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Opinion

Anti-deficit is anti-racist and transformative

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For science to be socially transformative it must be anti-deficit, meaning it must oppose efforts aimed at correcting perceived deficiencies in individuals. Instead, asset-based approaches are needed that recognize and value cultural strengths instead of framing them as deficits to be masked. Such approaches foster inclusive and innovative research that better yields equitable solutions for populations burdened by structural racism.

I recently attended the "Toward Algorithmic Justice in Precision Medicine" community event at the University of California, San Francisco and was baffled by the framing of an ethical dilemma based on a real-life case study. The case centered on a computer-based technology for improved health that benefited White and Black persons more than the standard of care (improved accuracy) but benefited White individuals more (not fair). Consequently, the dilemma was presented as a choice between accuracy and fairness. I rejected this framing due to a valuable asset I have accumulated as a result of my life path. Like many minoritized individuals in science, I have accumulated resistant capital[1] necessary to counter bias and to engage in transformative research. Consequently, I communicated to organizers of the event that dissemination of a computer-based technology that preferentially benefits White individuals causes unacceptable harms. Among other unacceptable harms, it would add to the extensive evidence of racism in health-related research[2] that drives historical distrust of science and scientists by communities of color. This distrust can only be overcome and improvements in the innovation, rigor, and impact of scientific solutions attained through intentional and valued inclusion of minoritized individuals.

Like me, researchers from historically excluded groups who were educated and trained at prestigious research institutions have experienced firsthand how applying deficit-based (often racist) approaches systemically fail students and trainees.[3] Therefore, in this piece I discuss how historical pitfalls in the design of American education limit the benefits of diversity on the outputs and outcomes of science. To surpass these limits, asset-based approaches are required to achieve transformative outcomes and innovative solutions as visualized by two figures. Following the figures and the theoretical rationale for their creation, I provide practical tools for creating teaching and research environments that are intellectually safe through multilevel affirmation of cultural strengths.

The billions of dollars already spent in the United States (US) to increase the participation of ethnic minority students in science has achieved only modest success.[4] This failure can be linked to a number of issues including systemic racism in higher education.[3] In fact, an insidious principle of American higher education that leads to student exit or failure is the inherent framing of student deficits as the problem. This results in a fundamentally flawed focus on "fixing the student" (i.e., deficit-based thinking and tool development) instead of "fixing institutions."[5] In fact, to strengthen the STEM workforce the National Academies recommends institutional change guided by best practices at minority-serving institutions.[4] At these institutions, asset-based approaches, often cornerstone to both anti-deficit and anti-racist efforts, are used to respond to the needs of minoritized students. I define an asset-based approach as one that recognizes and values the strengths individuals from historically excluded groups bring to science and argue that these strengths are key to transformative research (Figure 1).

Underlying design principles of American higher education limit solutions

To "fix" institutions we must recognize institutional barriers created by systemic racism in higher education and science as a root cause of the historical exclusion of racial and ethnic minorities in science fields.[3,5] It can be argued that American higher education was designed primarily for the benefit of male European descendants with a focus on maintaining their dominant roles as teachers and research leaders. Therefore, at its core this system ignores the benefits of cultural pluralism and equality; rather its focus is on perpetuating a monocultural and monolingual society.[6] At the student trainee level, this narrow vision may be partially responsible for the unprecedented distrust of higher education found in the 2020 National Survey of Student Engagement (https://nsse.indiana.edu/research/annual-results/2020/trust/index.html). This distrust erodes student success in higher education and science. At the systemic level, distrust of educational leaders and the overwhelming presence of science professors who are not culturally representative of their students or trainees lead to everyday microaggressions.[7] These, often unintentional, oppressive actions shut down learning and research exploration, thereby limiting scientific innovation. This is documented by Ebony Omotola McGee, PhD, in her book *Black, Brown, Bruised: How Racialized STEM Education Stifles Innovation*.[8] Dr. McGee also uses the tools of Afrofuturism to predict an alternate future where the inclusion of different ways of knowing and practicing science has led to better solutions and a thriving world. We can learn from this alternate future to inform our present.

Diverse problem solvers working collectively create better solutions

While the efforts of high-ability problem solvers who think alike can lead to solutions for complex problems, it is only

through the collective efforts of diverse problem solvers that innovative solutions are attained as visualized in Figure 2. This conclusion comes from theoretical modeling of problem solving in science.[9] Moreover, being around others who think differently sparks creativity and compels individuals within diverse teams to be more diligent in honing their arguments to mitigate bias. These findings were gathered in many disciplinary settings, and Katherine W. Phillips, PhD, has disseminated them in science domains, concluding that diversity makes us smarter.[10] It can also eliminate fatal flaws generated in clinical studies when the defined populations that are examined are fundamentally different than the researchers who are studying them. In fact, insider research where researchers and participants share a common language and culture is considered more rigorous than outsider research if all other components of the study are the same.[11] This finding compels the inclusion of insider researchers on teams of clinical scientists to both combat bias and better inform study design, data collection, analyses, and interpretation of findings given fundamental differences across humans of different ancestral origins. In a practical sense, this means that diverse researchers who address problems in diverse communities (i.e., US communities) have more relevant cultural assets for solving them and should be the starting point for developing scientific teams to create better solutions.

While humans belong to a single race, requiring the use of single quotes in 'race,' they are of different ancestral origins. As a result, ancestral groups often center themselves and others in ways that must be recognized and celebrated to improve scientific study. For example, the ability to think is a determinant of being human in Western cultures based on the philosophies of Descartes who premised, "I think, therefore I am." In other equally important cultures, human existence is tied to the well-being of *others*.

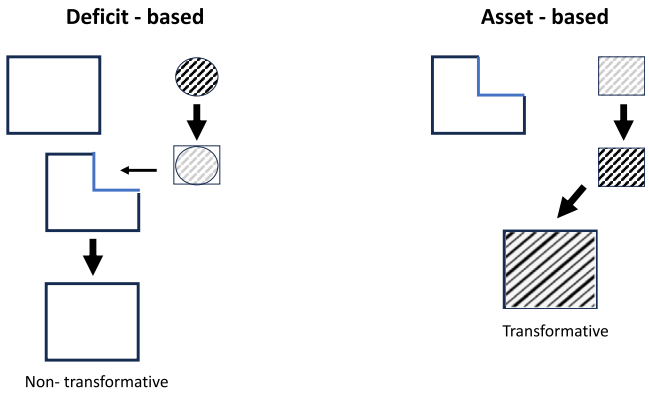

Figure 1. Visualization of deficit versus asset-based approaches to the development of the scientific workforce

In the deficit-based approach the existing scientific workforce responsible for teaching and training is represented as a solid white square. Students and trainees from historically excluded groups are shown as striped circles. The stripes diminish in intensity, and the circle becomes a square so as to integrate into the existing workforce resulting in non-transformative outcomes. In the asset-based approach the existing scientific workforce is depicted as an incomplete square. Students and trainees from historically excluded groups are shown as striped squares. The stripes increase in intensity as a result of asset-based approaches, and when the new square is included the scientific workforce is transformed.

For example, the word for humanity in the Ubuntu language of Bantu populations in South Africa is sometimes translated as, "I am because we are," and ancient Mayans of the American continent used "In lak' ech" to greet one another as, "you are my other me." These fundamental differences in how humans view themselves, others, and the world can be reclaimed to improve the practice of science to ensure progress leads to innovative and equitable solutions.

Reclaiming different ways of knowing and practicing science

On the American continents, the indigenous populations who sustained the environment for thousands of years before colonization centered their connection to each other, all animals, and plants in their ways of learning and knowing about the world. This is recorded by botanist, and indigenous scholar, Robin Wall Kimmerer, PhD, in her book *Braiding Sweetgrass: Indigenous wisdom, scientific knowledge, and the teaching of plants.*[12] While indigenous knowledge is attained in connection with others and the natural environment, higher education in the US prioritizes, incentivizes, and honors independent skills over *inter*dependent skills (https://www.vox.com/2017/9/11/16270316/college-mobility-culture). Yet, the interdependent skills of "learning to work together with others" and "learning to do collaborative research" are critical to solving complex problems of global significance. This can be best accomplished by recognizing and honing the community cultural wealth of individuals who have been historically excluded from science. These individuals include the thousands of minoritized science students at minority-serving institutions.

San Francisco State University is a minority-serving institution recognized as one of the most diverse public universities in the country. In 2014 it launched the SF BUILD project that has been funded by the Common Fund at the National Institutes of Health for nearly 10 years as part of efforts to enhance diversity of the biomedical research workforce.[13] SF BUILD Scholars are selected primarily because of their core values (not their GPA). As a result, the percentage of individuals from underrepresented groups is higher than the percentage found for the national cohort of BUILD Scholars.[13] Their selection and retention in the program are grounded by their values to "give back" and to resist messaging that they fail to belong in science. For example, SF BUILD Scholars participate in a stereotype threat workshop.

The stereotype threat workshop supports the development of skills for students to recognize and resist intellectual threats, and for faculty to recognize and work to eliminate them in their classrooms and research laboratories. The workshop often begins with the presentation of a case study. For example, the case of the sole Black student in a computer science lab course who despite her stellar performance in other science courses performs poorly on a quiz. In the case, the quiz immediately follows a request by the instructor to "find a partner" and the resistance of other students in the class to partner with the Black student. Workshop participants are then asked to discuss "What is going on?" In response to this prompt, student participants often

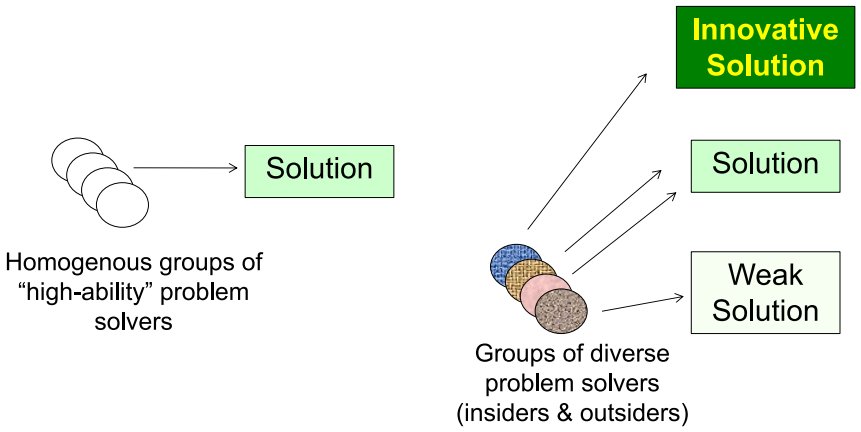

Figure 2. Visualization of theoretical model for underperformance of homogeneous groups
This visualization based on the work of Hong and Page[9] includes the addition of the importance of including insiders (investigators who share a common language and culture with study participants)[11] on clinical research teams.

recognize the isolation of the student in the case study, which leads to her underperformance. They ascribe it to the possibility that she may not feel she belongs, and occasionally students recognize the resistance to partnering as a non-verbal microaggression. On the other hand, some faculty participants have responded that the student may be having a bad day. This an unlikely possibility, and other responses to the prompt are explored through interactive review of the literature on stereotype threat to better recognize and minimize it.

The case study is based on my experience as a graduate student at the University of California, Berkeley. Tasked with being a graduate assistant for a laboratory course, I was given a lesson plan for the first day of instruction that included the presentation of precautions for keeping the students safe. These included wearing appropriate shoes, use of safety glasses, and monitoring of flames.. The lesson plan then listed the instruction to ask students to find a partner. This elicited the series of events described in the case study. In retrospect, I should have anticipated this outcome given my own experiences as an undergraduate at Stanford University, where I was often the one and only in many science environments. In fact, I only felt intellectually safe at Casa Zapata, the Chicano theme dorm where I lived the first two years of my undergraduate experience. Casa Zapata was a physical counter space that provided intellectual safety by signaling ambient belonging.[14] A similar counter space was established through SF BUILD funding. It is repeatedly found to be a critical facilitator of student success in program evaluation. Other results show the importance of building a sense of community and explicitly valuing the assets each Scholar brings to the practice of transformative science.

Affirming differences for transformative research

Another critical component of the SF BUILD intervention is the affirmation of differences. These include different social identities, life paths, and embodiment of cultural teachings, which can all be considered assets to science. They also comprise community cultural wealth. This concept is described in a seminal paper by Tara Yosso, PhD, which critically examines its component capitals (i.e., assets).[1] These include linguistic capital that can be defined as intellectual and social skills gained through communication in more than one language, and resistant capital that can be defined as knowledge and skills developed through challenging inequality. This latter skill is necessary for resistance efforts to drive cultural pluralism through a fundamental acknowledgment of the equality of all cultures in higher education[6] and in society. Only through visible acknowledgment of this equality can we create the intellectually safe spaces needed to advance science.

Tools for affirming different strengths originate from a foundational desire to wish and honor the success of all others. One of these tools is the use of microaffirmations. These were first defined by Mary Rowe, PhD, in her 2008 report to institutional leaders summarizing positive workplace factors she observed for underrepresented individuals at Massachusetts Institute of Technology (see Estrada et al.[15] for more on this topic). Microaffirmations are defined as apparently small acts, which are often hard to see, public and private, and often unconscious that occur wherever people wish to help others to succeed. When these interpersonal microaffirmations are linked to marginalized social identities, they improve persistence. This finding was obtained through SF BUILD funding and led to both the validation of a scale for measuring microaffirmations[15] and the creation of tools for combating microaggressions.

While racial microaggressions can cause minoritized individuals to exit or underperform in science environments, microaffirmations can improve both persistence and performance. Indeed, they can combat verbal and non-verbal microaggressions at the individual and interpersonal levels, as well as appropriately value cultural strengths at the institutional level. Examples are provided in Table 1. These were created by the collective engagement of hundreds of minoritized students in SF BUILD sponsored workshops designed to *Enable Full Representation*, which is the SF BUILD mission to counter underrepresentation.

In Table 1 common verbal and non-verbal microaggressions are presented. The statement, "You speak English really well," is reported as a verbal microaggression by many students, as is the statement, "You speak good English for a ____." The latter ends with the naming of a minoritized group. The nonverbal microaggression comes from the case study described in the previous section. For both the verbal and non-verbal microaggressions, countering microaffirmations at the individual, interpersonal, and institutional are developed by participants, and typical responses are provided in Table 1. At the individual level, workshop participants are encouraged to develop self-affirmations for an internal dialogue. For example, they could be said by an imagined avatar on their shoulder. At the interpersonal level, they are encouraged to develop bystander microaffirmations;

Table 1. Comman verbal and non-verbal microaggressions and countering microaffirmations

Microaggression	Verbal "You speak English very well."	Non-verbal Resistance to partnering in lab class
Individual (Self)	"I also speak 1-2 other languages."	"It's not me; it's racism"
Interpersonal (bystander)	"Wow, you speak two languages."	"Would you like to partner with me ?"
Institutional	Hiring criteria: Bilingual candidate preferred.	Professor assigns and rotates partners explicitly stating importance of working with different partners.

whereas, at the institutional level they recognize existing policies and practices and/or develop new ones. With respect to existing practices, being bilingual (linguistic capital)[1] is an asset to clinical studies enrolling participants who speak English as a second language. Therefore, being bilingual as a preferred hiring criterion makes sense. Furthermore, the ability to work with a diversity of people (social capital)[1] is critical to team-based, collaborative science that can yield better solutions to complex problems[9] (Figure 2). Toward this end, social capital can be honed by a professor who assigns and rotates partners as part of a common practice in their classes, and thus better prepares students to work in diverse teams. These professors can also write stronger letters of recommendation in response to queries from selection committees and employers who microaffirm the value of *inter*dependent skills to work effectively as part of diverse teams within their application materials.

Taken together, multilevel microaffirmations can counter microaggressions, and they can create a counter-narrative for institutional transformation that equalizes all cultures. However, to develop a counter-narrative, use of images that reify stereotypes in science settings must be minimized (e.g., a men of Star Trek poster in a computer science lab shown to trigger stereotype threat[14]). Instead, microaffirming images of individuals who have retained, enhanced, and utilized their cultural strengths (i.e., stripes depicted in Figure 1) to succeed in science can be displayed. Furthermore, hiring faculty who have retained and proudly display their cultural capital can be viewed as an institutional microaffirmation by minoritized students who perceive that academic and science leaders are purposively working to exclude others like them.[7]

Conclusion

Institutional barriers created by systemic racism in higher education and science are one of the root causes of the historical exclusion of racial and ethnic minorities in science. This exclusion is enabled and perpetuated by deficit-based (oftentimes racist) thinking and tools that erase or otherwise mask cultural assets critical to countering bias and driving innovation. Thus, the recent US Supreme Court ruling that eliminates 'race'-based admission in some university settings misses the point about why racial and ethnic minorities are needed to advance science. Indeed, educational and training efforts in science must systematically include individuals from historically excluded groups for socially transformative research that can yield better solutions for populations burdened by structural racism. In this endeavor, the focus for teachers and researchers should be on the use of asset-based approaches. Only through asset-based behaviors can we affirm and leverage cultural strengths to improve the outputs and outcomes of science through proven mechanisms. This conclusion is commonsensical. In fact, if these approaches are accepted and acted upon by the majority of the scientific workforce it could lead to the revelation that "*We are the ones we have been waiting for*," as foreseen by Hopi Elders in their declaration issued at the beginning of the 21st century. Their clarion calls urge us to unabashedly celebrate one another (e.g., through multilevel microaffirmations) so as to come together and provide solutions for the seemingly unsolvable problems facing today's society.

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DECLARATION OF INTERESTS

The author declares no competing interests.

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About the author

Leticia Márquez-Magaña is a native-born US citizen. She started school speaking only Spanish as the eldest daughter of Mexican immigrants. Unlike her parents, she had the opportunity to complete high school and was first-generation to college. At Stanford University she earned biological sciences degrees before becoming the first, and only, Latina to earn a biochemistry PhD at UC Berkeley. Following post-doctoral training at Stanford, she was an Affirmative Action hire in biology at San Francisco State University. In this 30-year role, she focuses on "giving back" to minoritized communities who co-created her radical path to becoming an impactful biomedical researcher.