My history with formal scientific research dates back to when I was in seventh grade, studying the effect of several treatments on the germination times for bird vetch (*Vicia cracca L.*) for the Alaska State Science & Engineering Fair. Since then I've done undergraduate research on dispersion algorithms for robots and graduate research on robotics, education, and human computer interaction. Here I lay out my relevant previous research experience, research that I'm interested in exploring, why this research is well suited to undergraduate students, and the style of research that I enjoy.

Past Research

Education Research

While in graduate school, I contributed to several projects and papers that sought to better understand how to engage middle schoolers with computer science by exposing them to different areas of computing. I helped lead a middle school summer camp for three consecutive summers. Our goal was to better understand what activities would help to foster an enthusiasm about computing, while also representing the diversity of activities that are encompassed in computer science. The camp, which has since grown into a much bigger enterprise, brought female, African-American, Latino, and Native American students together for a week long day camp. We introduced the students to different kinds of robots, let them program with Alice, and helped them solder together their own lunch box boomboxes [1]. This work, while preliminary, is something that could be continued at an undergraduate institution.

Finance Research

During my time at Google, I've been focused in the world of payments. As a member of the payments research team, I've done extensive foundational research on how people think about and interact with money in a variety of settings from individuals in India to accountants in large companies in the US. This has enabled me to better understand this space as a complex space that is often highly influenced by regulations and business practices. While much of this work has been proprietary (thus not published),, I have participated in a workshop and been an invited-panelist on these topics and have found that, given the important of money and finances in daily life, this topic is very underrepresented in the HCI literature.

Future Plans

Obviously some of what I do next will depend on where I'm working, who I'm working with, and what resources and options are available. Regardless, I imagine that my research will involve some combination of the two following paths.

CS Education

While significant work has been done in the field of CS education in past decades, it's obvious that there is still much work to be done. Most interesting to me is the fact that in 1985, women earned 37% of CS degrees in the US and in 2008, that had dropped to 18% [2]. There have been a number of studies aimed at learning more about this drop and trying to remedy it, but there are still many open questions. By changing some aspects of the current curriculum, working with outreach groups, or conducting survey work, we may be able to learn even more about how to attract more women and minorities to the computing field. For example, I'm interested in learning what happens in classrooms where we spend more time talking about female computer scientists than male, what happens when we talk about less traditional fields of computer science (not just programming and systems, but HCI and graphics), and what happens when we introduce children to a comprehensive picture of computer science early on, instead of just letting them equate computer science with programmer. None of these are easy questions and they would all likely require longitudinal research.

While some of these are questions I could tackle within my own classes, I do not intend to turn every class I teach into an experiment and will likely start by doing research with outreach groups.

Personal Finance

I've found while working in this space that I'm fascinated in learning how people think about and interact with money, what makes them feel secure, and how these differ across cultures and circumstances. While this is a big set of questions, there are ways to look at it more locally as well. Instead of looking at culture as US and India, you could look at rural Minnesotans and urban Minnesotans. Or different groups of immigrants. Or first generation college students and non-first generation college students.

I'm passionate about this research because it makes a difference. There are many aspects of this topic, such as access to financial services. Access to formal financial services, such as bank accounts and loans, is incredibly important, especially for helping to alleviate poverty because they help individuals save money, build credit, and protect against risk (sickness, job loss, etc.). In this digital age, there are a number of financial services available online, increasing the options for those who are geographically isolated or homebound, however the HCI literature has almost no research on existing barriers to online financial services or how online financial services are being utilized by different populations.

Another interesting aspect to learn about is managing finances. As more financial management moves online and more tools emerge, there are opportunities to be more aware and engaged in your finances than ever before. But we know very little about how people are utilizing those tools and engaging in practices that help them understand their personal finances holistically. One piece of this that I'm particularly interested in is how couples use online tools to understand and manage their finances. Research about finance management could also help inform educational efforts to help encourage people to actively manage their finances.

Student Research

While the above are my research interests, I believe that they are both well suited to the work of undergraduates. I believe that the issue is not whether the students can conduct the research, but how to scope the research so that students are able to understand the entire research process and feel as though they have been able to make a contribution to the work.

Both areas require students to explore a wide variety of skills and deal with real problems and real data. There are also many different facets to the work, so students who are more interested in working with statistics could analyze survey data and students more interested in talking with users could conduct interviews or facilitate classes or camps. Working with this type of data is empowering for students because it shows them that their skillset which they likely thought of as small can be used outside the classroom, with results. In addition, it underscores the liberal arts nature of their education as it relates, not only to computer science and statistics, but also to psychology, anthropology, and economics.

Regarding the CS education research, while changing the curriculum is likely not an appropriate project for undergraduate research, there are a number of projects that can be conducted by young researchers. During the summers, I could work with students to develop curricula and metrics, organize program logistics, and evaluate results from previous years. During the school year we could run the program, in local schools or Boys and Girls clubs, exposing kids to computing. It would also be possible to run a summer program, similar to the one I worked on at the University of Minnesota, with much of the summer dedicated to curriculum development, some to execution, and the final part of the summer to evaluation. Regardless of which approach we took, it would be beneficial to the research students, the attending students, and the overall community.

Research Style

I enjoy conducting research within a community. I find that working with other researchers helps me be a better researcher. I have people to bounce ideas off of, people who understand what I might think, and people who can criticize my work. I was an undergraduate researcher in the summer after my sophomore

year, working daily with two professors and two fellow students to develop better algorithms for dispersing robots quickly. I had never been involved in such deep collaboration before and I always enjoyed coming into work and attacking a new day of problems.

I aim to be one of those professors – someone who, yes, has been in the field longer and probably knows more, but still doesn't come close to knowing all there is to know. I want to brainstorm with my students, to challenge them, to have them challenge me, and to work as peers. I want them to learn the basics of research, but also to experience the excitement and energy that comes from being able to make a meaningful contribution to the solution of an important question.

There are obviously numerous paths my research could take and I'm open to working with fellow faculty and students to help determine the best choice at any given point in time. In an ideal world, I'd like to remain involved with both research communities, keeping abreast of the latest developments in CS education while also diving into the personal finance research that I find fascinating and incredibly important.

References

[1] Kelly R Cannon, Katherine A Panciera, and Nikolaos P Papanikolopoulos. Second annual robotics summer camp for underrepresented students. In *Proc. ITiCSE*, 2007.

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