Statement of Research

Research Philosophy

I focus my research on the design of technologies for populations that are not a high priority for large software companies, including children and people with specific health conditions. I believe there is an important role academic researchers can play in providing the benefits of computing technologies to these populations, attending to needs and goals that may otherwise not be addressed. In pursuing my research, I work on the full development lifecycle, from understanding stakeholders' needs and goals, to designing, building, deploying, and evaluating the technology.

To conduct this research effectively I use participatory design methods, deeply engaging with stakeholders and iterating through designs in order to ensure that technological outcomes address real needs and goals and that they have the intended impact. I also conduct research in interdisciplinary teams, including long-term collaborations with researchers with backgrounds in design, public health, nursing, and psychology, as well as practitioners in education.

A final component to my research philosophy is that I try to maximize its broader impacts. To do so I focus on designing for low-cost and/or widely available hardware. In addition, I have made most of my research outcomes freely available to the public, or at the very least available at no cost in a clinical context for people with specific health conditions. Below, I discuss my main areas of scholarship since obtaining tenure.

Interactive Technologies for Preschool Children

The ubiquity of mobile touchscreen devices means most children under the age of five in high-income countries have easy access to devices that match their motor and cognitive abilities. This ubiquity has resulted in widespread use of interactive technologies at an age critical for cognitive development. However, this newfound access has come with uses that may often not be beneficial, typically involving isolating, passive consumption, instant gratification activities, which leave children and responsible adults with little control over their structure and the data they collect. These uses are in great part a consequence of the affordances of mobile devices and of leading business models that rely on collecting personal data and high levels of user engagement.

In 2017, my research group proposed the 3Cs, a different approach to technologies for young children, supportive of **c**reative activities that **c**onnect children with their social and physical environment while emphasizing **c**ommunication. We realized few, if any, technologies for young children fit the 3Cs approach, and set out to develop one.

To develop a beneficial 3Cs technology, we faced three significant gaps in research: 1) identifying common and critical skill deficits for 3-4-year-old children that may be addressed through interactive technologies; 2) developing design methods to use with this age group; and 3) identifying technologies other than mobile devices that may be developmentally appropriate for this population while being sustainable and able to have a broad impact.

During the past five years, I have been making inroads into these research gaps in collaboration with my students. 1) We identified in executive function skills, including self-regulation, a

common area of deficit for American children arriving in Kindergarten that is critical for school success and currently not being addressed by the overwhelming majority of technology available to 3-4-year-old children. Sociodramatic play is arguably the activity with the most empirical backing for enhancing these skills for preschool children, and *StoryCarnival*, a system we developed, focuses on facilitating and lowering barriers to this type of play. It consists of interactive stories to motivate play, a play-planning tool, and voice agents controlled by adult facilitators to keep children engaged in play. In a paper published at the IDC 2021 conference we provided evidence that *StoryCarnival* enables beneficial sociodramatic play while better engaging shy children than when conducting the same activities without *StoryCarnival*. 2) We developed a method called play-based design to enable children's input through role-play, where children can act out what they would like a technology to do. We used play-based design in our *StoryCarnival* design activities. We published a paper about play-based design at the CHI 2020 conference. 3) We identified facilitator-controlled voice agents as a privacy-preserving technology that can enable concurrent interactions with the physical and social world and are compatible with 3-4-year-old children's cognitive abilities. We published a paper on a wide exploration of various versions of voice agents with 3-4-year-old children at the IDC 2019 conference.

We are continuing this line of research by conducting larger deployments, with a version of *StoryCarnival* that is easily scalable, tracks user activity while preserving privacy, and delivers surveys to learn more about user experience and impact. We are also exploring the use of *StoryCarnival* as a support for incorporating shy children into face-to-face social activities with other children, which we believe is quite relevant given the need for re-integrating children who stayed home during the worst portions of the pandemic. I would like to extend this line of work to lower barriers to a wider range of evidence-based interventions for young children. *StoryCarnival's* research is currently funded by two NSF grants.

Supporting Public Health Research with Custom Personal Health Records Technology

I have had an ongoing collaboration with colleagues in the health sciences focused on leveraging custom personal health records software to conduct public health research. The research has resulted in four externally funded grants from PCORI, NIH, and AHRQ, with the current grant's award being over $5M. For most of these projects we provide a novel approach to collecting data from patients enrolled in clinical trials or cohort studies. Instead of relying on paper questionnaires, we provide patients with personal health records (PHR) software tailored to the health condition relevant to the study. With their permission, we capture data collected through the PHR, providing participants with a valuable service while making it easier for them to contribute data to the studies than through traditional paper or stand-alone online questionnaires. My role in these projects has been to use participatory design methods to design PHR software tailored to people with specific health conditions. I have also pursued smaller projects with other partners in the health sciences related to electronic health records, including research with the Veterans Administration resulting in a few small funded grants and research on providing community partners with tools to help better track the opioid epidemic.

Child-Computer Interaction Book

I have written and self-published a book on child-computer interaction, the only one to cover the topic comprehensively. I released the first edition in 2015 and the second in 2022. As of September of 2022, they have almost 4,000 unique downloads and 119 citations. The decision to self-publish was intended to make the book more widely accessible, as it enabled me to offer a free electronic version, and a printed version at-cost. The book is ideal for new scholars in the field. I have used it in a course on the topic and I am aware it has also been used in a course at the University of Washington (HCDE 548) and designated as a pre-reading material for graduate students at the University of Edinburgh.

Other Scholarly Work

I have participated in many other smaller scholarly projects. One recent collaboration has been with a research group at the Universidad de la República in Uruguay, taking advantage of Uruguay having one of the most developed programs in the world providing children with laptops at schools and promoting computational thinking from early ages. We are collaborating on systems to explore teaching computational thinking concepts to children aged 5 and younger. Our work has already resulted in two conference and two journal publications.

I have had a continued interest in assistive technologies, which previously included the work of one of my PhD graduates, Guarionex Salivia, with people with motor impairments. More recently I collaborated with Prof. Kyle Rector on exploring the needs of adults who became blind later in life, which resulted in a paper at CHI 2019.

Another area of continued interest has been at the intersection of human-computer interaction and public policy. A focus has been in identifying roles technology can play in preventing, reducing, and recovering from armed conflict, which resulted in several publications.

I am also quite active in outreach efforts both to bring computing ideas to the wider population and to further the impact of my research. I have been interviewed and featured in multiple media outlets on a regular basis and am currently an *ACM Distinguished Speaker*.

Plans for Future Scholarship

I am interested in identifying high-impact aspects of child development that could be positively influenced by technology, with *StoryCarnival* as a foundation. I expect that these explorations could speed-up the translation of evidence-based activities into practice and provide greater experience in the design and development of 3Cs technologies.

I am also planning to conduct research on participatory methods to provide feedback on the ethics of novel technologies for children, such as extended reality. I have secured funding through a generous unrestricted gift from industry to conduct this line of research.

With respect to health informatics research, there are clear paths forward with greater integration of the PHRs we have developed with EHRs and with the increasing ecology of health devices in homes. I would like to add to this research by focusing more on how to provide value to and attract lower-income participants.

Finally, I am also interested in continuing research on children and computational thinking with a specific emphasis on appealing to a broad range of children's interests and abilities.