Exploring Replication Studies to Engage Underrepresented Students in HCI Research

JASMINE JONES, Berea College, USA

This provocation outlines a vision for using replication studies to foster inclusive and meaningful participation in HCI research for underrepresented undergraduate students. Participation in "high impact practices" such as extracurricular research opportunities has significant educational benefits for under-represented students, but many do not participate in these opportunities due to perceived barriers. The author is exploring how conducting replication studies in HCI at a small liberal arts college might provide appropriate and valuable research experiences for students while reducing the barriers to participating.

CCS Concepts: • **Human-centered computing → HCI theory, concepts and models**.

Additional Key Words and Phrases: replication, research, undergraduate, making

ACM Reference Format:
Jasmine Jones. 2022. Exploring Replication Studies to Engage Underrepresented Students in HCI Research. In *EduCHI'22: 4th Annual Symposium on HCI Education, April 30-May 1 2022, New Orleans, LA, USA.* ACM, New York, NY, USA, 5 pages.

1 DESIGN PROBLEM

How can an undergraduate, liberal arts college provide meaningful, in-place, single summer exploratory research experiences to engage underrepresented students in HCI?

The American Association of College and Universities identifies participation in undergraduate research as a *high-impact practice*: an activity that shows "evidence of significant educational benefits for students who participate in them—including and especially those from demographic groups historically under-served by higher education." [1]

However, despite the importance and value of these experiences, there are significant barriers to accessing these opportunities for students from vulnerable and marginalized communities. To present a case study, consider the statistics from the author's institution, an undergraduate, minority-serving institution in the southern rural US (anonymized for review). The campus is diverse: 40% are Black or Hispanic (underrepresented racial minority), 57% are first-generation college students, 17% have a recognized disability, and 100% are from low-income households in the US and developing countries. STEM is a high interest to these students: 10% of the student body graduated with a major in Computer Science, making it the most popular major on campus. Students are also motivated and competitive: 41% of the student body (STEM and non-STEM inclusive) apply for and successfully complete an internship during their time at the college. However, only 9% percent participate in undergraduate research opportunities.

2 PROVOCATION

The author's research explores how technology-mediated memory systems might be used to support intergenerational family storytelling, where elder family members record and leave behind stories attached to mementos and heirlooms for younger generations to encounter as an interactive, embodied memoirs. Scores of papers and design proposals spanning the scope of interactive computing have since followed the trend of using the evocative design space of family memories to illustrate the potential of new and emerging technologies in everyday life. Most of these proposals were not evaluated with respect to their actual import or impact to family remembering, but rather demonstrated a proof-of-concept of the enabling technology. More recently, a new group of scholars interested in the social study of technologies (including the author of this proposal) have begun to revisit these proposals with the goal of exploring the use of such technologies to support memory sharing and storytelling among long-distance families and across different cultural contexts (i.e. [2, 6, 8]). However, as in common in computing, scholars who wish to revisit this work in any meaningful way need to rebuild (or reverse engineer) the systems or devices proposed or described in the papers.

The Memory Museum is an innovative approach to the traditional literature review that challenges young researchers to not only read about prior work, but to implement design ideas and technical prototypes described in published literature. To engage with technology-mediated memory proposals, an actual working system implementation is needed, in addition to transparency in published details. The Memory Museum seeks to address this gap by creating an interactive exhibit of prototypes and ideas from the past 20 years of research in this area. The outcome of this work will be a physical and virtual archive of working demonstrations of prior research that can serve as a resource for future work by my research lab and others doing similar work. The interactive prototypes will also be exhibited in local and regional art and tech festivals to provide community-engaged publication opportunities, and the intellectual work submitted for review in technical research conferences.

Following a research-through-design approach, studies will involve creating an artifact (in this case fabricating a physical computing device) and reasoning about the artifact's form, function and its assumed value and purpose [11]. With guidance from the faculty member, students will read research papers describing a technology-mediated memory system, create a design specification based on available details in the paper, and reverse engineer the design by investigating historically and currently available components. Building a working prototype will involve programming embedded micro-controllers and integrated sensors and fabricating physical enclosures for the computing devices. The new artifact built as part of the Memory Museum cannot be an exact replica of prior work (due to technical advances and otherwise vague descriptions) so students' will need to draw on their own technical expertise to make connections between the possibilities described in the research papers and the reality of readily available components. This project will provide an appropriate level of challenge with meaningful research outcomes for students of computing, engineering technology, arts and design who are new to research and exploring potential careers.

3 RETHINKING UNDERGRADUATE RESEARCH OPPORTUNITIES

The international Council on Undergraduate Research emphasizes the following benefits of undergraduate research for students [4]:

- Enhances student learning through mentoring relationships with faculty
- Increases retention and graduation in academic programs
- Increases enrollment in graduate education and provides effective career preparation
- Develops critical thinking, creativity, problem-solving, and intellectual independence
- Develops an understanding of research methodology
- Promotes an innovation-oriented culture
- Develops competencies that speak to career-readiness

The impact of these activities for STEM students is recognized nationally. For example, the US National Science Foundation spends hundreds of thousands of dollars annually to support summer "REU" sites (research experiences for undergraduates), where NSF-funded researchers invite small groups of students from around the country to join their labs and work alongside graduate students and faculty on active research projects [7].

With the literal wealth of opportunities and benefits, why are underrepresented students not taking advantage? In conversations with advisees and students majoring or considering majoring in CS, the author identified the following perceived barriers:

- Students afraid to travel somewhere unfamiliar
- Cautious about trying something that they might not be good at
- No familiarity with research practice or culture due to lack of co-located graduate program
- Narrow awareness of broader CS field, with a focus on media depictions of software/web development
- Limited opportunities to explore interests in computing outside of class (i.e. extracurricular projects)
- Desire to make lots of money after graduation (no interest in graduate school)

Some of these perceived barriers reflect misconceptions about undergraduate research (i.e. only for someone who wants to attend graduate school.) Of particular interest to the author is the first barrier. Through personal communication, similar concerns have been echoed from faculty and student advisors working at Hispanic-serving institutions and tribal colleges, where students are reluctant to travel beyond their local community. Yet, it was surprising to find this geographic constraint at the current college, because many of the students are from "elsewhere." Further inquiry of students who voiced a reluctance to leave the campus revealed students felt a reluctance to leave the "familiar" and "safe" environment that they knew to be understanding of their unique circumstances and challenges, especially mental health struggles and learning disabilities. They found larger and far-away institutions to be "intimidating" even when the opportunities offered by those institutions were intriguing.

4 RE-EVALUATING THE SITUATION

In human-centered design, when a particular design is rejected or found unusable by a particular group of users, evaluators ask what is wrong with the design. The problem is never the user. In this context, the author realized trying to convince the students that "traveling far will be ok" or "trying something new will be fun" would be attempting to change the user rather than iterating on the design. Although there may be some value in increasing students' self-efficacy, the author decided to apply the design thinking process to create an undergraduate research experience in HCI that would address the mobility issue of students' perceived barriers to participation.

Beyond our particular campus, concerns about brain drain, equity, and inclusion have prompted conversations in the broader tech community about creating opportunities for tech students and workers to stay in their local communities rather than concentrating in places like Silicon Valley. Initiatives like Bitwise Industries promote creating tech industries "in-place" to support local economies and expand the participation of disenfranchised communities in tech careers [3]. Therefore, exploring an in-place approach seems a valuable endeavor.

The author took stock of available resources at the college to determine if a local undergraduate research opportunity was a viable option. An alternative might be to encourage students to pursue remote opportunities. However, after the year of remote learning caused by the COVID-19 pandemic, students at the college were quite adamant about in-person opportunities. The campus provided:

- New on-campus makerspace open for student creative projects

- Many college and departmental faculty with experience with student projects
- Author's own research focus in ubiquitous computing and interaction design
- Funding available for on-campus, residential summer research experience
- Strong interest from students to live and work on campus in the summer

Yet, simply creating an on-campus research experience is insufficient. The college has a long-standing summer undergraduate research program, yet the 9% statistic still remained. This initiative needed to also address other perceived barriers, such as misconceptions about the value of research and reluctance to try something unfamiliar.

An artifact-focused replication project can address both the familiarity factor and the value factor. Since the end-goal of the research is to create a product (rather than run an experiment or generate a theory), recruitment can emphasize the value of the technical skills to be gained through participation and point to a clear, concrete outcome that demonstrates successful skill acquisition. Since the goal product already exists in some form, the uncertainty and unfamiliarity will be reduced as students can see a clear example of what they will be working towards. Removing these perceived barriers, the students can then focus on the learning process and the experience.

Another barrier is the students' perception that they will not succeed in trying something new. This perception is not altogether incorrect. In fact, a common challenge for conducting research with undergraduates is the amount of time needed to train novices in the methods and techniques required to effectively conduct a project. A rule of thumb is to recruit a student as early as possible after they have completed basic coursework, use the school year to train and familiarize them with research lab culture, and then use the summers to get "real" work done. This model has been quite effective at other institutions. However, at this college, students may only be able (and willing) to commit one summer. Therefore, a "dense" experience that packs as much learning and productivity into the summer as possible would maximize that time.

The idea to pursue replication as a meaningful, single-summer experience came as a result of the RepliCHI series of panels and workshops conducted at SIGCHI conference, starting in 2011 [10]. In the first RepliCHI panel, Dr Harold Thimbleby, pointed out that in the natural sciences, replication studies were a key tool in training young scholars. "Deliberate reproducibility," as he explained, helped beginning researchers learn how to find problems, do good work, and improve on something that already exists. A related train of thought has grown in programming education, where "remixing" shows the potential for helping learners increase their programming skill in addition to working on novel projects [5].

Perfect! However, is replication "real research?" The RepliCHI panels and workshops identified the challenge that the CHI community is less receptive to replication studies, instead valuing novel research. Fortunately, the replicate-and-extend model has gained traction as a useful way to study technology design in different contexts [9]. The author identified a gap in the field of design for memory that is usefully addressed through replication: much of the research features theoretical design proposals and high-fidelity demos for proof-of-concept, with less attention on user evaluation and real-world deployments. Therefore, the extension aspect of the students' replication work will include conducting a technology perception study with the built artifact in their own home communities– advancing the field's knowledge about the user experience of memory technologies as well as diversifying the limited populations that have been included in the past.

5 REPLICATION FOR DENSE AND MEANINGFUL RESEARCH EXPERIENCES

This is the model of the Memory Museum, a research project to be launched in the Summer of 2022. Smaller scale versions of this project have been piloted by the author through independent studies and through mentored makerspace projects to help refine the design of the summer program and to set reasonable expectations of the students. Further, this research is designed as a collaborative team-based experience to provide a supportive learning community for students during the summer.

The goals of a "meaningful", in-place, single-summer experience were:

- Expose students to HCI research beyond software development
- Explore unfamiliar topics and working styles in a safe and supportive environment
- Enable students to practice and develop creative and critical thinking skills that leverage liberal arts education in concert with real computing problems
- Encourage students' to challenge their technical skills to increase self-efficacy
- Introduce potential and value of post-graduate education

The author is excited and hopeful about this initiative and hopes to gain valuable feedback and advice from the EduCHI community on ways to maximize this valuable opportunity from a pedagogical, experiential, and scholarly perspective.

REFERENCES

[1] American Association of Colleges and Universities 2022. *American Association of Colleges and Universities High-Impact Practices*. American Association of Colleges and Universities. Retrieved February 18, 2022 from https://www.aacu.org/trending-topics/high-impact

[2] Grace Ataguba. 2018. Maintaining Long-Distance Relationships with Children: Exploring Autobiographical Designs and Life Logging. In *Proceedings of the 17th ACM Conference on Interaction Design and Children* (Trondheim, Norway) *(IDC '18)*. Association for Computing Machinery, New York, NY, USA, 693–698. https://doi.org/10.1145/3202185.3210801

[3] Bitwise Industries 2022. *Mission*. Bitwise Industries. Retrieved February 18, 2022 from https://bitwiseindustries.com/about/mission/history/

[4] Council on Undergraduate Research 2022. *Mission and Vision*. Council on Undergraduate Research. Retrieved February 18, 2022 from https://www.cur.org/who/organization/mission_and_vision/

[5] Sayamindu Dasgupta, William Hale, Andrés Monroy-Hernández, and Benjamin Mako Hill. 2016. Remixing as a Pathway to Computational Thinking. In *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work and Social Computing* (San Francisco, California, USA) *(CSCW '16)*. Association for Computing Machinery, New York, NY, USA, 1438–1449. https://doi.org/10.1145/2818048.2819984

[6] Jasmine Jones and Mark S. Ackerman. 2018. *Co-Constructing Family Memory: Understanding the Intergenerational Practices of Passing on Family Stories*. Association for Computing Machinery, New York, NY, USA, 1–13. https://doi.org/10.1145/3173574.3173998

[7] National Science Foundation 2022. *CISE Research Experiences for Undergraduates Sites CISE REU Sites*. National Science Foundation. Retrieved February 18, 2022 from https://beta.nsf.gov/funding/opportunities/cise-research-experiences-undergraduates-sites-cise-reu-sites

[8] Dina Sabie, Samar Sabie, and Syed Ishtiaque Ahmed. 2020. *Memory through Design: Supporting Cultural Identity for Immigrants through a Paper-Based Home Drafting Tool*. Association for Computing Machinery, New York, NY, USA, 1–16. https://doi.org/10.1145/3313831.3376636

[9] Chat Wacharamanotham, Lukas Eisenring, Steve Haroz, and Florian Echtler. 2020. *Transparency of CHI Research Artifacts: Results of a Self-Reported Survey*. Association for Computing Machinery, New York, NY, USA, 1–14. https://doi.org/10.1145/3313831.3376448

[10] Max L. Wilson, Wendy Mackay, Ed Chi, Michael Bernstein, Dan Russell, and Harold Thimbleby. 2011. RepliCHI - CHI Should Be Replicating and Validating Results More: Discuss. In *CHI '11 Extended Abstracts on Human Factors in Computing Systems* (Vancouver, BC, Canada) *(CHI EA '11)*. Association for Computing Machinery, New York, NY, USA, 463–466. https://doi.org/10.1145/1979742.1979491

[11] John Zimmerman, Jodi Forlizzi, and Shelley Evenson. 2007. Research through Design as a Method for Interaction Design Research in HCI. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (San Jose, California, USA) *(CHI '07)*. Association for Computing Machinery, New York, NY, USA, 493–502. https://doi.org/10.1145/1240624.1240704