The Elephant in the Room: Race and STEM Diversity

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Despite considerable efforts to enhance participation of underrepresented demographics, participation of scholars of color in STEM remains stagnant. In contrast to other academic disciplines, the experiences of STEM scholars of color are relatively unvoiced, which hinders examination of the factors that reduce participation and retention. Social science and education research reveal the importance of intersectional strategies to address institutional and cultural practices that reduce diverse participation. Institutional change requires the support of the STEM workforce. I summarize important issues that influence recruitment and retention and offer strategies that can improve recruitment and retention of faculty of color. Broad awareness among STEM practitioners of the relationship between race and the biases that reduce recruitment and retention of underrepresented scholars can support STEM diversity initiatives.

Keywords: inclusion, intersectionality, institutional transformation

In response to "Operation Varsity Blues," the *Chronicle of Higher Education* (18 April 2019) published a review featuring the reactions of African-American scholars to the admissions-bribery scandal. Perspectives were presented by scholars in rank from graduate student through full professor and addressed many aspects of the marginalization the respondents have experienced and continue to experience in their respective disciplines throughout their careers. Notably, there were no contributions from African-American STEM scholars. This absence mirrors the relative silence on issues of race or ethnic marginalization among STEM practitioners, even as racial diversity in STEM has remained low. This silence is in contrast to STEM education research that reports racial and ethnic conflicts that contribute to low participation and retention of underrepresented youth and college students in STEM programs (Espinosa 2011, McGee 2016, Mascarenhas 2018). Although it may be tempting to attribute silence on such conflicts to more equitable conditions for STEM scholars than in other disciplines (e.g., Lawrence et al. 2014), chronic low representation of scholars of color in STEM challenges this assertion.

The participation of underrepresented minorities (URMs—e.g., African-American, Latinx, or Native American) is low in academia, despite efforts to enhance diversity, and this underrepresentation is largely driven by low representation in STEM fields (Li and Koedel 2017). Scholars of color make up 20% (9% Asians or Pacific Islanders, 6% African-American, 4% Latinx, less than 1% American Indian, Native Alaskan) of faculty employed at US degree-granting institutions. In contrast, within STEM, URMs represent 9% of faculty within the academic doctoral workforce (National Science Foundation 2019) and less than 4% of faculty within selective universities (Nelson et al. 2010, Li and Koedel 2017). Chronically low representation translates to the absence of institutional critical mass, with many URM scholars being the only representative of a given racial or ethnic group within their home department (Nelson et al. 2010). Because a diverse faculty can encourage the retention of URM students (McGee 2016), low diversity among faculty is a liability in maintaining diversity in the student pipeline even when STEM-specific initiatives that emphasize the mitigation of critical skill deficits among underrepresented students are employed (e.g., Foor et al. 2007). Therefore, understanding the climate experienced by faculty of color in STEM and its relationship to low participation can improve diversity enhancement objectives by improving faculty and student retention.

There is strong reluctance to address issues of race or racism in the unrelentingly low representation of people of color in the academy. Although it is difficult to broadly confront questions of race and racism in institutions, if broad participation in the STEM academy is to be achieved, such a confrontation is necessary (Winders and Schein 2014, Antón et al. 2018). At issue is the development of institutional strategies to effectively broaden participation, which can be served by synthesizing the experiences that lie at the intersection of gender and race or other marginalized demographics. The success of these strategies requires broad recognition among STEM practitioners that diversity interventions have been unsuccessful in recruiting and retaining

scholars of color. If the literature on implicit or unconscious bias reveals anything, even when limited to articles presented in journals targeted for STEM practitioners, it is that caring about inequity is insufficient to remedy inequity.

Marginalization and color-blind examinations

Experiences of marginalization among URM scholars who complete PhDs and achieve academic employment in STEM are underexamined relative to the experiences of those in non-STEM disciplines (e.g., Fenelon 2003, Henry 2015, Chatelain et al. 2019) or women in STEM (e.g., Hopkins 2002, Ceci and Williams 2011, O'Brien et al. 2019). Marginalization strongly reduces retention and is documented similarly among women and scholars of color, including but not limited to pay inequities, devalued research contributions, and heavy service loads (Turner et al. 2008, Lawrence et al. 2014). However, the responses of women and URM scholars to intervention have been uneven. Ceci and Williams (2011) reported that, in the life sciences, the participation of women, measured by the number of PhD degrees earned, increased from 13% in the 1970s to more than 50% as of 2010. The changes in participation in other STEM disciplines are not as dramatic, but diversity-enhancement interventions have been successful in increasing the number of women in the STEM academy, whereas URM participation has remained flat.

An important issue is that much of the examination of women in STEM is color-blind. As a consequence, issues unique to faculty of color that may impede participation can be masked (Henry 2015, Armstrong and Jovanovic 2017, Laursen and De Welde 2019). Scholars who voice their marginalizing experiences may feel threatened or isolated, which can mask inequities at the expense of retention (Turner et al. 2008, Ross and Edwards 2016). For people of color, it can be a formidable challenge to foster change when their lived experiences run counter to the narrative of a color-blind society (Johnson 1994). Such issues are researched in sociopolitical and other contexts and identify institutional inequities that are unique to URMs and that are not revealed using single-axis frameworks (sensu Crenshaw 1989), such as color-blind examinations of women's issues. Similar approaches may be useful to identify the extent to which value systems, power inequities, and other manifestations of marginalization experienced by those outside of the dominant culture reduce participation in STEM for scholars of color.

I present three factors that have strong potential to improve STEM diversity. I examine how the intersection of gender, race, and other underexamined identities, the role of institutional support, and practices unique to STEM culture influence the participation and retention of URM STEM scholars. Important groundwork on these issues has been laid out in the social sciences (Crenshaw 1989, Cho et al. 2013, Smith 2017); this work can provide insight into the relatively silent experiences of faculty of color in STEM. Although STEM diversity initiatives have made large investments in "pipeline" strategies, these investments can be

improved with increased retention of URM faculty (McGee 2016), a group whose climate is more rarely discussed. By examining these factors, a path forward to diverse participation in STEM can be improved.

Intersectionality

The combined impact of race and gender is documented at least as far back as the 1800s, originating from the contributions of women including Harriet Tubman, Sojourner Truth, and Ida B. Wells, who recognized how this interaction uniquely shaped their political struggles as women of color (Combahee River Collective 1982). This complex interaction of race and gender, now referred to as *intersectionality* (Crenshaw 1989), has been largely examined in the context of social justice and Black feminism but, more recently, has been applied to include broader marginalized groups who experience institutional power inequities (Cho et al. 2013, Taylor 2017). This lens can inform the disparities in the advancement of different underrepresented groups in STEM.

To date, diversity enhancement initiatives largely emphasize remedying overrepresentation by white men with an implicit assumption that underrepresented groups share similar experiences. Although the potential for perverse outcomes when assuming narrow definitions of equality is acknowledged in terms of gender (O'Brien et al. 2019), color-blind perspectives eclipse the experiences of people of color, a reality that is gaining recognition in STEM (DeCuir-Gunby et al. 2009, Winders and Schein 2014, Armstrong and Jovanovic 2017, Antón et al. 2018, Laursen and De Welde 2019). Without an intersectional perspective, the effects of race, socioeconomic status, or gender identity are felt only among those with multiple, underrepresented identities (DeCuir-Gunby et al. 2009, Armstrong and Jovanovic 2017, Freeman 2018). Such isolated experiences reduce the possibility of advocacy to improve working conditions. Although much of the research on intersectionality covers the experiences of women of color, the outcomes of such research have been recognized as able to benefiting a broad group of people who are marginalized by imbalanced power relationships (Cho et al. 2013), including people of color, regardless of gender, and those from low socioeconomic backgrounds.

Single-axis (Crenshaw 1989) perspectives can cultivate additive approaches (Leggon 2010) that view individuals as, for example, women *and* African-American rather than as African-American women. An additive approach assumes that there is a common experience among all women that is then modified by race, whereas intersectional approaches acknowledge the integrated experiences of a woman of color. Additive approaches are problematic when hierarchical differences associated with race, such as access to social and other networks, exist among women of different racial backgrounds (e.g., Turner et al. 2008, DeCuir-Gunby et al. 2009, Gaughan et al. 2018). When such differences are not acknowledged, they can be perpetuated within institutions (Tate and Page 2018). Additive approaches can then diminish the importance of race or other underexamined

identities independent of gender on faculty performance and retention, and at worst, may deflect investment in strategies to improve the climate for scholars in these groups.

Recent studies have shown promising benefits of intersectional strategies to improve retention and enhance diversity in STEM. Armstrong and Jovanovic (2017) reported that intersectional programs that foster targeted mentoring to support professional success, and networking with other women of color outside of the university can support URM women more effectively than those using solely additive approaches. Without institutional support, however, these interventions were not always successful. This is in part a result of the low representation of URM faculty, which challenges the ability of any individual program to support networking among URMs without institutional collaboration. Encouragingly, the National Science Foundation's (NSF) ADVANCE requests for proposals show a trend toward greater recognition of intersectionality, which can stimulate institutional commitment (Laursen and De Welde 2019). These studies are promising for STEM diversity, and they underscore the role of the institutional level in fostering diversity.

Institutional support

Institutional transformation geared toward recognizing and remedying embedded institutional biases can increase STEM diversity (Corneille et al. 2019, DeAro et al. 2019, Shaw et al. 2019). Such interventions have been formalized through federal initiatives, including NSF ADVANCE and the National Academy of Sciences' statement on bias in science and engineering (National Academy of Sciences et al. 2007). Underlying these initiatives is the understanding that systemic, cultural biases become embedded within institutional practices and contribute to inequities in participation and performance along lines of gender, race, and other historically marginalized demographics.

At the institutional level, diversity is readily tracked in terms of demographics (Nelson et al. 2010, National Science Foundation 2019) and more frequently examined in terms of gender compared with race (Winders and Schein 2014). The numbers are straightforward to track, but as Smith (2017) warned, because numbers cannot reveal information regarding climate, institutional access does not include institutional transformation. Combined with the analytical challenges associated with the very low numbers of URM scholars (Nelson et al. 2010, Gaughan et al. 2018), interventions to improve retention are commonly targeted at the success of individuals (Armstrong and Jovanovic 2017). Such an idiosyncratic approach may be necessary within a department or institution, but given systemic bias surrounding race, strategies that can be adopted at institutional levels will have more impact.

The low number of URM practitioners may challenge but not impede the development of institutional transformation strategies to increase participation. Early presentations of gender inequity in STEM recognized the value of personal narratives to raise awareness of the status of women (Lawler 1999). In fact, storytelling—or counterstorytelling—is a tool that has been used in law and other disciplines to advocate on behalf of marginalized people for decades (Delgado 1989). When the rules of institutions mainly consider the experiences of the dominant culture, there may not be rules in place to protect or advocate on behalf of people outside of those experiences.

Personal narratives, therefore, can raise awareness of institutional injustices or uneven advocacy. Although such presentations exist (e.g., Henry 2015), they are uncommon because of the risk associated with losing anonymity and the fear of repercussions (Lawler 1999). Nevertheless, marginalization along racial lines has been documented that includes unequitable distribution of space, tokenism, racist language from colleagues and students, devalued research, and a lack of inclusion that influences the ability to effectively navigate the institution, including tenure and promotion, and that reduces opportunities for collaboration (Turner et al. 2008, DeCuir-Gunby et al. 2009, Henry 2015, Gaughan et al. 2018). The emotional burden of these experiences can reduce retention in the academy at large (Fenelon 2003, DeCuir-Gunby et al. 2009, Henry 2015), but the lack of inclusion may be particularly limiting in STEM.

The lack of inclusion can limit URM STEM scholars because of the important role of social networks in scientific productivity. Networks may present as informal groups in which information on topics ranging from advice on mentoring students to an awareness of grant opportunities is casually presented (i.e., in water-cooler conversations) or as formal collaborative groups that may or may not result from funding initiatives but that are focused on specific scientific problems (Gaughan et al. 2018). Fortunato and colleagues (2018) reported that, in all branches of science, high-impact papers are collaborative. Similarly, calls for diversifying STEM recognize the value of collaboration from a representative workforce to generate novel ideas and innovative research (Uriarte et al. 2007, Perez and Hogan 2018). Exclusion from professional networks marginalizes URM scholars at the expense of their productivity and retention (Uriarte et al. 2007, Gaughan et al. 2018). Lower rates of promotion and greater salary gaps are well documented for URM scholars compared with white men in STEM (Turner et al. 2008, DeCuir-Gunby et al. 2009, Nelson et al. 2010), which suggests that institutional consideration of the relationship between implicit racial bias and limited professional networks is warranted.

To be effective, institutional interventions will require broad support among STEM faculty. Just as male faculty's discomfort with confronting gender bias can compromise equitable gender policies (Carnes et al. 2012, Shaw et al. 2019), faculty race awareness is important to the success of increasing diverse participation at the institutional level (Antón et al. 2018, Chapman 2018, Mascarenhas 2018). An important component of this intervention includes an assessment of some of the assumptions embedded in STEM

culture that have been used to explain biased participation. One assumption that is being challenged in outreach (Nadkarini et al. 2019) and education (Estrada et al. 2016) is the importance of skill deficits versus institutional barriers in diverse participation in scientific issues and STEM program retention.

STEM culture

Addressing the role of systemic bias in STEM participation may be challenging because of the value of objectivity in these disciplines and research emphases on empirical, objective, and largely noncultural topics. Diversity enhancement initiatives in STEM are particularly focused outward from the culture of academic institutions to address such issues as developing interventions to foster interest in STEM or remedying skill deficits that limit access to STEM among underrepresented groups. Such "pipeline" strategies are designed to increase the diversity of students pursuing STEM-eligible curricula. This approach is in contrast to the assessment of social and cultural dynamics within STEM disciplines that can serve as barriers to those with low representation. For example, cultural misalignment can generate contrasting perceptions and expectations among STEM educators and underrepresented students that influence student success (MacPhee et al. 2013, Allen-Ramdial and Campbell 2014). Pipeline and cultural interventions are not mutually exclusive, but they differ in the extent to which the emphasis is on deficits of underrepresented groups versus cultural barriers that exist within the STEM academy.

Ongoing discrepancies between the diversity of students majoring in STEM disciplines and the diversity of scholars entering and remaining in the STEM workforce (National Science Foundation 2019) support the need to address institutional, systemic biases in support of nurturing a diverse STEM workforce. Studies have documented institutional barriers that discourage the retention of diversity (Espinosa 2011, Leggon 2011, McGee 2016), such as an overemphasis on student deficits and a lack of cultural awareness to avoid negative stereotypes.

Similar to other academic disciplines, STEM disciplines are vulnerable to societal ills that discourage diverse participation. The culture of STEM is developed by people who are products of the world at large and who historically represent a privileged experience. Cultural influences continue to be seen in the observation that there is still evidence of gendered biases, influencing publication success and citation rate (Wenneras and Wold 1997, Fox and Paine 2019)—both of which are critical components of scientific prestige and advancement—despite the considerable efforts to counter such problems. What is more difficult to confront is the extent to which dominant culture values can serve as gatekeepers of which research questions are pursued and which are not (Leggon 2011, Chapman 2018) or what is legitimate and what is not. A recent attempt to suggest foundational ecological papers (Courchamp and Bradshaw 2018)

exemplifies this issue by generating a flurry of responses addressing the lack of gender and racial diversity of scholars included the list (e.g., Baum and Martin 2018, Bruna 2018, Gilbert 2018). Such examples underscore the importance of broad support for diverse participation at all levels of the STEM academy.

Conclusions

There has been much investment in diversifying the STEM workforce, but scholars of color continue to be strongly underrepresented. The three factors presented in this article have in common that greater awareness of cultural competency (sensu Smith 1998) within academic cultures and realignment of institutional values can improve diversity initiatives. Cultural competency promotes awareness of the importance of social identity in academic success and self-efficacy (Allen-Ramdial and Campbell 2014, Gazley et al. 2014, Quigley 2016, Vakil and Ayers 2019) and is showing promise in improving STEM education diversity efforts (e.g., Dewsbury and Brame 2019). Encouragingly, the geosciences (Winders and Schein 2014) and anthropology (Antón et al. 2018) are actively assessing embedded cultural biases in their respective disciplines with the objective of enhancing diverse participation.

In contrast, the reward systems in academic institutions can be evaluated to measure the extent to which they value the work required to achieve stated diversity targets. Uriarte and colleagues (2007) raised awareness of this issue and suggested strategies to align institutional inclusion and equity values and with practices. A recent study quantified how diversity enhancement activities are disproportionately conducted by underrepresented faculty (Jimenez et al. 2019). The extent to which these activities contribute to lower productivity, promotion rates, and salaries among underrepresented faculty (Turner et al. 2008, Lawrence et al. 2014) is not clear but is suggested by the commonness with which publications and grants rank much higher than service and teaching in many STEM departments. Changing the value system of academic institutions is an achievable goal, but it is one that requires broad agreement of the value of diverse participation and recognition of the barriers to its achievement.

In closing, the benefits of a diverse workforce to scientific productivity are accepted, but the benefits of diverse participation can be viewed as a two-way street. In one direction, a diverse academy brings fresh ideas and unique perspectives to shared objectives. In the other direction, those who represent diversity bring valuable experiences to help identify institutional barriers. In addition, these scholars can model the resilience and cultural wealth that are associated with experiences beyond the dominant culture (Chapman 2018), and that empowers people to engage across cultural identities—to be diverse. The broad experiences of URM STEM faculty need to be voiced and valued, whether they are positive or negative, because they have strong potential to improve diversity initiatives.

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