

Perspectives on disparities in scientific visibility

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Scientific visibility is key to an academic career and rooted in the traditional academic cycle of training, (informal) connections, support, publications, citations, recognition and funding — a cycle from which under-represented groups are often excluded. In this Viewpoint, five scientists discuss experiences and thoughts about disparities in scientific visibility and provide action points.

Q *What, in your opinion and from your personal experience, are the main factors determining scientific visibility?*

Omolola Eniola-Adefeso. Scientific visibility, in many ways, can be arbitrary, like birth, as it is often linked to the scientific and academic family one finds themselves in¹. Some academic trees are inherently more visible than others; thus, young scientists who find themselves part of an already famous tree will have some visibility baked in as they start their careers. Visibility also builds; with the proper academic training or pedigree, an individual can obtain an academic position in the top programmes in their field, adding to the visibility needed to win high-profile grants and awards. Every award then brings additional awards, creating the so-called Matthew effect², which can propel an individual to the highest scientific visibility level. These individuals are then more likely to be invited earlier in their career to give seminars at high-profile venues, write reviews and publications in high-profile journals and join proposals for large research centres, for example, Energy Frontier Research Centers (EFRC) and the Materials Research Science and Engineering Center (MRSEC). Of course, the arbitrary component is that many first-year graduate students often do not fully appreciate the importance of visibility as they decide which research group to join, especially in the case of individuals from racially under-represented groups. Now and then, a person can gain scientific visibility from a novel discovery

independent of being part of a visible academic tree. Still, this opportunity is rare for under-represented minority scholars, especially ones that are also women, given the known diversity–innovation paradox in science — where innovations by these groups are often discounted³. Thus, such ‘innovation-driven’ scientific visibility for racially under-represented individuals and women can be rare and often occur later in their career.

Tejal A. Desai. I was not fully aware of the importance of scientific visibility until much later in my career. I had not trained with a well-established bioengineering lab, did not complete a post-doctoral fellowship before starting a faculty position and had not been part of a visible academic tree. It was only after a well-respected scientist told me that I did not have the right ‘pedigree’ for an award that I realized the importance of visibility, particularly as it is related to publishing.

When I submitted my first paper to a Nature journal, I waited in anticipation. Weeks later, I got a letter saying that, while they thought the work was innovative, they would not be able to publish it without several additional studies. I stopped there and decided to publish somewhere else. I did not realize that having the paper reviewed at a high-impact journal was half the battle or that I could directly respond, given that I had already done many of the studies suggested. For many years, I did not submit to any Nature journal as I did not think my work would be considered. It was

only when an editor reached out to me to author a review article based on our body of scientific work that I felt recognized and visible. That high-profile article, in turn, led to new invitations to speak at conferences and universities and new scientific opportunities. It turns out that my story is not uncommon — there are unwritten rules that are not known to all scientists, particularly when it comes to publishing.

Why does this matter? We know that high-impact papers lead to greater scientific visibility, which leads to more grant funding, which leads to promotion and further high-impact papers, and the cycle goes on and on. We need to make sure that all scientists are recognized for their contributions, not just those who are trained in certain labs or have the right connections. We can all play a role in expanding scientific visibility, by amplifying scientific voices from diverse backgrounds, by citing under-represented scientists in our review articles and press releases, by highlighting women and under-represented scientists in the media⁴, by taking the time to look at more than just the highest profile articles; only when scientists of all backgrounds are visible can we truly tackle the most challenging problems of society.

Q *The diversity–innovation paradox in science suggests that discounting of minorities’ innovations may partly explain their under-representation in influential positions of academia. How could this paradox be addressed?*

Maribel Vazquez. The discounting of innovations from under-represented minority faculty arises, in part, from the reticence of academia to accept non-traditional development of novelty in STEM. Researchers who bring new perspectives often develop creative solutions because they approach challenges from distinct and ‘atypical’ vantage points. As a first-generation college student and then a first-generation STEM faculty, I chose to develop my research novelty, in part, through integration with educational programmes and community outreach. I, therefore, began my faculty career at a minority-serving institution with directives to increase STEM educational attainment,

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campuses⁹. I believe that several, if not all, of these obstacles should also be addressed in science. While I encourage everyone to read the work of these and other race-STEM scholars, for brevity, here, I only name one obstacle: “the incapacity to see institutional racism in familiar routines”⁹. These routines are the ‘everyday practices’ of admitting, advising, teaching, hiring, citing, reviewing, funding and inviting, and they can all lead us to ignore the innovations of Black, Indigenous, Latinx and gender-minority researchers.

To address this obstacle, I propose we begin by redefining innovation, with a focus on inclusion. Innovation is often held up as premier scientific value. Redefining innovation requires some soul searching — asking questions. How is innovation manifested in our advising and in our classrooms/Zoom Rooms? Are we teaching what is innovative or what is familiar? What would it look like to shift to an innovation framework that is more inclusive in these spaces? What does innovation look like in our admissions and hiring? Are we starting with pools of applicants whose body of work and lived experience reflect innovation? How might we change our practices? How does innovation show up in our laboratories, study sections, reviews and conferences? Are we valuing an inclusive innovation that pushes us to question customary routines or are we defaulting to what we comfortably understand?

Some may feel that redefining innovation is fluff and that the way science functions is the way science ought to function. So, let me share a personal story about how such thinking could have fundamentally changed my STEM path and how inclusion-focused recruiting supported my commitment to a STEM career. When I was a kid, I was very excited about STEM and attended summer camps and weekend enrichment activities across the Midwest. Many of these activities required early morning rising and long drives by my supportive parents — and for a lifelong night owl, morning STEM was true dedication. Although I was incredibly close to my family, I loved STEM so much that I left home at the age of 15 to attend the nation's only residential, public three-year high school for students gifted in math and science: the Illinois Mathematics and Science Academy. We took classes on Monday, Tuesday, Thursday and Friday, and on Wednesdays, we engaged in independent inquiry — I either tutored math at a local elementary school or performed a drug delivery research project at a local college. By my senior year, I wanted to apply my

rather than pursue more traditional academic pathways with well-known investigators at research institutions. Under-represented faculty may often have similar professional goals that intertwine with their communities⁵. However, the novelty of research that helps attract new audiences to STEM by connecting technical concepts with community issues has been seldom recognized or valued as traditional innovation.

Moreover, the diversity–innovation paradox is fed by an ingrained academic culture that often values the reputation of the mentor more than the creativity of an early innovator. Technical articles and funding proposals from alumni of distinguished research centres are often afforded novelty as a benefit of the doubt, whereas those from lesser known institutions and laboratories must produce higher-level data to validate the innovation⁶. However, the research areas of under-represented investigators new to STEM fields may be in adjacent or entirely different areas from those of established labs. Additionally, these younger under-represented minority faculty may feel constrained or uncomfortable in decades-old research structures shaped by established investigators and forego this path for more exploratory opportunities.

Tejal A. Desai. Diversity fosters innovation. Yet, scientists from diverse backgrounds are often the least rewarded as innovators. Just look at who obtains the most prestigious national and international awards and recognitions. The diversity–innovation paradox³ shows that traditionally under-represented groups, in particular, women and non-white scholars, find that their novel contributions receive less ‘uptake’. What is uptake? Uptake essentially drives academic careers in science. It is the visibility, recognition and citations that go along with discovery and innovation⁷. Central to this is the

ability of under-represented groups to have their contributions highlighted and showcased by high-impact journals. When you last read a high-impact review article, how many under-represented minority and/or female scientists were cited⁷? Even if a new field emerges or new discoveries are made by under-represented scientists, these ideas often do not get legitimacy until a high-profile scientist starts to work or publish in this area⁸. I have also seen this first-hand in grant submissions, where previous work carried out by women or minority scientists is not acknowledged as being relevant or groundbreaking, leading to funding disparities for under-represented scientists^{6,8}. We see a similar phenomenon in group discussions, in which thoughts by women and under-represented minority scientists are often dismissed or not acknowledged by others who speak after. Here, allyship and sponsorship are key, which, perhaps, should also be applied to publishing. What would happen if we asked that all review articles highlight scientists with diverse backgrounds or if editors made it a point to get diverse reviewers? Perhaps we would not just overlook the contributions of these innovators.

Princess Imoukhuede. Addressing the diversity–innovation paradox requires us to engage more wholeheartedly: delving into literature on race, collaborating with scholars in this area and trying the solutions for inclusion that these scholars have spent lifetimes crafting. Among race and gender scholars are Drs Ebony McGee, Kelly Cross, Odis Johnson and Lindsey Malcom-Piqueux. Ironically, their work at the intersection of race and STEM is often overlooked in diversity–innovation paradox discussions.

In the book *From Equity Talk to Equity Walk*, Dr Malcom-Piqueux and her colleagues suggest that we must overcome several obstacles to racial equity on our

favourite classes, organic chemistry and calculus-based physics, towards the study of chemical engineering. When I spoke with my guidance counsellor about my interest in the Massachusetts Institute of Technology (MIT), he made it clear that MIT wasn't for people like me: "It takes a special student to go to MIT." He redirected me to smaller colleges without chemical engineering programmes that he believed were 'better' for me. Thankfully, the MIT Admissions Office had inclusion-focused recruiting. I was invited to attend an MIT event for Black high school students in the Chicagoland area. I was captivated by the stories of Black MIT alumni and students. As I connected more and more with their experiences, it became very clear that I was indeed that 'special student', even if my guidance counsellor did not think so. If MIT had not been inclusion-focused, the way advising functioned would have led me down a very different path than I am on today.

How many Black, Indigenous, Latinx and gender minorities are we actively directing away from STEM because we refuse to embrace their innovation and intellect? Until we see institutional racism in our familiar routines and move beyond non-innovative thinking, we as 'good people' or 'good scientists' will not be able to address the layers of barriers and blind spots that result in the diversity–innovation paradox. The key is to work and collaborate with scholars who study these issues deeply and pursue new, equity-focused paths with the same zeal as we pursue truth in our research.

 *What are the key action points to increase the scientific visibility of under-represented minorities and how could editors help?*

Omolola Eniola-Adefeso. For better or worse, scientific visibility relies on connections — academic collaborative or social connections. Some will acquire these connections through their training and the academic tree they are part of. Others will have to make these connections via avenues such as conferences and review panels. Invited talks to meetings and department seminars, particularly in top universities, are vital avenues to get visibility early in a faculty career. Unfortunately, these avenues are often not accessible to academics from racial groups under-represented in academic research, as they rely on informal and social connections, favouring white academics, given the foundation of our academic scientific enterprise. A key action point for academic departments is simply committing

to including one faculty member from racially under-represented groups in their seminar lineup each semester. There is no downside to this approach, given that seminar invites are only loosely based on merit — most department lists are arbitrarily generated by faculty interest, with many drawing from their social, academic network — conversely, both the department and the invited faculty benefit when racially under-represented faculty are included. Similarly, top national scientific conferences should ensure that their invited speakers line-up is diverse, including junior faculty and women — especially women, who are also members of groups traditionally under-represented in the discipline.

Journal editors should take more risks. As in many cases, it is a publication in a top journal more so than the quality level of the published work that propels a scientist's career. Why not work with under-represented faculty to develop their story rather than the knee-jerk rejection? Sometimes, fresh 'green' perspectives are needed to re-energize a field. Furthermore, editors should evaluate the fairness of reviewer comments or requests for revisions, given that disparities are often propagated in subtle ways, such as requesting more data (or proof of their brilliance) from racially under-represented individuals, particularly women. If not research articles, why not offer opportunities for reviews, opinions or focus pieces? After all, reviews and opinion pieces, in many cases, generate more citation counts than research articles, weighted equally in the highly coveted impact factor number. Finally, journal editors need to revamp their citation process to ensure each published work equitably cites current literature.

Publications from under-represented groups, particularly from women who are also racial minorities, are often excluded from research articles' citation lists. Far too often, I find myself reviewing articles that editors send my way due to my recognized expertise in the topic area, yet, my work is almost always glaringly omitted from the citation list. Unfortunately, this seemingly benign act further propagates the disparity faced by racial minorities, as low citation means low impact factor, which is now the de facto currency for tenure, promotion, award and, importantly, research funding⁹. Therefore, I encourage journals to halt blanket policies that prevent reviewers from requesting that authors cite the reviewers' published work. Individuals from racially under-represented groups do not tend to make such requests lightly.

Instead, journals should take an approach that allows reviewers to make well-justified requests. Finally, I applaud the editors of Biomedical Engineering Society journals for their recent adoption of a policy that invites authors to submit an optional citation diversity statement with their manuscript¹⁰, allowing introspection on the process by which authors select citations for their manuscript. I encourage all scientific journals to follow suit.

Princess Imoukhuede. When I think about how scientific visibility can be championed, I think about the positive experiences that I have had in my career. I had amazing doctoral and postdoctoral advisers who championed my scientific visibility. They nominated me for awards and extended invitations for me to submit papers. I hope that most people will think, "Well, of course, that's what any good adviser would do," but I have heard enough horror stories of advisers 'eating their young' to know that these experiences are not universal.

Beyond these research advisers, there have been several women who have mentored me and developed programmes that have had a remarkable effect on my visibility and my STEM path. I name only a few of them here to honour their work. For example, I remember Drs Paula Hammond and Linda Griffith at MIT meeting with me as an upperclasswoman. Knowing that I wanted to apply to PhD programmes, they explained the process to me — from requesting recommendations to submitting applications. They were familiar with my research interests, so they suggested departments and research groups that I should consider. Such guidance was pivotal in my continuing a research path. Later in my doctoral studies, I had the opportunity to participate in the [National Science Foundation \(NSF\) ADVANCE workshop](#) on Negotiating the Ideal Faculty Position, organized by Drs Rebecca Richards-Kortum and Jennifer West. This was the first time I learned about the faculty search process. They walked us through the search, application and negotiation processes. This programme also created a wonderful cohort of women who are now in faculty positions. Another very effective cohort model that I participated in was the [NSF Minority Faculty Development Workshops \(MFDW\)](#) led by Drs Gilda Barabino and Stephanie Adams. Here, our leaders created a community that guided us from postdoc to junior faculty to mid-career faculty and beyond. The space they created to enable us to meet with peers and senior leaders

fuelled me, while giving me insights on everything from grant submissions to invention disclosures to work–life balance considerations. Indeed, at each workshop, I gained new tools and connections that propelled my visibility and my research. This programming was significant then and continues to be necessary into the future.

Formal professional organizations also help amplify scientific visibility. Through the Biomedical Engineering Society, I have been grateful to work with women leaders, such as Drs LaShan Simpson, Monet Roberts, Catherine Whittington, Erika Moore, Ana Porras and Evangelia Bellas, who are working tirelessly to create spaces for diverse biomedical engineers. But more is needed individually and collectively.

Along these lines, what can journals and editors do? I believe engaging with and learning from experts and groups that are examining the long-standing issues is always the right move. One expert that comes to mind is Dr Charisse L'Pree Corsbie-Massay, whose body of work and upcoming book on satire and diversity examines identity and the systematic objectification and dehumanization of marginalized people. She posits that, “in order to improve diversity of citations and amplify the work of under-represented groups, we have to see the scientist as a whole human, not just a name or a set of publications.” Another place to engage could be the [joint commitment for action on inclusion and diversity in publishing by the Royal Society of Chemistry](#), which has brought together 35 publishing organizations. They described the role of editors in the cycle of injustice and offer five steps that can be taken to address injustices, a few include diversifying editorial commissioning contact lists, editorial teams and reviewer pools. In addition to engaging experts and joining with other journals, editors can institute new policies in the submission and review process to ensure that scientists learn and develop as well. For example, the Biomedical Engineering Society journals recently encouraged authors to include a citation diversity statement¹⁰. By reporting the proportion of under-represented people that we cite, we are learning who our colleagues are and what they do, which will hopefully lead us to humanize one another.

 Was there a time when your scientific visibility was championed? What could others take away from that experience?

Maribel Vazquez. My scientific visibility was championed by peers, who invited me

to present scientific lectures at prominent conferences and research institutions. This was counter-intuitive, as I thought it was the purview of department leadership and senior faculty to help junior investigators with academic networking. I, therefore, recommend highlighting networks with peers to increase opportunities to showcase your work, which leads to increased citations and visibility. In addition, although many established researchers want to help junior faculty succeed, they are often only willing to do so within the confines of their own specialty. Department heads, or department mentors, willing to exit their comfort zones to learn about your field and meet senior people in that space are rare. I recommend providing talking points for a person in senior leadership (administration or research) about your research and career goals. Simple, short sentences that can easily be remembered and summarize your greatest contributions (to date) will go a long way towards promoting your scholarship.

Kelly R. Stevens. My biggest opportunities for visibility have come out of the blue, in which a person on the offering end of the opportunity made the decision to make me more visible. For example, Dr Desai offered the opportunity to take part in this article.

What has this taught me? Opportunities for visibility frequently come from others. To transform the visibility of our under-represented minority colleagues, each of us needs to wake up. Look around ourselves. Proactively watch for opportunities to promote visibility of others, and when these arise intentionally offer the opportunity to at least one person who brings diversity to our profession.

Opportunities to promote visibility of others might include speaking invitations for conferences and seminars, award nominations, opportunities to co-author papers, amplification of published papers or work on social media and more.

To those on the receiving end of opportunities or invitations, you might wonder how to increase the number of such opportunities? I believe the best way to do this is to be your authentic self and pursue your passions, even if this lies outside the current norms of our profession or field. When you live your passion, you come alive. This can lead to greater visibility through leadership, emergence of more authentic relationships and, thus, strong peer and mentoring networks, and more opportunities. Be brave. Don't let the narrowly defined views of others set your

standards and your glass ceiling. Let your light shine, even if it takes courage, so that opportunities for visibility can find you.

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