Research Statement

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Introduction

Technology and culture directly influence each other; as cultures change, so does the technology they innovate. Modern technologies are redefining and reshaping every aspect of our lives. The benefits provided by new technological approaches have a huge impact on social and cultural practices, education, economics, infrastructures, etc. Understanding the implications of modern technologies to design for social and cultural change has become a fast-growing and highly important research area. My research interest focuses on the significant impact of technology on cultural issues and cognition in three aspects: The significance of technology for aging populations, the cognitive effects of embodied interaction, and research methodologies and analytic models.

Dissertation Research: Reconceptualizing the Engagement of Older Adults in the Use of Interactive Technology

My dissertation thesis presents an ethnographic study that reveals the importance of initial engagement for older adults and the context in which engagement is most likely to succeed. Aging is one of the most significant social transformations of the twenty-first century, and applying technology to the aging process can help people stay active and age well. The COVID-19 pandemic has triggered an urgent need to address societal changes of an aging population due to the need for health care and social isolation. However, designing new technology for older adults is challenging. Studies on diverse technological interventions for older adults tend to focus on utilitarian factors, such as usability and physical experiences, and rarely mention engagement and positive social effects. Many studies overlook the fact that when older people have a positive mindset, it has a positive impact on their physical and mental health. Recent research about aging and technology tend to underestimate the initial barrier to using technology faced by older adults. In this study, we claim that initial engagement is more important than need and usability and has different challenges for older adults based on their behavior with interactive technology. With this study, we begin to address that gap by asking the overarching research question: What are the key factors that engage the older population in the use of technology to adapt and live well in the digitized world? In my study, I used four technological interventions (Move and Paint, Savi, uDraw, and GrandPad) that are novel for older adults on stimulating and increasing initial engagement to use technology. Older adults are a diverse group, covering a wide age range, with varied characteristics, behaviors, and needs. In my research, I played an active role in understanding the aging population, designing interactive technologies, developing prototypes, and testing and evaluating technology for older adults. I was immersed in the senior-living facility and conducted a longitudinal study as an intervention along with diary studies, self-reports, in-depth pre- and post-interviews, focus group discussions, and in-the-wild user studies to investigate the engagement and behavior patterns of 127 older adults. I analyzed the data using various qualitative methods, including thematic analysis, behavior classifications, and framework analysis. The contributions of this study include the following: 1) a new model of engagement that goes beyond need and usability to address the gap in studying older adults' initial engagement with interactive technology; 2) an active–passive spectrum of the behaviors of older adults towards technology relevant to their initial engagement with interactive technology; and 3) the identification of the key factors that influence the initial engagement of older adults. It presents new expectations of initial engagement in HCI along with suggestions for new research directions in the use of interactive technology by older adults.

The cognitive effects of embodied interaction

During my Ph.D. program, I conducted other independent research studies on the cognitive effects of embodied interaction. New technologies develop quickly and continuously; society is used to this and adapts quickly to these constant innovations. We are experiencing a transition from traditional modes of interacting with computing devices, in which we are typically sitting still and moving our fingers on a keyboard, to large body movements to effect changes and engage with digital information and artifacts. Designing embodied interaction is not just about designing computing ability; it is also about designing the human experience and anticipating human behavior. Embodied interaction is very different from the way that we traditionally communicate with machines because the users can use their bodies to interact with digital systems in the same way they do with the physical world. In this collaborative project, we explored the design opportunities and issues associated with two embodied-interaction modalities that allowed us to leave the traditional keyboard behind: tangible interaction and gesture interaction. We explored the design of tangible interaction with a reconceptualization of the traditional keyboard as a Tangible Keyboard and the design of interactive three-dimensional (3D) models as Tangible Models. We explored the design of gesture interaction through gesture-based commands for a walk-up-and-use information display and gesture-based dialogue for the willful marionette. (To find more detailed information about embodied interaction design projects, please visit my website: https://llee52.wixsite.com/linalee/research)

During my Ph.D. program, my supervisor and I wrote a book titled Designing for Gesture and Tangible Interaction. In this book, we explored the issues in designing for this new age of interaction by highlighting the significance of and contexts for embodied interaction modalities. We presented design principles for tangible and gesture interaction and called for research on the cognitive effects of these modalities. Throughout these research projects, my focus was not only on the increasing range of technologies that enable interaction design but also on the range and focus on human-centered design methodologies. Human-Computer Interaction (HCI) is a cognitive process in which the user's mental model is the basis for their exploration and use of the interactive system. Users decide how to interact based on expectations and prior experiences, and the affordances of the specific interactive systems modify the user's mental model. I have much experience with designing user experiences and employing a mix of qualitative and quantitative methods. Applying appropriate design methods is crucial and should help bridge the differences between the designer's view of the system and the user's mental model. It is important to conduct user research to know how to incorporate the insights from users' experiences into the design. I used various user research and design methods, such as gesture elicitation, protocol analysis, heuristic evaluation, prototyping, body-storming, role-playing, personas, and image boards, to explore and develop ideas for the user experience.

Research methodologies and analytic models

In this section, I introduce two representative research projects that explain how I designed the methodology of the research approach through a variety of techniques. In the previous chapter, I introduced several research projects in HCI files that show how embodied interaction engages human cognition differently than traditional computer interfaces that do not include bodily interaction within the design context. The notion of embodied cognition provides designers and researchers with valuable insight into how the body-mind interplay can influence meaning-making during embodied experiences. In one research project, I designed research experiments through protocol analysis using a coding scheme based on the Function-Behavior-Structure (FBS) ontology to measure the effect of tangible interaction on design cognition. Protocol analysis is a widely used technique to study design processes and the cognitive activities involved in designing. The FBS ontology offers a domain-independent, task-independent, and designer-independent scheme to code protocols. My contribution to this research was conducting within-subject experiments with the procedures. These included proposing a hypothesis, designing experiments, recruiting subjects, conducting experiments, transcribing protocols and materials generated in the interaction process, devising a coding scheme based on the FBS ontology, segmenting and encoding protocols, comparing encoded protocols quantitatively and qualitatively,

and proposing results. We claimed that the affordances of tangible interaction could affect design cognition on spatial tasks. Through this experiment, the results showed that Tangible User Interfaces (TUIs) encourage users to perform more epistemic actions, which leads to unexpected discoveries and offloads spatial reasoning to physical objects. We concluded that the positive impact of tangible interaction is more dominant in spatial design tasks than in non-spatial design tasks. Another project showcasing my analytical skills is "Exclusion Response Workshops (ERW)" research. University of North Carolina at Charlotte was eager to create a community where STEM students felt safe, included, and ready to learn. We designed the ERW as a unique approach that uses role-playing and rehearsal to help students identify and respond to moments of social exclusion. We also created eight different scenarios of unfair or prejudicial treatment of people and groups based on race, gender, religious beliefs, language, sexual orientation, etc. We designed in-class activities to examine students' abilities to develop responses to scenarios of discrimination/exclusion. A total of 875 students participated in the workshops, and 396 students answered the class activities throughout three semesters. With these datasets, I conducted both quantitative and qualitative analyses. Descriptive and inferential statistics were calculated on the quantitative data when appropriate (e.g., Are there statistical differences across demographic groups?). Content analysis was conducted on the qualitative data to reveal overarching themes related to exclusion/discrimination and to inform the quantitative data analysis.

Future Work

I gained an exceptional understanding of space through earning my bachelor's and master's degrees in design. I also have experience in designing technological interventions since I majored in HCI in both the master's degree and Ph.D. programs. Through various research experiences, I have become an expert in HCI, a specialist in understanding the characteristics of aging, and a spatial designer who understands the living spaces of older adults. I am in the unique position of being able to perform a central role in interdisciplinary collaborations based on an adequate understanding of each research area.

I see my dissertation research as the starting point for future research goals of exploring how engaging technologies provide insight into the aging process to build smart environments. As various smart technologies continue to evolve and integrate into smart living spaces, it is important to understand older adults' cognitive and emotional aspects and make the smart environment a more comfortable place for them. The findings of my dissertation will provide an open research platform that can be widely used by researchers to understand key factors that influence the acceptance of interactive technologies. I will strive to develop a theoretical framework for principles that can be commonly applied to understand the emotional needs and engagement of older adults, which will enable us to design for the complex phenomenon of aging with technology. With this theoretical background, I am interested to explore future smart environments to support positive aging. These research areas will provide ample collaboration opportunities with multidisciplinary teams, with strong partnerships in architecture, computer science, psychology, gerontology, and health and medical research in both the public and private sectors. I plan to apply for National Science Foundation grants in the areas of aging, technology, and smart environment. I will also publish in tier-one conferences and journals such as the ACM CHI Conference on Human Factors in Computing Systems, ACM Transactions on Computer-Human Interaction (TOCHI). As a graduate student at the University of North Carolina at Charlotte, I had the opportunity to network and collaborate not only with faculty from the College of Computing and Informatics but also from the College of Arts and Architecture. These opportunities gave me perspectives on the applicability of my research and its potential broader impacts on academia and the industry to improve technologies related to the enhancement of aging.