

Personal Statement

My research examines how humans perceive, learn, and navigate spaces in natural, virtual, and visually impoverished environments. I take an interdisciplinary and use-inspired approach, combining the study of space perception and spatial cognition with motivations from applications to virtual environments and visualization. My research interests inform my teaching. In the last five years, I have taught undergraduate courses in Sensation and Perception and Cognitive Neuropsychology, and graduate courses in CNS research methods and applied vision science. I have mentored numerous undergraduate and graduate students in related content areas who have gone on to graduate programs, postdocs, and faculty and industry positions. My recent departmental service has mostly been as Associate Chair, participation on the Executive Committee, and CNS Area Coordinator. I also serve on the Academic Senate. My professional service includes editorial positions and program chair and committees for conferences. I will elaborate on my current and planned work in these areas below.

Research

I highlight three areas of my current research that are all motivated by real world applications. The first is perceptual fidelity across extended reality. My lab uses virtual environments (VEs) — computer generated scenes that envelope and move with an observer— to manipulate the world in ways that allow us to test spatial cognition mechanisms. This is an approach to using VEs that treats the technology as a tool and allows for controlled manipulations of cues that test theories (see Creem-Regehr et al., in press). But from an applied perspective, the utility of a VE for potential applications— such as training and rehabilitation—increases with *perceptual fidelity*, the likelihood that people perceive and act as if they were in a real environment. Decades of research has shown that there is a bias to perceive virtual spaces as if they are smaller than intended. Our research tries to understand the challenge of perceptual fidelity given different measures of perception and action, different effects across the lifespan, and changing technologies that likely influence the basic visual cues that are used to perceive and act in spaces (see Creem-Regehr et al. 2023). A second research area is spatial cue combination and the impacts of sensory loss. For over a decade, my colleagues and I have studied the notion of “visual accessibility” with a focus on how people with severe and uncorrectable vision loss (low vision) perceive and navigate in spaces (see Creem-Regehr et al., 2021). The idea is that if we understand the perceptual capabilities of people with low vision, then we can inform the design and building of environmental spaces that support independent travel. In our most recent approach to low vision research, we are using VEs to determine how visual and non-visual cues are used and combined in fundamental navigation processes (e.g., spatial updating or keeping track of one’s own location with self-movement) with the goal of identifying how cue use changes with vision loss. We are planning to develop and use a low vision virtual reality simulation to study and improve visual accessibility. Ultimately, this approach could help to understand changes in sensory cue use and integration in navigation that occur with healthy aging as well as in conditions that impair sensory function, a focus of several recently submitted federal grant proposals from our lab. The third area is the use of Augmented Reality cues to facilitate wayfinding and spatial learning. In this work, we rely on new technologies that have the potential to add or manipulate information in real world environments (such as adding a virtual landmark or directional cues) while people are exploring new spaces. Using AR, we can test theories of navigational processes (e.g., the use of landmarks and spatial frames of reference) as well as usability and trust in these new systems. This is the focus of our current Office of Naval Research grant.

Teaching and Mentoring

Teaching. My main goal in teaching is to create a scientific, engaging, and comfortable atmosphere in which students are presented with relevant and up-to-date information and expected to take an active

role in learning. This setting encourages students to think critically and conceptually and to integrate new knowledge into existing perspectives in order to promote broader ways of thinking. Each time I teach, I refine my own ideas about how to engage different audiences in the class material. This has been especially true (and challenging) over the last several years where we all needed to adjust our teaching approaches both online and in the classroom. Much of my undergraduate teaching has been for the large course Sensation and Perception. I love teaching this class because it inspires the students to think about everyday functioning from an information processing perspective that is often new to them. They are amazed by the complexity of the problems that our sensory systems solve. But I was happy for the chance to teach a new course, Cognitive Neuropsychology in 2020 and 2021. The timing was not ideal—given a completely online semester—but I created a new online version of the course that was structured after the Sensation and Perception class that I had developed with TLT. In 2019, I also developed a new graduate seminar called Vision Science 4Good, where we considered basic science topics in vision and the applications that they are inspired by or that they serve. In addition to giving the students an applied perspective on vision science, the class followed the use-inspired approach of the Psychonomic Society journal, *Cognitive Research: Principles and implications*, of which I became Editor in 2022. During this period, I also revised and taught my graduate CNS Approaches course to include several new topic weeks on replicability, including a workshop on preregistration, and I updated my courses following suggestions from our diversity committee and workshops to promote inclusivity.

Mentorship. I greatly value my mentoring relationships with students at all levels. My goals in undergraduate student supervision are to provide a basis to the theoretical background of the research projects in my lab, to provide training in experimental methods, and to encourage the students to think, write, and challenge ideas. With graduate students and post-docs, I believe that mentoring involves finding a balance among guidance, structure, and the encouragement of independence in creativity in research. As in teaching, I emphasize the importance of writing to think. Encouraging and improving writing skills also serves the practical purpose of getting students to write and submit manuscripts for publication. In the last five years, I had four students complete their PhDs, and I co-supervised two underrepresented scholar postdocs. I currently co-advise (with Jeanine Stefanucci) eight graduate students across disciplines of cognitive psychology, neuroscience, and computer science. The students actively collaborate with each other both within and across disciplines. This leads to generation of new ideas and new projects that would likely not have occurred independently. It also increases productivity, opens new opportunities for grant writing and funding, and broadens the scope of students' knowledge.

Service

Over the current review period, I was Associate Chair (2018-2022), including being a member of the Executive Committee, and CNS Area Coordinator (2017-2019). I also currently serve on the Academic Senate (since 2020) and I was a member of the Presidential Search Committee (2021) as well as a University Taskforce on graduate student success (2019-2020), graduate council review for the English Department (2019), and search committees in the Kinesiology and Health department (2017-2019). My professional service outside of the University includes an appointment as a journal Editor in Chief for *Cognitive Research: Principles and Implications*, as well as completion of a term as an Associate Editor for *Quarterly Journal of Experimental Psychology*, and guest editing of several journal special issues (see vita for details). I am also an active participant in IEEE/ACM computer science conferences where editorial roles include program chair (IEEE VR 2022) and program committees (that review and decide on full papers submitted to these conferences). I plan to continue this Editorial Service (e.g., Editor term is 4 years) and I am particularly interested in promoting diversity and open science within this role. Finally, some of my recent work has involved working with older adult and visually impaired populations and I look forward to developing more outreach to these groups with the goal of improving daily independent functioning.