Cell
Leading Edge

Commentary

Race Matters

David J. Asai[1,2,*]
[1]Science Education, Howard Hughes Medical Institute, Chevy Chase, MD 20815, USA
[2]Lead Contact
*Correspondence: asaid@hhmi.org
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Despite their initial high interest in science, students who belong to excluded racial and ethnic groups leave science at unacceptably high rates. "Fixing the student" approaches are not sufficient at stemming the loss. It is time to change the culture of science by putting inclusive diversity at the center.

> Culture is as much a structure as the economy or politics; it is rooted in institutions.—Cornel West (*Race Matters*)

From the beginning, race and ethnicity have been at the center of our nation's identity, defining who does and does not belong (Lepore, 2018). Far from being an innocent bystander, science has been an active participant in the exclusion of persons (e.g., Gould, 1981). The consequence of exclusion is underrepresentation, with persons from some racial and ethnic groups persisting in science in far fewer numbers than is expected from their representation in the nation's talent pool. In US science, this includes persons who identify as Black or African American, Latinx or Hispanic, and peoples indigenous to the spaces comprising the United States and its territories (https://grants.nih.gov/grants/guide/notice-files/NOT-OD-20-031.html).

These are science *PEERs*—persons excluded because of their ethnicity or race.

The exclusion of PEERs from STEM has long been recognized as a problem. In 1992, a special report in the journal *Science* documented the low participation of PEERs over the previous two decades (Culotta and Gibbons, 1992). Figure 1 shows the 1992 data together with the corresponding numbers from today (National Center for Science and Engineering Statistics (NCSES), 2019). A bright spot is the increased interest in STEM; the proportion of PEERs entering college intending to study STEM has nearly tripled since 1992. This increase is due, at least in part, to outreach programs that engage middle and high school students in science experiences. Despite this increased initial interest, PEERs leave STEM at rates much higher than non-PEERs, and the pattern of poor PEER persistence is essentially the same as it was nearly three decades ago (Figure 2). This is bad for science because we are losing the diversity that can be a key driver of creativity and innovation (Page, 2007). The disproportionate loss of PEERs underscores our broken system that excludes a large number of persons who want to join the scientific community.

Why the poor progress? It's not for lack of interest; PEERs are now *over*-represented among students entering college intending to study STEM (Figure 2). Nor can the lack of progress simply be attributed to the preparation of the students. When comparing students with similar backgrounds in terms of high school coursework and family interest in higher education, PEERs switch out of STEM at significantly greater rates than non-PEERs (e.g., Huang et al., 2000). However, the poor progress is not for lack of effort on the part of the scientific community. Over the past half century, an array of student-centered interventions—including research experiences, academic advising, remedial courses, summer bridge programs, and cohort-based programming—have been deployed to increase the participation of PEERs. While these student-centered programs can initially propel PEERs into science, in far too many instances, the students leave science almost as quickly as they arrived.

Deficit thinking—assuming students lack interest or preparation—and the resulting "fix the student" mindset are not working to close the racial and ethnicity gap. In order to reap the benefits of diversity, it is important to go beyond student-centered activities. It is necessary to also create institution-centered approaches that will change the culture of science and education so that students feel that they belong and that the system expects them to be successful. This is *inclusive diversity*. The responsibility for achieving inclusive diversity rests on scientists and faculty. Here are three ways we can make the culture of science more inclusive.

Question Assumptions

An assumption shared by many of us is that persons from certain backgrounds really don't belong in science because they don't "fit in." In education, this implicit belief is formalized in the theory of "mismatch," which claims that standardized test scores like the SAT and Graduate Record Examination (GRE) are both immutable and infallible, thus accurately foretelling a person's future likelihood of success in college (Sander and Taylor, 2012). These assumptions lead to the conclusion that a person with lower test scores will inevitably fail in an environment in which other students have higher test scores. In several recent federal court cases, mismatch is prominently cited as a rationalization for the end of consideration of race and ethnicity in university admissions. For example, in his concurring opinion in the first Fisher v. University of Texas Supreme Court ruling (2013), Justice Clarence Thomas wrote: "…as a result of mismatching, many blacks and

Hispanics who likely would have excelled at less elite schools are placed in a position where underperformance is all but inevitable because they are less academically prepared than the white and Asian students with whom they must compete." Under the cynical guise of compassion, mismatch justifies the exclusion of persons.

In fact, there is no evidence for mismatch. While SAT scores closely correlate with a student's background such as family income and parental education (https://reports.collegeboard.org/pdf/total-group-2016.pdf), standardized test scores are not immutable nor do they accurately predict a person's future achievements (e.g., Petersen et al., 2018). Examination of the data finds that "mismatched" students are as successful as non-mismatched students in selective schools (Kurlaender and Grodsky, 2013; Carnevale et al., 2016). And even if mismatch were a real phenomenon, there is no evidence that it particularly applies to PEERs.

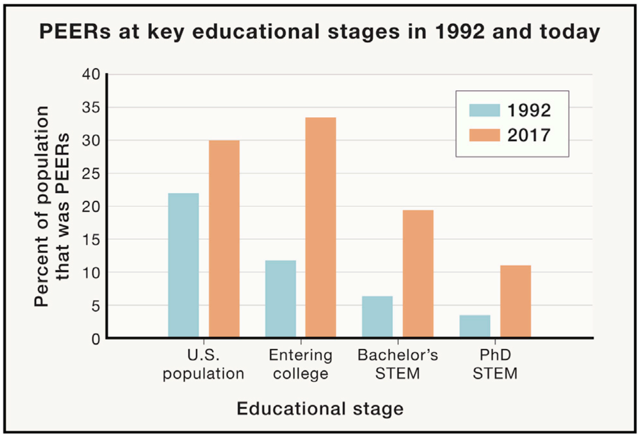

Figure 1. PEERs Are Underrepresented in STEM Degree Attainment
Persons excluded because of their ethnicity or race (PEERs) at key educational stages in 1992 and today. The most recent compilation includes data up to 2017 (National Center for Science and Engineering Statistics (NCSES), 2019). 1992 data in blue; 2017 data in orange. In 1992, the U.S. population was approximately 22% PEERs, students entering college intending to study STEM were approximately 12% PEERs, and PEERs were 6% of the STEM bachelor's and 3% of the STEM PhDs (Culotta and Gibbons, 1992). In 2017, the U.S. population was approximately 30% PEERs, students entering college intending to study STEM were approximately 34% PEERs, and PEERs were 18% of bachelor's and 11% of the STEM PhDs. From the National Center for Science and Engineering Statistics (National Center for Science and Engineering Statistics (NCSES), 2019).

Learn How to Talk about Differences

Most of us don't know how to talk about race in a constructive manner, but we can learn. As advocates for culture change, it is important that we walk our talk. Our team at the Howard Hughes Medical Institute (HHMI) engages in activities to develop a shared understanding of race and ethnicity. We discuss readings and videos, we host speakers, and we spend time together in workshops—organized and facilitated by experts—in which we talk about race and racism, explore implicit bias and how to identify and respond to microaggressions, and learn the skills of listening to understand. These conversations have helped us grow together as a group and inform how we approach our work. In turn, we encourage others to organize similar conversations in the context of their own organizations. With HHMI support, faculty and staff at colleges and universities have engaged in conversations on race and inclusion and in holding workshops facilitated by various organizations, including Crossroads (http://www.crossroadsantiracism.org/), Beyond Diversity (https://courageousconversation.com), and Visions (https://www.visions-inc.org). Through the HHMI Gilliam graduate fellowships program, dissertation advisers are encouraged to develop their skills in culturally aware mentoring through a year-long series of online and in-person activities led by the Center for the Improvement of Mentored Experiences in Research (CIMER, https://cimerproject.org).

Re-center the Science Learning Experience on Inclusion

There is something unique about science education that is leading to the disproportionate loss of PEERs. After accounting for several important factors including high school preparation and family educational and economic background, non-whites in college leave STEM fields at much greater rates than whites, but this racial disparity is not seen in non-STEM fields that also require quantitative skills (Riegle-Crumb et al., 2019). The culture of science and the behaviors of we who teach science are driving away the very persons who can contribute the most to diversity in science.

Improving what and how we teach will benefit all students and promises to especially impact PEERs when a more inclusive learning environment increases self-efficacy. For example, microaffirmations—the subtle kindness cues communicated through tone of voice and the practice of listening to understand—can increase the integration and persistence of students in science, and there is evidence that microaffirmations particularly support PEERs at least in the short term (Estrada et al., 2019).

The majority of students intending to study STEM do not finish with a STEM bachelor's degree, and most of the departure from science occurs during the introductory experience. How can we change the introductory experience so that it is more inclusive? We can change our attitude, pivoting from a "weed-out" mentality to the recognition that the introductory course is our opportunity—often the only opportunity—to show students how scientists use evidence to make conclusions about the world. We can change our expectations, asking students what they think instead of what they've memorized. If we grade on a curve, we can end this practice and replace it with developing assessments of clearly articulated competencies. We can change the laboratory courses from a series of exercises for which the answers are already known to organized opportunities for students to engage in the process of discovery (e.g., course-based research experiences [CREs]; https://serc.carleton.edu/curenet/index.html). And we can change the way we use prerequisites so that they are an effective mechanism to prepare students to learn instead of an arbitrary barrier that excludes students.

In addition to changing what we teach, we must change *how* we teach. Faculty should be provided with more opportunities to learn how to be more inclusive teachers and mentors (e.g., Dewsbury, 2019; National Academies of Sciences, Engineering, and Medicine, 2019). And we should not stop there. We must couple the learning of pedagogical skills with the development of validated instruments to measure inclusive behavior and then use the evaluation in the faculty rewards system including promotion and tenure.

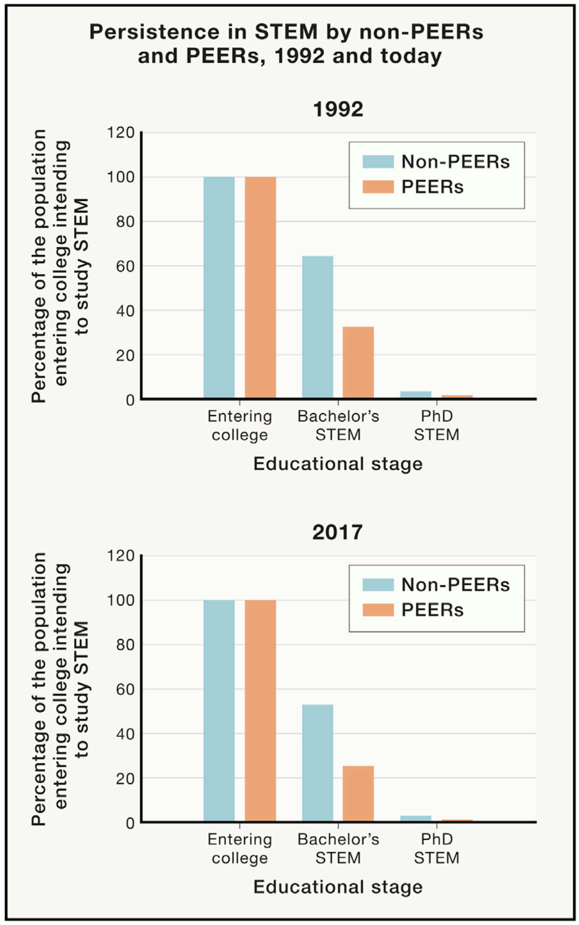

Figure 2. No Improvement in PEER Persistence in STEM
Persistence in STEM by non-PEERs and PEERs, 1992 and today. The most recent compilation includes data up to 2017 (National Center for Science and Engineering Statistics (NCSES), 2019). This comparison assumes that all of the eventual STEM bachelor's and PhD recipients started off in college intending to study STEM; i.e., there was no significant transfer into STEM from non-STEM disciplines. Normalizing the data to the numbers of students entering college intending to study STEM, the relative persistence of non-PEERs (blue) and PEERs (orange) in STEM through the bachelor's and PhD is shown. The percentages of students persisting in STEM are as follows: in 1992, 64.3% of non-PEERs completed a bachelor's degree and 3.2% a PhD, while 32.5% of PEERS completed a bachelor's degree and 0.9% a PhD; in 2017, 52.3% of non-PEERs completed a bachelor's degree and 3.0% a PhD, while 25.9% of PEERs completed a bachelor's degree and 0.8% a PhD.

Conclusions

Achieving inclusive diversity will not end racism, but it might be the beginning of the end. A scientific community that intentionally and systematically embraces diversity through inclusion will challenge the status quo and perhaps one day become the driving force for re-centering science so that it is committed to inclusion. Several changes will benchmark our progress, including these:

Who owns the challenge will change. "Diversity programs" often reside in a silo apart from the core activities of the campus and are assigned to a special administrative office. This marginalization means that diversity and inclusion are things most of us believe in but for which few of us have the responsibility to advance. The responsibility for creating an inclusive culture belongs to all of us.

Our language will change. We will begin to talk about students as peers and not as a commodity. We will be able to clearly articulate the values of diversity and inclusion. These statements will be found in places like the school's strategic plan and website, and, more importantly, their meaning will be felt when students visit campus, learn in classrooms, and engage in research experiences. We will recognize that science excellence is a culture that encourages creativity and innovation through inclusive diversity.

The number of PEERs who are STEM leaders will increase, thus providing compelling role models for our students and reduce imposter syndrome. Inclusive diversity will become a central principle in faculty recruiting and will be the responsibility of the hiring institution and not the candidate (Sensoy and DiAngelo, 2017).

Race will matter to all of us.

Another Supreme Court justice, Sonia Sotomayor, in her dissenting opinion in Schuette v. Coalition (2014), summarizes why race matters:

> And race matters for reasons that really are only skin deep, that cannot be discussed any other way, and that cannot be wished away…Race matters because of the slights, the snickers, the silent judgments that reinforce that most crippling of thoughts: "I do not belong here."

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