ROBOTS AND SOCIETY

A call for diversity, equity, and inclusion in robotics

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Since its launch in 2016, *Science Robotics* has published research about nanometer-scale robots made from strands of DNA and life-sized humanoids, soft flexible material powered by pneumatic sources and rigid structures and actuators operated by artificial intelligence, and robots designed to navigate vertically up a pipe as well as robots to explore the deep sea. Looking at this admittedly incomplete list from just one journal, one would conclude that the breadth of robotics research is quite diverse. But what about the roboticists themselves? Do they also make up a diverse set of individuals, with a range of identities and backgrounds as broad as the general population? Or is the robotics community, like much of academia, lacking in minority representation? Do those individuals who do not "fit the mold" still feel included?

There are very limited reports on diversity data in robotics specifically, but we can assume that the data for science, technology, engineering, and mathematics (STEM) disciplines also reflect the current state of affairs for robotics. Although the gap is decreasing, Black and Hispanic populations remain underrepresented in the US STEM workforce, earning a smaller percentage of STEM degrees than their percentage of the population (*1*). Women now earn more than 50% of all STEM college degrees and yet have just 15% of tenure-track and tenured faculty positions (*2*). This situation, deemed "the leaky pipeline," indicates that women and minorities leave academic positions at higher rates than white men as their career progresses.

Many women who leave academic careers point to a toxic working environment, whereas others find the work-life balance to be unwelcoming (*3*). This particular fact resonates with me because I stepped away from pursuing an academic career after my first daughter was born. While I was in graduate school, I knew of few female professors who were also mothers, and those who were typically waited until after tenure to start a family. For mothers who remain in academia, they often suffer a productivity penalty, publishing fewer research articles than their male colleagues with children (*4*). Conversely, men on parental leave show a correlated increase in publications.

The lack of diversity in STEM is not limited to race and gender. The presence, or lack, of people with disabilities has received less attention than that of other underrepresented minorities. The experiences of people with disabilities are quite broad because this group encompasses individuals with chronic conditions, neurodivergence such as autism and attention deficit hyperactivity disorder (ADHD), mental health disorders, and physical disabilities. In the United States, one in eight people identify as having a disability, and yet only 3.8% of STEM academic staff declare a disability (*5*). These numbers point to two underlying issues. First, scientists with disabilities often do not openly declare their disability or seek accommodations, perhaps because they do not feel comfortable doing so in their work environment. Second, they often do not have equitable access to STEM education and career paths in the first place.

Another marginalized group that has received too little attention in STEM are those who identify as lesbian, gay, bisexual, transgender, queer, intersex, and asexual (LGBTQIA+). LGBTQIA+ STEM professionals are more likely to experience harassment and social marginalization in the workplace and more likely to express an intention to leave STEM than non-LGBTQIA+ STEM professionals. Therefore, LGBTQIA+ scientists make up another group of individuals who are more likely to leave before reaching their full potential.

The evidence is clear—there is an ongoing problem within STEM fields, including robotics, of equitable access to education and hostile environments that push out marginalized groups. I see the path forward as twofold: widening the pipeline by providing young underrepresented students with equitable opportunities to pursue robotics and fixing leaks in the career pipeline by fostering an inclusive environment that is both welcoming to and accommodating of individuals of various identities. Indeed, many in the robotics community have been working toward these goals. For example, using soft robot design can broaden female high school students' perception of engineering and increase their interest in pursuing robotics. Initiatives such as offering specific grants and providing childcare at conferences can work toward repairing the leaky pipeline.

This issue of *Science Robotics* features several articles that provide perspectives on diversity, equity, and inclusion (DEI) in the field of robotics. In an essay, Nikita Greenidge writes of the racism and sexism she has experienced in her own academic journey in the UK and argues for a globally inclusive research community that encourages collaboration with low- and middle-income countries. In another essay, Marquise Bell details how interactions with Black professors gave him the confidence to pursue robotics in graduate school and argues that approaching DEI efforts with intentionality can shape the robotics community into a

more inclusive space. Two Focus articles discuss the organizations of Black in Robotics and Women in Robotics, respectively, highlighting their various initiatives and growing memberships. For example, Black in Robotics provides financial resources to help students participate in robotics conferences through their student sponsorship program. Women in Robotics gathers an annual list of the "Women in robotics you need to know about" to increase global representation and to serve as a resource for event organizers. A Viewpoint article in this issue by Macari *et al*. argues that diverse research groups in robotics spur more cutting-edge research. Through an analysis of citation metrics of robotics papers along with insights gained from interviews with leading roboticists, they outline several benefits of diversity for robotics research, including improved performance, disruptive innovation, and reduced bias in technology.

It certainly makes sense that the broad, diverse, and interdisciplinary nature of robotics would benefit from the innovations of a diverse set of people, each bringing their own perspective and individuality to the lab bench. Increasing access to robotics education and fostering an inclusive environment for all both serve humanity and improve robotics.

—Melisa Yashinski

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