

Broader Impact Statement

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Throughout the work that I do in research, teaching, and service, there are opportunities to make broader impacts on the world. Below I describe a few focus areas for these impacts.

1 Equal Access to Technology

As a technologist, I am aware that my work has the potential to both bring people together and create divides between them. Technology has been transforming society for two centuries. These changes often create winners and losers, since people without the education or resources to use technology get left behind. A major objective of my research is the democratization of technology to make its benefits accessible to everyone. I aspire to create robots that understand human social signals and mental models so that special education or training is not required to operate them. At the same time, I seek to build robot systems that are adaptable to unanticipated use cases, which will allow more people to adapt robots to their own needs. I strive to build these robot systems with minimal computational and sensing requirements so that they may become more affordable and available to all people who could benefit from them.

2 Broadening Participation in Education and Research

In my dual roles of educator and researcher, I am privileged to be able to train many talented people. One of the delights of this enterprise is that human beings have so much latent potential inside them. On a personal level, I find much satisfaction in being able to support all of my students in reaching their full potential. At a larger scale, by training students and sending them out into the world, I am helping to develop a diverse, globally-competitive workforce.

When it comes to participation in the CS major and robotics courses, retention of a diverse student body is a major challenge. Statistics show that students from minority identities and backgrounds drop out of each at higher rates than majority students, who (at Cornell) tend to be heterosexual, white males from an upper-middle-class background. I have confronted this challenge head-on by addressing some of the major causes of drop-out: struggle, isolation, and marginalization. Within my Foundations of Robotics course, I assign three-person project groups that ensure that women and underrepresented minorities are not isolated within a group. By making them a majority within the microcosm of each group, it tends to level the playing field by helping them overcome obstacles that might have otherwise led them to drop the course.

Achieving a diverse group of student researchers is even more challenging. In the process of recruiting students, there is significantly more selection bias because it requires students to take the initiative of reaching out to me, whether as a Ph.D. applicant or an undergraduate looking to get involved in research. I recruit many undergraduates to do research in my lab. In order to counteract the selection bias, I use my class roster to find promising and talented undergraduates, whom I recruit for both teaching and research positions. High grades alone are not the best predictor of research performance, so I invite a diverse list of students chosen using traits like enthusiasm, curiosity, and persistence as well as grades. For example, one recent student I recruited was not in the top grade tier, yet she was an excellent TA and RA for me. Her contributions were instrumental to a major experimental paper that my lab recently published.

Like her, many students have been summer interns in my lab. For many, the internship is their first deep dive into research, so it is an opportunity to cultivate their natural curiosity and hone their skills toward productive ends. I frequently help students turn summer internship projects into successful conference papers. These experiences also hone students' leadership and

open-ended problem solving skills, thus preparing them to contribute to society.

In all recruiting activities, whether students, staff, or faculty, these days we see a focus on diversity that is justified by the need to foster equity and inclusion. Given the limited information contained within an application, it is common to use visible forms of diversity (especially race and gender) as a proxy for broader diversity in life experiences. I served on the Cornell computer science Ph.D. admissions committee that garnered attention in 2018 for our success in recruiting a diverse incoming class according to these visible features. A key component of that success involved reaching out to minority organizations around the country and making students within those organizations feel welcome as individuals and encouraged to apply. Such organizations include the Richard Tapia Celebration of Diversity in Computing, the Grace Hopper Celebration of Women in Computing, the Society of Women Engineers, and the National Society of Black Engineers. In screening applications, it is common for readers to search for reasons to reject an applicant. We made explicit criteria for reasons to accept an applicant. Applicants from underrepresented groups in computing (women, racial and ethnic minorities, disabled persons) received additional rounds of scrutiny to avoid rejecting good candidates who might have been overlooked. I follow these same practices when recruiting for my lab.

3 Outreach to Underserved Schools

I am actively involved in a variety of outreach activities. I find that robotics is an excellent way to motivate kids of all ages and backgrounds. The inherent challenge as an educator comes in turning the experience into something more than just show-and-tell, which is why I continue to develop an annual summer program in collaboration with 4-H of New York State. The program that my team and I created is designed to use robots to teach computational thinking to high-school-aged children from underserved communities throughout the state. We crafted the activities and curriculum to avoid many of the hurdles that frustrate students; for example, we avoid teaching syntax and make debugging approachable. By gently challenging students at an appropriate level of difficulty, we create positive experiences that build confidence and teach skills for success as the challenges start to become more open-ended.

4 Increased Partnerships with Academia and Industry

Professors are empowered to envision the future and lead the way there. In addition to my prescribed jobs of teaching, research, and service, I play an important role in helping bridge the gap between current robots in the lab and future robots helping all people. To that end, I am actively engaged in collaborations not only with fellow robotics researchers but also with experts in other disciplines. For instance, I am currently collaborating with a psychologist on a project to understand how people form mental models of robots. I also work with industry, including Amazon Robotics, Intel, Toyota, and Boeing, to help set their agendas about promising and useful directions in which to take their development efforts.