American College of Neuropsychopharmacology

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PERSPECTIVE

To dismantle structural racism in science, scientists need to learn how it works

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Neuropsychopharmacology (2023) 48:579–582; https://doi.org/10.1038/s41386-023-01534-2

Protests across the United States during the summer of 2020 triggered a wave of commitments to address structural racism in neurobiology research. The directors of the National Institutes of Mental Health (NIMH) and Neurological Disorders and Stroke (NINDS) promised to reduce racial disparities in grant funding and acknowledged the negative impact these disparities have on equitable provision of mental health care [1]. Besides being ubiquitous, the calls to action were unprecedented in condemning structural and institutional forms of racism, rather than narrowly focusing on the racist thoughts and actions of individuals (see Fig. 1).

Yet as we illustrate below, maintaining focus on both the structural and individual causes of inequity is an unstable equilibrium: scientists' attention tends to gravitate toward the individual psychological causes of inequity, such as unconscious bias and imposter syndrome, and drift away from structural oppression—the maintenance of inequity through institutional policies and practices. Here we argue that scientific training should include education about the structures that contribute to inequity in science. Dismantling those structures will require deep understanding from scientists at all levels, and education can mobilize collective action for this important work.

THE DOMINANCE OF UNCONSCIOUS BIAS

Of course, the individual-level causes of oppression, such as bias, microaggressions, or imposter phenomenon, must be recognized and countered. But these individual psychological causes have taken on an outsized role. Unconscious or "implicit" bias, in particular, has become a "master narrative" [2] for racism: widely covered in the media; eagerly adopted in corporate diversity training; permeating politics, law, and academia.

Even when diversity, equity and inclusion (DEI) advocates try to emphasize both structural and individual factors, the individual factors seem to register above all else. The legacy of the 2016 White House report "Reducing the Impact of Bias in the STEM Workforce" [3] is an illustrative example. The actual text of the report addresses both implicit and institutional bias. But in the follow-up, implicit bias became the main story and institutional bias an afterthought. When officials from the top federal agencies met to discuss the report, the event was titled "Colloquium on Reducing Implicit Bias" and official coverage was similarly narrow [4]. More significantly, when Congress passed the *STEM Opportunities Act of 2019*, it ignored the report's recommendations on institutional bias, only mandating that federal agencies use the report for "reducing the impact of implicit bias."

NARROW FOCUS ON BIAS OBSCURES STRUCTURAL CAUSES OF INEQUITY

Yet an overwhelming focus on individual bias can distract from other critical factors. In neuropsychiatry, for example, research on racism-related stress often focuses exclusively on the health and behavior of individuals, ignoring structural factors such as residential segregation. The omission leads to flawed scientific findings that discount environmental influences on health and unfairly place the onus of change on people who are most harmed by the system, not the system itself [5].

The same narrow perspective distorts understanding of racism within academia. This dynamic is well-illustrated by the decade-long response of the National Institutes of Health (NIH) to the "Ginther report," in which an early focus on unconscious bias may have delayed recognition of more significant structural causes of racial inequity in grant funding. In 2011, economist Donna Ginther found that the NIH funded grant applications from Black scientists at 55% the rate for white scientists, and the gap was only slightly reduced when controlling for other measures of academic success [6].

In response to the Ginther report, the NIH pledged $5 million for an ambitious effort to counter reviewers' unconscious bias [7], but so far no definitive evidence of bias has yet emerged: neither switching the perceived race of grant applicants by modifying their names [8], nor removing the names altogether [9] had any impact, and a 2009 change in the NIH review process designed, in part, to mitigate unconscious bias had no effect [10]. Limitations in the design of these studies mean that bias cannot be ruled out [8]. Importantly, however, the effort to study bias has not yielded actionable pathways to reduce disparities in funding.

In 2019, however, Hoppe et al. discovered that a substantial portion of the NIH funding gap stemmed from an unexpected source: topic choice. Black scientists were more likely to submit grants with words such as "socioeconomic, health care, disparity, lifestyle, psychosocial, adolescent, and risk" [11]—topics that receive less overall funding in congressional appropriations [12]. As of 2020, the National Institute on Minority Health and Health Disparities (NIMHD), for example, had the lowest award rate of all

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Received: 1 November 2022 Revised: 30 December 2022 Accepted: 4 January 2023
Published online: 16 January 2023

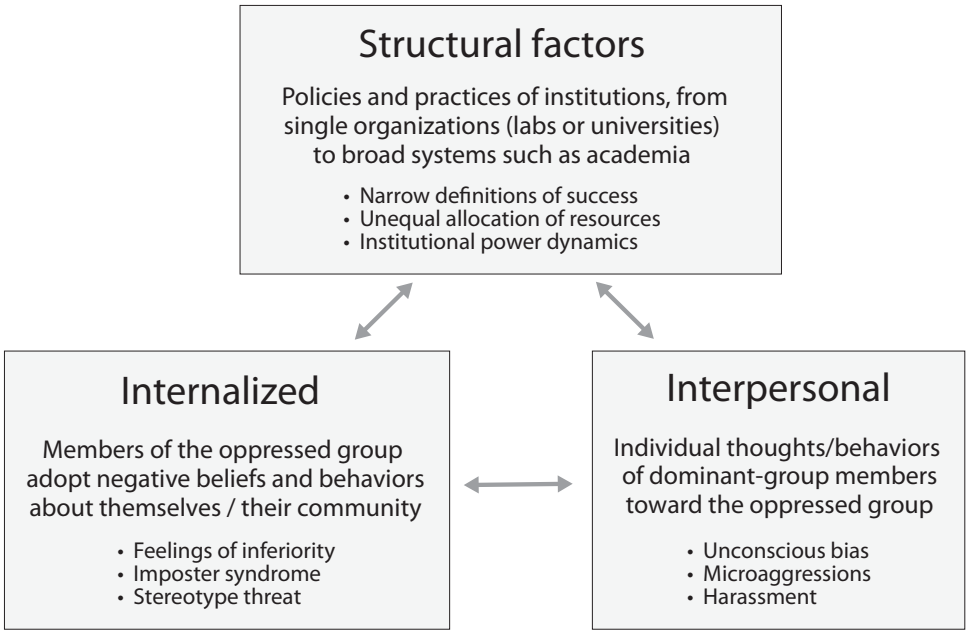

Fig. 1 Mechanisms of oppression. Oppression operates through the interaction between internalized, interpersonal, and structural factors.

23 NIH Institutes, and it ranked 21 out of 23 in absolute budget size—a situation that is now starting to improve thanks to advocacy over the past two years. For researchers who have committed their lives to the crucial work of health disparities research, this structural bias is well-known. In a 2021 Stat News article [13], Dr. Whitney Irie, a professor in the School of Social Work at Boston College, described the experience of colleagues who "have been applying for NIH funding for decades and just hit a wall because of the nature of their grants." Canny efforts to work the system—"they had to talk about health disparities without using the word"—can only go so far when that system fundamentally disadvantages one's entire field. The current budget allocation penalizes researchers for addressing the health of marginalized groups [14], and this cruel irony, Hoppe et al. show, is a major contributor to racial disparities in NIH funding.

One may argue that individual bias is still a prime mover in this story since it guided the decisions of key policymakers about what areas to fund. Yet once the NIH budgets are made, they take on a life of their own, more permanent than the thoughts and attitudes of the people who made them. Structural oppression is defined by the collection of these durable policies and practices. If we do not directly train scientists to recognize and dismantle structural oppression, such policies and practices will endure.

STRUCTURAL CAUSES OF INEQUITY

The racial funding gap at NIH is just one facet of a much larger system of structural biases within science. Below we highlight two examples: the growing dominance of bibliometrics (impact factor, h-index, patent count) in perceptions of scientific merit, and the structure of doctoral training.

Bibliometrics and other quantitative measures of scientific impact are not, of course, inherently racist or otherwise biased. Yet they reinforce existing social inequities by formalizing them and translating them into a numerical language that obscures their origin. In addition to topic choice, for example, bibliometrics turned out to play a large role in the racial funding gap at NIH. On average, Black applicants reported fewer papers, had fewer citations and published in lower-impact journals than white applicants [15]. Structural racism clearly contributes to these statistics. As noted above, congress has systematically under-invested in minority health, suppressing overall activity in the field and thus the number of citations accruing to each researcher. Social segregation can also influence citations: An extensive analysis of neuroscience literature found that white researchers preferentially cited other white researchers, and the degree of imbalance correlated with their tendency to cite colleagues who were closely related in a co-authorship network [16]. Yet, these biased social and political dynamics are masked by a culture that treats bibliometrics as objective measures of scientific value.

The focus on bibliometrics also penalizes academic care work such as teaching, mentoring, administration, and DEI advocacy, which is disproportionally done by faculty of color, female faculty, queer faculty, and faculty from working-class backgrounds [17].

Doctoral training programs can be another site of structural bias. After one or two years of classes and rotations, graduate students embark on a long unstructured period of research under the supervision of a single principal investigator (PI). Two aspects of this process—the lack of structure and the power of the PI—systematically advantage students who share a cultural and socioeconomic background with their mentors and supervisors.

Research has shown that compared to white students, students of color experience higher levels of anxiety and report feeling less rapport (interconnectedness and closeness) with their PI when the PI is white [18]. While challenging on its own, the consequences of a poor student-PI relationship are vastly amplified by the institutional power that PIs have over their students. The PI is usually the sole funder, mentor, scientific advisor, public ambassador, and future advocate for the student and their work. Low rapport with a PI can therefore have profound and lasting effects on a student's success.

Lack of structure creates an additional advantage for students from privileged backgrounds [19]. In general, in-groups tend to benefit from informality in institutions since they have more opportunities to internalize the unwritten rules for success [20]. The consequences of informality are so great, in fact, that the UC Berkeley chemistry department was able to erase the publishing gap for students of color with a simple intervention to make explicit the (previously unwritten) rules for success: They clearly defined milestones for progress in research and ensured community-wide agreement on these milestones [19].

A FLOWERING OF LOCAL AND NATIONAL INITIATIVES

A flurry of action over the last 2 years illustrates the potential for progress. The new efforts include major investments in health disparities research and creative programs for training and hiring scientists from historically excluded groups. In 2021, for example, NIH launched UNITE—a concerted effort to transform "systems, policies, and cultures to advance racial and ethnic equity and address disparities" [21] across biomedical research. Under the auspices of UNITE, NIH has already disbursed $58 million to study health disparities, with a focus on research conducted at minority-serving institutions. An additional $400 million has been committed over the next ten years through the newfound ComPASS initiative.

Support from NIH has also enabled local change at individual universities and departments. Through the $241 million FIRST initiative—another UNITE program—universities and medical schools can apply for funding to recruit ten or more new faculty who will contribute to diversity and a culture of inclusion. As of early 2020, roughly two-thirds of new hires under the FIRST program were women, and half were Black or Hispanic [22].

Scientists have also invested in mentorship. Undergraduate research experience is an informal requirement for admission to many PhD programs—one that not all aspiring scientists can easily obtain. Initiatives like the Program in Neuroscience Post-Baccalaureate (PiNBAC) at Harvard Medical School fill this gap by offering paid and mentored research experiences to recent undergraduates. Launched in 2020 in collaboration with the Harvard Research Scholar Initiative, PiNBAC includes a bootcamp on how to thrive in lab, training in quantitative data analysis, and immersion in the broader neuroscience research community. Together, these activities prepare students to navigate the hidden curriculum of graduate research.

Compared to this explosion of activity, the focus on quantifying impact through bibliometrics has been slower to change. But momentum is building. More than 20,000 people and 2,650 organizations have signed on to the San Francisco Declaration on Research Assessment (DORA), a worldwide initiative to change how scientific research is judged and rewarded. The DORA website includes a dozen case studies that illustrate what these changes look like in practice. The Netherlands, for example, announced a suite of policy changes in 2019 to strengthen incentives for academic leadership and deemphasize quantitative metrics of scientific output [23]. Implementation is underway across the country. This year, Utrecht University formally abandoned impact factor in all hiring and promotion decisions, encouraging departments to focus instead on rewarding teamwork and open science.

MOBILIZING SCIENTISTS THROUGH EDUCATION

There is no guarantee that the progress since 2020 will continue. Already, attention to inequity in science has started to fade, leaving the work of racial justice to a minority of committed researchers and administrators [24].

Teaching how structural racism operates within science can help establish a broader base of support. Barriers to advancement are often invisible to scientists who have not faced them personally, and education is pivotal in motivating such scientists to action. Moreover, learning about how structural racism operates within science may help illuminate its role in society at large—a crucial prerequisite for research on the interactions between race and human health, especially in neuropsychiatry [5].

As doctoral students at Harvard Medical School, we had the opportunity to develop a curriculum for incoming Ph.D. students on the sources of privilege and marginalization in science and strategies for self and mutual empowerment. The curriculum introduces three basic mechanisms: interpersonal, internalized, and structural oppression (see Fig. 1), and then analyzes how these mechanisms can interact and reinforce each other. In the end, students discuss practical tools to thrive within science as it exists now and envision how we could change it in the future. The curriculum is available online (bit.ly/identity-empowerment-in-science).

At this vulnerable moment in the fight for racial justice in science, we hope university and departmental leaders will invest in educating a new generation of scientists who have the will and the means to transform science for the better.

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ACKNOWLEDGEMENTS

We are grateful to Lisa Goodman, Julia Stoller, and David Brann for their edits and feedback, and to PiNBAC co-director Taralyn Tan for information about the program. Qiu Chang Wu, Galit Lahav, and Angela DePace collaborated on creating the Identity and Empowerment in Science curriculum and Abigail Plummer contributed to an early version. We also thank the Systems, Synthetic, and Quantitative Biology Ph.D. Program at Harvard Medical School, as well the Harvard Office of Diversity and

Minority Affairs, for their financial and administrative support. CW is a fellow of The Jane Coffin Childs Memorial Fund for Medical Research. DSS is supported by the National Institutes of Health training grant (T32AI132120).

AUTHOR CONTRIBUTIONS

CW and DSS co-created the Identity and Empowerment in Science training curriculum and conceived this Perspective. CW wrote the manuscript.

COMPETING INTERESTS

The authors declare no competing interests.

ADDITIONAL INFORMATION

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