feelings of isolation (Turner & Myers, 2000). Payne, Thompson, and Pesonen (2011) found that that women faculty and faculty of color reported significantly stronger needs for career-related mentoring, psychosocial mentoring, and role model mentoring, compared to their majority counterparts.

Although we agree that WOCF could benefit from mentorship programs, we view mentorship as a less effective strategy for preventing turnover. Due to the paucity of WOCF who can serve as mentors, WOCF mentees are frequently paired with mentors who are demographically dissimilar from themselves (i.e., male or White). This is problematic because research has shown that WOCF mentees feel that it is important to have a mentor who is similar to them in terms of race and gender (Blake-Beard, Bayne, Crosby, & Muller, 2011). Furthermore, when mentors and mentees are both minorities, mentees receive more instrumental and psychosocial support and feel more satisfied with the mentorship (Adusei-Asante, 2018; Ortiz-Walters & Gilson, 2005). Although there is evidence that demographic similarity is not necessary for fostering effective mentoring relationships (P. R. Hernandez, Estrada, Woodcock, & Schultz, 2017), mentees are likely to seek out mentors who can better relate to their personal experiences (Brunsma, Embrick, & Shin, 2017; K. M. Thomas, Willis, & Davis, 2007). Thus, it is possible that mentors who are men and/or White may be less able to fully support colleagues facing specific issues pertaining to their gender and race (i.e., WOCF). Additionally, not all mentorship is created equal; Noy and Ray (2012) found that when it came to adviser support, women of color graduate students were the most disadvantaged, compared to all other groups of graduate students. This finding may be due to lack of WOCF mentors. Thus, typical mentorship programs are likely to be most beneficial to junior White, male faculty, thereby exacerbating existing demographic differences in turnover.

Barrier to Promotion: Institutional Housekeeping

Although WOC are underrepresented in STEM faculties across the board, the proportion of WOCF decreases substantially as professorial

rank increases (Villablanca, Beckett, Nettiksimmons, & Howell, 2011). A primary barrier to advancement for WOCF is the fact that within STEM departments, they are often tasked with additional service obligations, known as "institutional housekeeping," that divert time away from research (Hart, 2016). Research has suggested that women in STEM positions perform about three more service jobs per year than male faculty members do (Guarino & Borden, 2017). However, because of their double-minority status, WOCF are often specifically called upon to teach classes related to racial−ethnic issues, serve on diversity-specific committees, mentor students of color and female students, and handle minority and gender affairs (Ford, 2011). Additionally, El-Alayli, Hansen-Brown, and Ceynar (2018) found that students who were academically entitled (i.e., think they deserve to succeed despite a lack of academic effort) had a tendency to expect women faculty (but not men faculty) to concede to requests for special favors. Upon denial of such requests, these students often reacted negatively, adding to the emotional burden of institutional housekeeping.

Indeed, WOCF are often expected to be teachers, mentors, friends, and a source of inspiration for all women of color, racial minority men, and White women who are out of place in STEM fields. This extra, invisible service burden is a form of "cultural taxation," which Padilla (1994, p. 26) described as the additional service burden placed on minority faculty to be the primary point of contact for all minority students. As faculty spend more time with these students, they have less time to spend on their own work.

Although these tasks are inherently well intentioned (to perhaps increase representation and diversity in academia and provide mentorship for racial−ethnic minority women who are interested in pursuing STEM careers), there is an ironic contradiction in these demands. The small number of WOCF available in STEM departments forces these faculty members to participate in committees more often than their White and/or male colleagues do (Ford, 2011; T. J. Hernández & Morales, 1999). Their presence is also quite salient, causing WOCF to feel intensely scrutinized and judged by their race−ethnicity and or gender (J. W. Smith & Calasanti, 2005). In the words of L. E. Malcom and Malcom (2011, p. 169), "they are at once highly visible and invisible." Ultimately, they are penalized during the tenure and promotion processes for allocating their time to these service committees rather than their research pipeline. This issue is exacerbated in top-tier research institutions, which value research productivity much more than service and teaching (Baker, 2012; Turner, 2002). Thus, although the voice of minority women is crucial to building lasting change in universities, expecting WOCF to act as representatives of all minorities and shoulder the responsibility of addressing diversity-related issues is what leads to the disproportionate amount of institutional housekeeping in the first place.

Interventions to Reduce Barriers to Promotion

In this article, we posit that establishing transparent and equal workload distributions will be the most effective intervention to reduce the barriers to promotion that WOCF face in the STEM academia, compared to Just Say No! and formally rewarding service work. However, it is important to note that these strategies have not been studied specifically for WOCF in STEM. Thus, future research still needs to be conducted to determine which of these interventions is the most influential in combating these barriers faced by WOCF in STEM academia.

Establishing Transparent and Equal Workload Distributions

The transparency of institutional policy must extend to tenure and promotion guidelines. Tenure and promotions periods can be stressful, but they are even more so if the process seems nebulous and the guidelines vague, as described in a study of Latino/a professors (Urrieta, Méndez, & Rodríguez, 2015). The employment policies of the institutions need to be clearly stated, centrally developed, and consistently implemented. Examples of these policies, noted in Gappa, Austin, and Trice (2005), include establishing "equitable evaluation criteria, processes, time frames, and compensation plans—including benefits—for teach type of academic appointment" (pp. 37–38). This information should be accessible for new academic hires, and the processes for tenure and promotion at the institution should be explicitly stated (Hart, 2016).

To prevent the exploitation of women and minority faculty members, researchers have suggested that academic institutions enforce even distribution of workloads across departments as well as mandatory annual audits of teaching and service to monitor and adjust these workloads accordingly (Hart, 2016). O'Meara, Kuvaeva, Nyunt, Waugaman, & Jackson (2017, p. 1181) suggested creating easily accessible "dashboards," showing low, medium, and high teaching, advising, and service levels across campus and departments to better pinpoint unequal workloads. WOCF could potentially benefit from these interventions because the increased transparency of workload distributions could free WOCF from having to shoulder a disproportionate amount of institutional housekeeping duties. Without these hidden workloads, WOCF will be able to continue to focus their efforts on the research and writing that are most richly rewarded during the tenure and promotion processes.

Just Say No!

One strategy that is commonly recommended in both the academic literature and popular press is for WOCF to simply refuse these additional service requests. This idea centers on the notion that learning how to say no encourages women to speak up on behalf of themselves and set firm boundaries on how they spend their time (Pyke, 2015). Senior female faculty members are expected to model such behaviors for their junior colleagues.

This Just Say No! technique may not be effective for WOCF for several reasons. First, this strategy places the obligation on WOCF to undo their own disadvantage and does nothing to address the fact that women are asked to spend more time and energy on non-research-related activities and service requests (O'Meara et al., 2017). Second, although all women open themselves to criticism by refusing requests, WOCF are particularly impacted. Stereotypes at the intersection of race and gender open underrepresented WOCF to accusations of being angry, lazy, bossy, unreasonable, and uncooperative (Ashley, 2014). Thus, this model must move from Just Say No! to Just Don't Ask! to avoid pressuring WOC into the service positions that typically detract from their career progression (Pyke, 2015). Just Don't Ask! highlights the fact that the problem is not with WOCF who refuse such service requests but with the overly demanding system placing undue and unequal pressures on them in the first place.

Formally Rewarding Service Work

Some researchers have also suggested formalizing mechanisms to reward service work in order to account for these unequal service burdens (Reynold & Corda, 2011). Such suggestions include adequately documenting both the quality and quantity of service work,

reducing teaching loads for those involved in particularly heavy service, and considering service work when discussing salary merit increases (Bird, Litt, & Wang, 2004; Roos, 2008). Administrators are often compensated for similar types of service, so it seemingly makes sense to simply extend the compensation for day-to-day tasks that keep the university running to faculty as well.

The formalization of service work is problematic for the same reason Just Say No! is problematic—formally rewarding service work does not address the underlying problem of who is being asked to perform higher amounts of service work in the first place. Formalizing service work may pressure WOCF into believing they need to perform extra service work to be competitive. This service work, however, takes time away from the research crucial to earning tenure, promotions, and prestige (especially at top-tier research universities, where research will always remain a top priority). Any policies regarding compensation for committee assignments should also account for the emotional burdens felt by those consistently tasked with fighting their own oppression in a system built on systemic racism and sexism. Instead, male faculty committed to racial and gender equality should be required to step up and accept these positions. Furthermore, it should be made clear that the onus must be on the university administration, and not on WOCF, to undo institutional inequity (Fehr, 2011; Bird et al., 2004).

Conclusion

When Crenshaw (1991) first coined the term *intersectionality*, she highlighted the urgency with which the world must address and correct the dual challenges–also known as the ″double bind″ (pp. 12, S. M. Malcom et al., 1976)—faced by the targets of race-and gender-based prejudice. Researchers have identified a multitude of barriers that impact women in academia but often disregard the unique challenges facing women of color. Solutions for promoting minority success in STEM academia are often viewed through the lens of either gender *or* race. Indeed, much of the extant literature has proposed strategies targeted at either gender or race, and few have addressed the specific challenges faced by WOCF in STEM. Because WOCF experience injustice at multiple levels, so too must the solutions for these problems address the multiple levels of social injustice.

At this point, academics must do more than simply raise awareness—there are tools, methods, and solutions in the literature for correcting the roadblocks for WOCF in STEM fields. Of course, advocacy is a crucial step for implementation. However, advocacy must be paired with action. The solutions we have recommended purposefully engage an intersectional framework to highlight the unique barriers and best corresponding interventions associated with selecting, retaining, and promoting WOCF.

To truly address the leaky pipeline challenges faced by WOCF in STEM, one must tailor interventions to the unique experiences of WOCF. In this article, we highlight strategies that we believe would be less effective to address the selection, retention, and promotion challenges faced by WOCF because many of them fail to account for the intersection of race and gender. However, empirical research is needed to test the assertions made within this article regarding the relative effectiveness of the different strategies for combating the barriers to selection, retention, and promotion for WOCF in STEM academia.

Although it must be noted that not every intervention is appropriate for every institution, we charge departments, institutions, and academic fields as a whole to think critically about these intersections of stigmatization to more effectively identify and fix these leaky pipelines hindering the success of institutions and science as a whole. We encourage researchers to reexamine prior solutions for the leaky pipeline using an intersectional framework. There will never be gender or racial equity in STEM if the solutions produced continue to leave WOCF behind.

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