HUMAN CENTERED DESIGN & ENGINEERING

PUTTING PEOPLE FIRST, WE RESEARCH, DESIGN, AND ENGINEER INTERACTIONS BETWEEN HUMANS AND TECHNOLOGY.

Students and faculty come together in Human Centered Design & Engineering (HCDE) at the University of Washington, Seattle, to focus on understanding human needs and interests as they solve the engineering problems our world is facing. From user-centered design to human-computer interaction, we are designing the future.

HCDE advances research, design, and practice in order to improve cognition, behavior, engagement, and participation among individuals, groups, organizations, and communities of people. Our approaches are interdisciplinary but are fundamentally sociotechnical: we investigate the interaction of people’s practices and meanings with technologies and technical development.

Educating tomorrow’s leaders is our highest priority. HCDE offers four academic programs where we teach students to focus on human needs and interests: Bachelor of Science, Master of Science, Doctor of Philosophy, and a graduate Certificate in User-Centered Design. Beyond traditional coursework, students join directed research groups led by our world-class faculty to research, design, and build solutions to real-world problems in collaborative teams.

TABLE OF CONTENTS

4 CECILIA ARAGON
Human Centered Data Science

6 CYNTHIA J. ATMAN
Understanding Design Thinking, Learning & Teaching

8 MARK HASELKORN
Collaborative Systems for Security, Safety & Resilience

10 GARY HSIEH
Tailoring Motivators for Prosocial Computing

12 JULIE KIENTZ
Computing for Healthy Living & Learning

14 BETH KOLKO
Human Centered Design for Global Health

16 CHARLOTTE P. LEE
Computer Supported Collaboration

18 DAVID W. MCDONALD
Social Computational Systems

20 SEAN MUNSON
Nudging People Towards Better Behavior

22 DAVID RIBES
Infrastructure Studies Lab

24 DANIELA ROSNER
Design as Inquiry

26 JAN SPYRIDAKIS
How Differing User Goals Drive Stakeholder Decisions

28 KATE STARBIRD
Emergent Capacities of Mass Participation

30 JENNIFER TURNS
Reflection: An Emerging Topic in Engineering Education and Human-Centered Design

32 MARK ZACHRY
Communicative Practices in Virtual Workspaces

34 FACULTY DIRECTORY

35 ACADEMIC PROGRAMS
INFLUENCING BEHAVIOR, THINKING, AND AWARENESS

As designers, we have the ability to create interventions that support or prompt changes in people’s everyday lives, ideally for the better. We study how interventions affect people’s behavior, thinking, and awareness. In addition, we design and assess new tools for making these changes.

DATA VISUALIZATION AND DATA SCIENCE

We focus on the design, implementation, and evaluation of human centered systems and techniques, such as visual analytics and infrastructures, in support of collaborative activities in environments that generate and require very large and complex data sets.

MATERIAL AND EMBODIED TECHNOLOGIES, AND UBQUITOUS COMPUTING

We conduct research on material and embodied technologies as well as ubiquitous computing. We are interested in the overlap and collision of atoms and bits, looking at how emerging technologies involve and affect the material and physical worlds. We look at a range of platforms and form factors, and we are especially interested in how computing augments and transforms other technologies as well as social relationships, institutions, and communities.

LOW RESOURCE AND UNDERSERVED POPULATIONS

Using human centered design methods, we design and evaluate technologies for resource-constrained environments and deploy those technologies to support vulnerable populations. We are committed to ensuring the world enjoys the benefits of diverse technological solutions that can serve multiple populations.

DESIGN FOR EMERGENT COLLABORATIONS AND ORGANIZATIONS

We study and build digital technologies that people use to coordinate, collaborate, and interact in other ways. Our work typically focuses on emerging uses, practices, capacities, and organizational arrangements associated with collaborative technologies. We understand, influence, design, implement, and assess sociotechnical systems.

LEARNING IN PROFESSIONAL AND TECHNICAL ENVIRONMENTS

We focus on learning, with an emphasis on professional and technical activities. This work occurs across areas such as professional development and identity, translation of knowledge into action, expertise in problem framing, representation of design contexts, digital interfaces, reflection, language learning, and learning from text.
Dr. Cecilia Aragon’s research focuses on understanding and enabling humans to explore and gain insight from vast data sets. This emerging field, known as human-centered data science, is situated at the intersection of human-computer interaction (HCI) and data science. Aragon’s work includes:

- Visual analytics (visualization and machine learning)
- Data science and analysis of very large data sets
- Emotion in text communication
- Data-intensive scientific collaborations
- Games for good (collaborative educational games)

**DATA SCIENCE OF DATA SCIENCE**

Cecilia Aragon is a co-Principal Investigator on a $37.8 million initiative for data science research from the Gordon and Betty Moore Foundation and the Alfred P. Sloan Foundation. The project is a collaboration between faculty teams at the University of Washington, the University of California, Berkeley, and New York University in a five-year initiative that was announced at a White House Office of Science and Technology Policy event. The award will support further work in the “data science of data science” using an ethnographic approach. “It is critical to understand the culture of data science as a socio-technical system and not as a purely technical problem of developing better algorithms to process huge volumes of data, although those are needed as well. In the end, human insight will be required to make sense out of exponentially greater quantities of complex data,” said Aragon. Aragon’s research focuses on visual analytics, computer-supported cooperative work, and the socio-technical aspects of data-intensive science.

**VISUAL ANALYTICS FOR CHAT AND SOCIAL MEDIA**

Social media are producing vast quantities of valuable data every day. However, currently available techniques for extracting knowledge from these data sets are limited. Aragon and her students in the Human-Centered Data Science (HDS) Lab are developing and evaluating interactive visual analytics tools and techniques for large, temporal, text communication data sets with many participants. Their work focuses on enabling efficient qualitative analysis of social media data sets by maintaining context, providing examples, and supporting group discussions around the data.

**SCALING QUALITATIVE ANALYSIS OF EMOTION WITH NATURAL LANGUAGE PROCESSING AND MACHINE LEARNING**

Social media leave traces that enable rich qualitative analyses of how communication media shapes collaboration. However, the volume of these traces makes qualitative coding of entire data sets impractical. Based on the labels of emotion expressed in each message, Aragon and HDS Lab students have been able to train accurate machine learning classifiers to label the rest of the data set. These labels are fine-grained, including fear, anticipation, and interest, and several can be applied to a single message, forming a challenging formulation of the sentiment analysis problem. Through the use of diverse feature sets and sliding-window feature extraction, the researchers have been able to create relatively accurate SVM classifiers. They are currently extending their approach by using graphical models to incorporate message context.

HDS Lab students Michael Brooks and Nan-Chen Chen led a Directed Research Group to develop Lariat, a tool to visually explore data from social media posts. Pictured above, Lariat lets users create keyword-based groups to plot tweets over a specific time period, related to the 2014 Oso mudslide in Washington State.
TRAFFIGRAM

Making decisions about where to go to avoid traffic snarls can be a pain, but some of the latest research coming out of HCDE suggests that there is hope. Research in Aragon's HDS Lab is changing the way people assess traffic data. Using a tool they developed called Traffigram, the team was able to improve users' time and accuracy in choosing departure times or locations to go to based on traffic conditions. Traffigram is an interactive map visualization system that uses isochronal cartography, a technique where temporal data (such as traffic patterns) are used to distort the map in a way that provides the user with a faster way to visually assess traffic conditions. Unlike a regular map, in an isochronal map, congestion expands areas, while ideal travel conditions make the map shrink in comparison to the actual distance scale of a traditional map (for a comparison see the below figure). The results of an initial study found that users were able to save time and increase accuracy where completing tasks involving a choice of multiple destinations during times of traffic congestion.

COLLABORATIVE GAMES FOR BIOINFORMATICS EDUCATION

The collaborative games for bioinformatics education project leverages recent research into the socio-emotional mechanics of online collaboration and multi-player game development to create an educational game that incorporates bioinformatics and data science concepts aimed at high school students. The HDS Lab is interested in cyber problem solving specifically among young underrepresented minorities and women, and the production of conceptual models that will help them to better understand the larger relationships between people, educational games, and infrastructural computational technologies. Collaboration and creative strategies are encouraged and integrated into the gameplay mechanics.

Max Five is a game based around a futuristic crime scene investigation scenario in which players must collaborate in teams and take on the roles of forensics experts, computing experts, and scientists to solve clues and recover data from a top-secret research project that has gone awry. The game integrates bioinformatic concepts and simulations of tools including BLAST and Jalview. Further information about the game and the team's latest development updates can be found at gamestem.com.

Aragon and her students have built partnerships with highly diverse Seattle area public schools and have involved student designers in every aspect of game design, development, and testing.

ABOUT CECILIA ARAGON

Dr. Cecilia Aragon is an associate professor in the department of Human Centered Design & Engineering and a senior data science fellow in the eScience Institute at the University of Washington. She directs the Human-Centered Data Science Laboratory. She received her PhD in Computer Science from UC Berkeley in 2004, and her BS in mathematics from the California Institute of Technology. Her research focuses on human-centered data science, an emerging field at the intersection of human-computer interaction (HCI), computer-supported cooperative work (CSCW), and the statistical and computational techniques of data science. In 2008, she received the Presidential Early Career Award for Scientists and Engineers (PECASE), the highest honor bestowed by the US government on outstanding scientists in the early stages of their careers, for her work in collaborative data-intensive science. She has been principal investigator for over $24M in grants from government agencies and private foundations. She is also active in program service and supporting diversity in computing, and is a founding member of Latinas in Computing.
Dr. Cynthia J. Atman is a professor in the department of Human Centered Design & Engineering, director of the Center for Engineering Learning & Teaching (CELT), and co-director of the Consortium to Promote Reflection in Engineering Education (CPREE). Dr. Atman’s research focuses on engineering design learning, considering context in engineering design, and the use of reflection to support learning. Through CELT and CPREE, Atman works with colleagues at the University of Washington (UW) and across the nation to advance engineering education.

CELT AND CPREE LEADERSHIP

CELT, with Atman as director, has had a leadership role in engineering education among engineering education researchers and policy-makers both at UW and around the world since it was established in 1998. This leadership has taken the form of developing new models to advance engineering education from establishing faculty development as an effective means for change in the College of Engineering at the UW, to directing the national Center for the Advancement of Engineering Education (CAEE), an NSF-funded, $12 million center that was active until 2010. Currently, Atman is co-Directing CPREE with Dr. Jennifer Turns of HCDE. CPREE, funded with a $4.4 million grant from the Leona M. and Harry B. Helmsley Charitable Trust, is a consortium of 12 educational institutions across the country with educators who are dedicated to implementing reflection to help engineering students learn the concepts and skills to become engineers.

RESEARCH ON DESIGN THINKING

How do designers spend their time scoping out a problem, discovering user needs, developing alternative solutions and communicating about design decisions? How do students understand and apply issues of context when they are solving design problems? Does a designer’s path through activities of design thinking have a “shape”? How does reflection fit in? How can we take the insights from the answers to these questions to inform design teaching and learning? Atman’s scholarship for the last two decades has been providing insights to answer these questions.

ANALYSIS AND REPRESENTATION OF DESIGN PROCESSES

Atman conducts empirical studies of engineering students’ and professionals’ approaches to open-ended design problems. Her design process timelines provide a compact but detailed representation of the many different activities involved in the design process. These timelines and the other representations have proven to be valuable tools for researching and teaching students about design processes.

Current work includes augmenting the visual representations with multimedia and presenting processes as brief audio clips synchronized with timeline animations. Atman and her research team have analyzed how novice and expert engineers solve open-ended design problems. Both solutions and design processes have been compared across three groups: first-year engineering students, senior engineering students, and practicing engineering experts. Methods including the timeline
analyses have led to a detailed understanding of the development of design skills, including the following findings:

• Engineering experts distinguish themselves from undergraduates in the effectiveness of their problem scoping, how much problem-relevant information they gather, and time spent on a wide range of design activities (e.g., generating and evaluating solution ideas).
• Graduating seniors are, as expected, more similar to experts than first-year students are, with respect to design processes.

STUDENTS DESIGNING THEIR OWN DESIGN PROCESS

Professor Janet McDonnell of Central Saint Martins, London developed effective educational experiences to teach about design processes using Atman’s design representations. Specifically, these tasks ask students to develop a new representation of design using the CELT data, and then develop a representation of their own personal design process. Atman collaborated with McDonnell and offered a research group for HCDE students who did McDonnell’s tasks as well as others tasks that address perspective, context and ethical dimensions of design. Students’ insights about their own design thinking were substantial and meaningful. Some selected student representations of design processes that were based on the CELT representations show the wide range of HCDE students’ creativity.

SELECTED STUDENT REFLECTIONS

At the end of the quarter students were asked to reflect on the activities of the research group. The students’ responses demonstrate the depth of insights on design thinking that the students gained from this learning experience.

“[This seminar] exposed me initially to the concept of grouping different aspects of design, and understanding how they are beneficial. For the rest of the quarter, I have used that understanding and knowledge to shape my experience in the course work. I hadn’t realized that planning out how you are going to design can actually assist you in creating better and quicker solutions. Often, I have just chugged away at a design task, jumping to whatever I think needs to happen next, and don’t have much of a plan going forward. Understanding this, I am better able to comprehend prototyping and coming up with alternative solutions, instead of generally just one which is what I am prone to do.”

REFERENCES


ABOUT CYNTHIA ATMAN

Dr. Cynthia J. Atman is a professor in the department of Human Centered Design & Engineering, founding director of the Center for Engineering Learning & Teaching (CELT), and the inaugural holder of the Mitchell T. & Lella Blanche Bowie Endowed Chair at the University of Washington. Atman and HCDE Professor Jennifer Turns are co-directors of the Consortium to Promote Reflection in Engineering Education (CPREE), a $4.4 million grant from the Leona M. and Harry B. Helmsley Charitable Trust, whose goal is to implement reflection in engineering classrooms. Atman earned her PhD in engineering and public policy from Carnegie Mellon University and joined UW in 1998 after seven years on the faculty at the University of Pittsburgh. Her research in engineering education focuses on engineering design learning with a particular emphasis on issues of design context and the use of reflection to support learning. She is a fellow of the American Association of the Advancement of Science and the American Society for Engineering Education (ASEE), was the recipient of the ASEE Chester F. Carlson Award for Innovation in Engineering Education, and the UW’s David B. Thorud Leadership Award.
Dr. Mark Haselkorn established an organization in 2015 to lead innovation in the design, development and use of collaborative systems that support regional operations for security, safety and resilience: The UW’s new Center for Collaborative Systems for Security, Safety, and Regional Resilience (CoSSaR). This center is a unique resource for the homeland security enterprise, offering a multi-disciplinary facility and environment where professionals from a wide range of entities (Federal, State, County, City, Tribal, International, Public and Private) team with university experts to align strategies, processes and investments in systems for security, safety and resilience.

CoSSaR continues to expand, focusing on a three-pronged approach to benefit the citizens of the Pacific Northwest and government partners: (1) understanding the current environment; (2) using that understanding to engage the community in future technical enhancements; and (3) facilitating sustainable collaborative mechanisms that enhance that engagement.

UNDERSTANDING THE ENVIRONMENT:
OPERATIONAL INFORMATION SHARING ANALYSIS

In 2013 three Federal agencies joined together, driven by a common recognition that resource allocations, policy decisions, and technical solutions intended to improve regional security and safety needed to be based on a better understanding of daily operational information sharing practices and challenges. The DHS Interagency Operations Center program (IOC), the National Maritime Intelligence-Integration Office (NMIO) and the Program Manager for the Information Sharing Environment (PM-ISE) partnered with the University of Washington to initiate the ongoing Maritime Operational Information Sharing Analysis (MOISA) project. The first year of MOISA was based on the simple assumption that before we can improve something, we need to understand how it currently works. Therefore, MOISA began as a collaborative effort with the Puget Sound safety and security community to answer the question: What is the nature of the community’s daily operational information sharing environment (ISE) and what is the role of that ISE in achieving their collective missions? The community’s answer, repeated many times in many ways, was simple and nearly unanimous: “When it comes down to it, the ISE is all about relationships.”

IMPROVING TECHNICAL SOLUTIONS:
TRUST AND INTEROPERABILITY

To provide meaningful impact, technology “solutions” must be appropriate for and accepted within the community’s operational environment. Among other things, initiatives to improve information sharing efforts across a region need to support the existing, often informal, trust relationships that are the backbone of daily operations. Federally-centric formal systems, delivered as a series of technology-centric solutions, have not thus far sufficiently supported the daily work and mission of the community, nor have they supported the strengthening of community trust and self-knowledge. Many of these systems have been brought in piecemeal with few plans for sustainability. They have made current work harder, not easier. They have not been owned by the community as a whole, not designed based on a thorough knowledge of how the regional community works, how they share information, and how they self-organize. They have introduced constraints and had unintended consequences, addressed one problem of a complex, highly interdependent system (usually a problem of the Federal component) at the expense of introduc-
ing new issues elsewhere in the system (usually at the local level).
The parts of these formal technology-based systems that are most critical to improving the work of the community are identity, entitlement and trust management—who are you, can I trust you, what can I appropriately share with you? Formal methods for Identify, Credential, and Access Management (ICAM) are a focus of national initiatives to improve the ISE, but thus far these formal methods are not having a major regional impact. The Puget Sound community shows little interest in or awareness of data standards or meta-tagging or national exchange models. Perhaps this is because they are working on a daily basis to maintain a far more nuanced system of identity, entitlement and trust management, based on knowledge of and experience with people, organizations and work practices.
To address this opportunity, a pending project seeks to link the tools and concepts of PM-ISE’s project interoperability to regional mission accomplishment by building on the MOISA analytical work and CoSSaR-facilitated state and regional expertise to improve information sharing and safeguarding. Moreover, throughout this project, the tools and concepts rooted in Project Interoperability will be further refined to better meet mission need—serving as a model for community-driven and mission-based interoperability that could be adopted by other geographic regions.

**ENGAGING THE COMMUNITY THROUGH COLLABORATIVE MECHANISMS**

CoSSaR is exploring with the community the development of collaborative mechanisms that can support these activities and enhance engagement with Federal partners. For example, the operational community has expressed frustration with the frequency and lack of coordination of Federal requests for information and the lack of return information that can help them in operational mission accomplishment. In response, CoSSaR is facilitating a community-driven coordinated survey capability with the goal of transforming federal requests for information from a series of distracting one-offs to a community repository of useful operational information. CoSSaR is also collecting information on regional sensor capabilities and facilitating a community analysis of the potential of sensor integration to provide enhanced operational value.

CoSSaR works with the full spectrum of security and safety stakeholders in the Puget Sound region to achieve a more holistic, human-centered, mission-centric perspective on our investments to enhance the critical ISE. This may sound like a difficult and complex approach, but it is clear that if you cannot afford the time and resources to do it right the first time, you certainly don’t have the time and resources to do it over again... and again.

**ABOUT MARK HASELKORN**

Dr. Mark Haselkorn is a professor in the department of Human Centered Design & Engineering and director of the Center for Collaborative Systems for Security, Safety, and Regional Resilience (CoSSaR). He is also a lead investigator on an AHRQ R01 to develop work and information centered methods for achieving evidence-based health information technology. Haselkorn conducts research for the Red Cross Global Disaster Preparedness Center and has completed an NSF initiative to define the emerging frontier of “Humanitarian Service Science & Engineering.” Haselkorn has conducted foundational research in the area of intelligent transportation systems, including development of the first Web-based real-time traveler information system (Traffic Reporter, 1990). He is Past President of the IEEE Professional Communication Society, has served on ISO/IEC-JTC1, is a member of the IEEE Medical Technology Policy Committee, and was a founding Board Member of the International Community on Information Systems for Crisis Response and Management (ISCRAM).

**MARK HASELKORN**

EMAIL markh@uw.edu
TWITTER @mhaselkorn
WEB hcde.uw.edu/haselkorn
COSSAR hcde.uw.edu/cossar
Information and communication technologies hold great promise in promoting and empowering prosocial actions, such as sharing, donating, cooperating, and volunteering. Unfortunately, while continued advances in technologies can help lower barriers and increase the efficacy of prosocial behaviors, the fundamental challenge of motivation persists—people still need to have the desire to help others. Dr. Gary Hsieh and his students in HCDE’s Prosocial Computing Group aim to study, design, and build technology-mediated motivators to facilitate prosocial behaviors.

UNDERSTANDING PEOPLE’S MOTIVATIONS

People are not homogenously motivated. Just because two people both volunteer, it does not mean that they do it for the same reasons. For example, one may volunteer because of altruism, but another may be doing it to make friends and meet people. To more effectively encourage prosocial behaviors from everyone, Hsieh and his research team employ mixed methods to gain a better understanding of why people do or do not participate in prosocial activities. One area of Hsieh’s research examines the use of technologies for civic activism. Increasingly, social technologies are used for various forms of activism, such as fundraising, community building, lobbying, and organizing. Yet, despite its potential to reach people and raise large-scale awareness, critics argue that this “slacktivism” may hurt real activism. For example, by simply clicking on the “like” button on the American Red Cross Facebook page, people may feel that they have already supported a good cause and feel justified to refuse a subsequent request for help (the moral balancing effect). This argument, however, overlooks the potentially counteracting effect due to one’s desire for cognitive consistency; performing low-cost activism may actually increase people’s compliance in subsequent requests. Hsieh and his research team are conducting a series of online experiments to test whether signing an online petition would influence subsequent contribution to a charity.¹ Their findings show promise in leveraging people’s desire for consistency to help transition them from performing low-cost activism to other, more “costly” types of civic actions. In addition, their studies of petition signers on change.org further shows that it may be possible to identify active petition signers based on their initial participation on the site.

Hsieh and his students also study volunteered across a number of different contexts. In the online context, Hsieh and his research team have examined volunteers who help newcomers become familiar with the practices and attitudes of their community, which then contributes both to the community’s growth and its establishment. In a study of more than 1,000 Reddit users, Hsieh and his team found that generalized reciprocity, social identity, and prosocial orientations were all significant predictors of whether people voluntarily helped newcomers.² In the local neighborhood context, through studies of cashmob (coordinated mobs that make purchases at local businesses) organizers, they found that some of the most effective ways to attract participation is by making the event a social one and to utilize personal stories about the businesses. In the academic research community, Hsieh and his team studied motivation behind participation in the research peer-review, which are often anonymous and time-consuming. They found that the two most often given reasons for participation are: 1) to encourage higher research quality; and 2) the desire to give back to the community.

DESIGNING TAILORED MOTIVATORS

Due to heterogeneity, Hsieh cannot employ a “one size fits all” design to motivate prosocial behaviors. Otherwise, not only are the motivators ineffective, they may also undermine diversity by attracting only a subset of potential users to participate (see Figure 1, right). Part of his research focuses on how to infer individuals’ motivation and to design the appropriate motivator. Collaborating with researchers at IBM, his initial work has demonstrated that individuals’ personal values correlate with a number of behaviors on social technologies. For example, those who value achievement more frequently used work-related words in an online community, while...
those who hold self-transcendent values were more likely to focus on others. The observable link between values and behaviors shows promise that Hsieh and his students may one day be able to infer individuals’ motivational values through our participation in social technologies.

At the same time, advances in technologies have enabled the development of a plethora of technology-mediated motivators, such as badges, gifts, virtual presents, and financial rewards. But they have only begun exploring what is possible. Hsieh’s research team has also studied how to tailor content, advertisements, and rewards based on individuals’ values.

BUILDING BEHAVIOR CHANGE TOOLS

To integrate his findings and novel motivators, Hsieh is developing a suite of behavior change tools. These tools will facilitate the breakdown of long-term goals into daily challenges and utilize novel motivators to support and sustain participation. In addition, through community-based features, he is working on creating communities where people can share general and domain-specific behavior change information and support. Examples include a daily-challenge-based site for adolescent teen moms to teach better infant feeding practices, and a guide-based site for international students to share resources and offer peer help.


FIGURE 1

(a) Without motivators, less than 5% of users contribute in social technologies.
(b) Generalized motivators may appeal to only certain types of people.
(c) Tailored motivators appeal to individual users’ values and needs; increase quantity and diversity of participation.

ABOUT GARY HSIEH

Dr. Gary Hsieh is an assistant professor in the department of Human Centered Design & Engineering and director of the Prosocial Computing Group at the University of Washington. His research focuses on studying, designing, and developing technologies that enable people to interact in ways that are efficient and welfare-improving. He was previously an assistant professor in Communication and Information Studies at Michigan State University and has conducted research at multiple industry research labs, including Microsoft, IBM, Intel, and Fuji-Xerox. He received his PhD from the Human-Computer Interaction Institute at Carnegie Mellon University and his BS in Electrical Engineering and Computer Science at the University of California, Berkeley. He is also a recipient of the National Science Foundation Career Award.
Recent work by HCDE doctoral students Hyewon Suh, Alexis Hiniker, and John Porter has focused specifically on adapting technology for underserved populations and using SMS, Twitter, and the web for tracking milestones. This work is sponsored by the National Science Foundation on a Faculty Early Career Development grant.

**Healthy Sleep Behaviors**

Sleep is a key aspect of health, yet relatively underemphasized compared to diet and exercise. Kientz is exploring how ubiquitous computing can help play a role in influencing sleep behaviors, aiding in the diagnosis of sleep disorders, and promoting good sleep hygiene. She and her students Matt Kay, Jared Bauer, and Ruth Ravichandran have developed several mobile and sensing applications to unobtrusively sense sleep duration and quality and allow people to identify potential behavioral and environmental sleep disruptors. This work is supported by a National Science Foundation Smart & Connected Health grant.

**Mindful Technology Use in Families**

Many families have adopted technologies like smart phones and tablets into their lives, but some struggle with how to integrate it in ways that make them feel like they are in control. Led by HCDE doctoral student Alexis Hiniker, the CHiLL Lab is exploring ways of understanding how families feel about their technology use and designing interventions for helping to promote mindfulness around technology use and mediation.

**Self-Experimentation for Health**

Many people have questions about their health, such as “does drinking caffeine late in the day keep me up at night?” or “does eating lactose trigger my gastrointestinal distress?” Currently, there are not easy ways of answering these questions definitively. Kientz and her students, in collaboration with HCDE Professor Sean Munson, James Fogarty, Jasmine Zia, and Roger Vилardaga are identifying ways technology can guide people to conduct more scientific self-tracking through the execution of personal “n of 1” health experiments. This work is funded by a University of Washington Innovation Award.
ABOUT JULIE KIENTZ
Dr. Julie A. Kientz is an associate professor in the department of Human Centered Design & Engineering at the University of Washington. She directs the Computing for Healthy Living and Learning Lab, is active in the Design, Use, Build (dub) alliance, and has adjunct appointments in The Information School and the department of Computer Science & Engineering. Kientz’s primary research areas are in the fields of Human-Computer Interaction, Ubiquitous Computing, and Health Informatics. Her research focuses on understanding and reducing the user burdens of interactive technologies for health and education through the design of future applications. She has designed, developed, and evaluated mobile, sensor, and social applications for helping individuals with sleep problems, parents of young children tracking developmental progress, individuals with visual impairments, people who want to quit smoking, and special education teachers working with children with autism. Her primary research methods involve human-centered design, technology development, and a mix of qualitative and quantitative methods. Kientz received her PhD in Computer Science from the Georgia Institute of Technology in 2008 and her BS in Computer Science & Engineering from the University of Toledo in 2002.

ADDITIONAL RESEARCH AREAS
Kientz and her students are also researching and developing new approaches to applications for health and education that have more general applicability. These research projects include designing empathic interfaces, understanding user burden, and designing for inclusion and accessibility.

Empathic Interfaces
The CHiLL Lab is working to understand and define ways that technology can be designed to be more empathic and sensitive in the delivery of healthcare information, especially concerning health news such as a diagnosis or disorder. They believe this can reduce anxiety and concern over health outcomes.

Understanding User Burden
Interactive technologies have a lot of value they bring to people’s lives, but they can also place different burdens on the user that can impact the user experience and possibly lead to abandonment. Kientz and HCDE doctoral student Hyewon Suh are working to define a model of user burden and define its constructs, as well as develop a validated scale that can be used to measure user burden in computing systems.

Designing for Inclusion and Accessibility
Kientz’s doctoral students John Porter, Kiley Sobel, and Kyle Rector are exploring ways to improve access to technology for people with disabilities. Porter is working to identify ways of using crowdsourcing to help make mainstream video games more accessible. Sobel is researching how technology can be used to promote inclusive play between children who have cognitive disabilities and those who do not. Finally, Rector is exploring ways of making exercise technologies more accessible to the visually impaired.

Empathic Interfaces
The CHiLL Lab is working to understand and define ways that technology can be designed to be more empathic and sensitive in the delivery of healthcare information, especially concerning health news such as a diagnosis or disorder. They believe this can reduce anxiety and concern over health outcomes.

Understanding User Burden
Interactive technologies have a lot of value they bring to people’s lives, but they can also place different burdens on the user that can impact the user experience and possibly lead to abandonment. Kientz and HCDE doctoral student Hyewon Suh are working to define a model of user burden and define its constructs, as well as develop a validated scale that can be used to measure user burden in computing systems.

Designing for Inclusion and Accessibility
Kientz’s doctoral students John Porter, Kiley Sobel, and Kyle Rector are exploring ways to improve access to technology for people with disabilities. Porter is working to identify ways of using crowdsourcing to help make mainstream video games more accessible. Sobel is researching how technology can be used to promote inclusive play between children who have cognitive disabilities and those who do not. Finally, Rector is exploring ways of making exercise technologies more accessible to the visually impaired.

HCDE PhD students Alexis Hiniker (left) and Kiley Sobel (right) test mobile apps with preschoolers to study how young children learn technology.
Dr. Beth Kolko’s work is rooted in a commitment to technology innovation and diversity, to ensure that the benefits of technology are available to all populations. Kolko co-directs HCDE’s Tactile and Tactical Design Laboratory (TAT Lab) with Professor Daniela Rosner. Students in the TAT Lab focus on innovative approaches to technology design throughout a product life cycle from ideation to use—with the goal of emphasizing diversity of users and usage contexts.

**PORTABLE MIDWIVES’ ULTRASOUND**

Ultrasound imaging is an effective tool for identifying maternal mortality risk factors, but it is also a complex and expensive technology that requires extensive training. As a result, ultrasound is nearly absent in many rural healthcare facilities in developing regions.

To meet the challenge of how to effectively incorporate ultrasound technology into existing healthcare systems, Kolko’s lab, partnering with colleagues in the UW Departments of Radiology and Computer Science & Engineering (CSE), tackled the central issue of the ultrasound user interface. They have taken off-the-shelf components—including a USB ultrasound probe and a touchscreen netbook—with a total cost of around $3,500, and created a functional ultrasound device that reframes the challenge of ultrasound use in terms of people rather than technology. Compared to currently available ultrasound devices that cost around $40,000, their device simplifies the user interface while maintaining functionality to allow midwives to detect three common obstetrical conditions: placenta previa, multiple gestations, and breech presentation. They tested the accuracy of ultrasound measurements and image quality, compared the diagnostic capabilities of the device to commercial machines, and conducted extensive on-the-ground fieldwork.

With support from a Bill & Melinda Gates Foundation Grand Challenges Exploration Award, students traveled to Uganda and Kenya to conduct field testing of the device. After three field visits to Uganda and Kenya, the project partnered with a Seattle-based biomedical device company to create new, low-cost hardware to accompany the new user interface.

**HACKATHONS TO SAVE LIVES ACROSS THE WORLD**

At the height of the Ebola crisis, Kolko was approached by the IMAI-IMCI Alliance—the training arm of the World Health Organization—to help build a digital simulator that could supplement new training material designed for healthcare employees working with Ebola patients. Kolko and the team at her startup company, Shift Labs, recruited HCDE students, game developers, UX designers, medical professionals, and even two clinicians who had previously worked at an Ebola treatment in Sierra Leone, for a 48-hour hackathon to render fine details of the experience. The result was an interactive simulation that allows practitioners to navigate a field hospital, learn various procedures and interact with other healthcare workers and patients, even alerting participants to dangerous behaviors such as moving their hands to their faces to wipe away virtual perspiration—a natural reaction that could spread viral particles to the eyes, nose or mouth. Shift Labs is continuing with the IMAI-IMCI Alliance to develop the prototypes further.
BRIDGING ACADEMIA AND INDUSTRY

In 2012, Kolko co-founded Shift Labs, a medical technology device startup committed to improving health and wellness around the world. Shift Labs is built on the premise that non-experts as well as experts make great contributions to innovation, and that a global innovation community tied to the hackerspace and makerspace movement can be leveraged to bring ideas to life and into people's hands if we can create product development processes targeted for the engineering challenges of low resource environments. Shift Labs uses human centered design principles to build easy-to-use devices that don't require hours of training to use and that withstand vigorous usage. Kolko took Shift Labs to Silicon Valley in Winter 2015 to participate in the Y Combinator (YC) startup incubator.

DripAssist

Kolko and her team at Shift Labs have developed a low-cost, portable IV fluid monitor called DripAssist. DripAssist—which runs on one AA battery—reliably monitors the pace of IV drips, and its intuitive design minimizes training needs and saves hospitals money. In 2015 Shift Labs was selected for an award as part of the US Agency for International Development (USAID) Fighting Ebola Grand Challenge. The award funds extensive user testing throughout sub-Saharan Africa and R&D work to ensure the DripAssist can be used effectively in outbreak settings like the recent Ebola epidemic. In Summer 2015, the Shift Labs team—including HCDE graduate Alexis Hope—traveled to a partner hospital in Butare, Rwanda, to conduct testing. From their fieldwork, the team found that DripAssist maintains its accuracy levels in varied climate and elevation settings.

The Shift Labs team is currently focusing on sales in the veterinary market while they position themselves for the human market when regulatory hurdles are passed. In August 2015, The Industrial Design Society of America recognized DripAssist in their Silver category for the 2015 IDEA Awards Social Impact Design.

ABOUT BETH KOLKO

Dr. Beth Kolko is a professor in the department of Human Centered Design & Engineering at the University of Washington and co-director of the Tactile and Tactical Design Laboratory with Professor Daniela Rosner. She started her academic career in the humanities, and she uses that grounding in theory to inform her current work on technology design. Central to Professor Kolko's work is research on how technologists, social scientists, and humanities scholars can collaborate on technology-related development and implementation projects. She also conducts research on new educational models that can foster innovation outside traditional boundaries of expertise.

Kolko is the co-founder and CEO of Shift Labs, a Seattle-based startup that brings high-impact, life-improving technologies to bottom of the pyramid markets by leveraging open innovation and using Maker-inspired designs. She has been the Director of Innovation at the Makerbot Foundation (2013), a Fulbright professor at the University of World Economy and Diplomacy in Tashkent, Uzbekistan (2000), a Visiting Faculty Researcher at Microsoft Research (2007), and a Fellow (2007-2009) and Faculty Associate (2009-present) at the Berkman Center for Internet and Society at Harvard University.
Dr. Charlotte P. Lee and her students in the Computer Supported Collaboration (CSC) Laboratory work to understand how people collaborate in order to design systems that support innovation.

ABOUT CSC LAB
The core program of the CSC Lab is to research how scientists collaborate in order to inform the design and development of scientific information infrastructures, sometimes referred to as virtual organizations called “cyberinfrastructures.” These virtual organizations are complex aggregations of individuals, organizations, hardware, software, data, and material. Lee’s CSC Lab investigates how scientists draw upon these varied resources and knit them together, within severe constraints, to make outstanding contributions to scientific method, theory, and knowledge. To this end, we collect rich qualitative data on everyday practice in order to generate empirically grounded theory. The aim of these theories, or conceptual frameworks, is to create a basis for a principled approach to the design of collaborative systems, organizations, and ultimately, the endeavor of collaboration itself. While the examination of science itself is our “petri dish,” our work has ramifications for all areas of human endeavor that require collaboration as a means for achieving an innovative outcome.

THEORETICAL DEVELOPMENT FOR COLLABORATIVE SYSTEMS DESIGN
Model of Coordinated Action
The Model of Coordinated Action (MoCA) represents a bold initiative to leverage ethnographic or qualitative research in the field of Computer Supported Cooperative Work (CSCW) in an unprecedented manner. By finding a way to compare studies of practice, we aim to contribute to the generalizability of previously ungeneralizable findings and also to enable data-driven design guidance that is tailored to particular collaborative settings and organizations. MoCA is a conceptual framework for describing complex collaborative situations and environments including, but not limited to, collaborations that have diverse, high-turnover memberships or emerging practices. MoCA consists of seven dimensions of coordinated action. Each of these “dimensions” fall on a continuum. This new conceptual mapping of types of collaborative work enables a fuller representation of the design space for collaborative systems. By focusing this model on collaboration per se, we open up more room to investigate how multiple technologies can be mapped to a single coordinated action—a sociotechnical aggregation of actors and technologies.

<table>
<thead>
<tr>
<th>Synchronicity</th>
<th>asynchronous</th>
<th>synchronous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Distribution</td>
<td>same location</td>
<td>different locations</td>
</tr>
<tr>
<td>Scale</td>
<td>2</td>
<td>N</td>
</tr>
<tr>
<td>(Number of Participants)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number of Communities of Practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nascence</td>
<td>routine</td>
<td>developing</td>
</tr>
<tr>
<td>Planned Permanence</td>
<td>short-term</td>
<td>long-term</td>
</tr>
<tr>
<td>Turnover</td>
<td>low</td>
<td>high</td>
</tr>
</tbody>
</table>

Model of Coordinated Action

CYBERINFRASTRUCTURE AND ESCIENCE PROJECTS
Scientists and their Software: A Sociotechnical Investigation of Scientific Software Development and Sharing
This research project examines how scientists develop Scientific Cyberinfrastructure Software (SCIS) as part of their day-to-day research practice through a qualitative, ethnographic study of three research groups using observations, semi-structured interviews, and document analysis. Despite the importance of SCIS for data-intensive research, too little is known about how scientists use, adopt, and develop scientific software. Understanding SCIS development and sharing is necessary to ensure continued integrity of data-sets shared within and among communities, facilitate the sharing of the tools and practices that are developed using national research funds, and most importantly continue to support a fundamental tenet of scientific research: the
open communication of the processes and practices behind published research findings. The aims of this study are: (1) Investigating how decisions are made and document, classify, and analyze actual practices for using, adopting, developing, or sharing software; (2) Identify scientists’ incentives and disincentives to share software at the local, organizational, and community levels; and (3) Discern the impacts, intentional and unintentional, that scientific cyber-infrastructure software systems have on scientific data and the scientific research process.

Interacting with Cyberinfrastructure in the Face of Changing Science

This research is developing a framework to understand the set of sociotechnical relationships that comprise cyberinfrastructure. The technical challenges of cyberinfrastructure are already so demanding that projects often have little time to engage reflexively on how cyberinfrastructures are used and created in the current state of rapid scientific change, in which the necessity of data sharing and multidisciplinary approaches is putting pressure on disciplinary boundaries. This project investigates how scientists and engineers decide which cyberinfrastructure resources (e.g., databases, tools) to use, under what circumstances they decide to develop their own resources, and how scientists and engineers are mixing disciplinary practices within their own laboratories. Currently in its fifth year, the study has enrolled six different research groups as study sites, in areas such as biological sciences, astronomy, and seismology. Lee’s CSC Lab is currently examining how data and software artifacts support the collaborative work of these scientists. This project is funded by NSF Award IIS-0954088, an NSF Career Award for promising teacher-scholars.

Stakeholder Participation and the Emergence of Dominant Design in Cyberinfrastructure Systems

This project examines the social processes in the design of cyberinfrastructures, focusing on the role that different stakeholders play in design and development, the ways in which their interests and priorities can be aligned, and the social organization of the development effort. More specifically, this project examines the development and evolution of the GENI.net cyberinfrastructures (PlanetLab, ProtoGeni, ORBIT, ORCA). The goal of this research is to develop a framework for understanding how cyberinfrastructure designs emerge and evolve over time. The CSC Lab is conducting a qualitative study of the interactions between developers, experimenters, and other stakeholders, and of their involvement in the design and development processes across its four cyberinfrastructures. This work will inform research and practice in the area of cyberinfrastructure design and large-scale IT development. This project is funded by NSF Award OCI-1220269.

DISSERTATION RESEARCH

Two members of Lee’s CSC Lab, Katie Derthick and Drew Paine, are PhD candidates currently undertaking dissertation research. Derthick is studying the role of technology in mindfulness and zen meditation practices, including research questions such as how individuals and communities with meditation practices use Information and Communication Technologies (ICTs): whether and how their values influence the use ICTs of in their everyday lives, and whether and how they use ICTs to support their meditation practices. Paine is studying how the practices of scientific research informs scientists’ development, adoption, use, and sharing of software and in turn how software informs scientific research practices as an intertwined sociotechnical system.

ABOUT CHARLOTTE P. LEE

Dr. Charlotte P. Lee is an associate professor in the department of Human Centered Design & Engineering, an adjunct associate professor in the Information School, and director of the Computer Supported Collaboration Laboratory at the University of Washington. She has a BA in Sociology from the University of California, Berkeley, an MA in Sociology from San Jose State University, and a PhD in Information Studies from the University of California, Los Angeles. Lee’s research is in the fields of computer supported cooperative work, human-computer interaction, and science and technology studies. Her work focuses on empirically describing and theorizing the informational practices, artifacts, and collaborative structures of communities of practice working towards a shared goal: collaborative design. Lee has received awards from Google and Nokia Research. She has also received a National Institutes of Health grant and four National Science Foundation grants, including a Faculty Early Career Development Award. She received the 2013 University of Washington College of Engineering Junior Faculty Innovator Award and is also an Associate Editor of the Journal of Computer Supported Cooperative Work.

CHARLOTTE P. LEE
EMAIL cplee@uw.edu
TWITTER @ducktopian
CSC LAB depts.washington.edu/cslab
Dr. David W. McDonald researches Social Computational Systems (SoCS)—systems that interweave computing activity and human activity to solve problems that neither machine nor human can solve alone. Out in the world there are a number of early examples of systems with SoCS-like properties such as Wikipedia, PatientsLikeMe, Amazon Mechanical Turk, Twitter, and many others. But SoCS has the potential to go beyond these well known, high-profile examples.

SoCS can be developed and studied at multiple scales, potentially spanning a single individual with a single machine, to millions of people interacting with millions of machines. SoCS are inherently collaborations at the intersection of people and machines.

McDonald and his students in HCDE’s Social Computational Systems Lab are engaged in research projects that seek to understand how Social Computational Systems perform, how people participate in them, and how to design them more effectively. The SoCS Lab has several projects in process, several of which are described here.

ARTIFICIAL SOCIAL ACTORS

Artificial Social Actors (ASAs), bots, or agents, are code that make some attempt to pass themselves off as actual people in a social computing system. The growing sophistication of social bots presents a number of challenges to social computing. A challenge for analysts: How can we know if the behavioral traces, the Wikipedia edits, the message board posts, the tweets, or even Instagram photos, were produced by a real person with real human motivations, or whether the motivations were provided by the code of a programmer? A challenge for system designers: As social computing systems grow up, we should naturally expect that ever more sophisticated social bots will take their place in the milieu of people and code that interact online.

McDonald worked with doctoral students Norah Abokhodair and Daisy Yoo to analyze one social botnet related to the Syrian civil war that lived on Twitter for about 32 weeks. The researchers found that the growth, behavior and content of this particular bot did not specifically align with previous conceptions of bots. The team also found interesting aspects of the bot that distinguish it from human behavior. This work aims to increase awareness of ASA activity to influence the design of future systems.
McDonald has an ongoing collaboration with Dr. Phil Howard in the UW Communications department to study ASAs and how they influence political discussions. This collaboration is funded by the National Science Foundation.

**SUPPORTING EFFECTIVE ONLINE COLLABORATION**

Research in SoCS helps people collaborate more effectively, both with other people and with the technical systems that enable the collaboration. Members of the SoCS Lab in collaboration with HCDE Professor Dr. Mark Zachry and his lab have been studying online collaborations and designing systems to help people understand what is happening in those collaborations and how they can more effectively contribute. One system, Re:Flex, was designed as an enhancement to Wikipedia to allow users to visualize who collaborates with whom and which users collaborate on specific work activity, such as Wikipedia articles. In more recent work, the two research groups have been studying Voluntary Virtual Teams and developing tools that allow people to understand what the team is doing and how to contribute to the team effort. Wikipedia has hundreds of virtual teams called “Wikiprojects” and the Virtual Team Explorer is an addition to Wikipedia to help individuals understand how a team is working together. Another study, currently in progress, is considering how Voluntary Virtual Teams express territoriality and how designed technologies can mitigate the biases that may arise when one group maintains “territorial” control over a work product or process.

**GUIDING PEOPLE THROUGH SOCIAL MEDIA**

Many of today’s social media systems have broad participation with users of different ages, different backgrounds, and different cultural assumptions, all contributing in different languages. At times, these differences result in misunderstandings and even outright conflict. The SoCS Lab is working to design new systems that help users who participate in a social media system understand what is happening in that system so that they can more effectively interpret other users’ behaviors and statements.


**ABOUT DAVID MCDONALD**

Dr. David W. McDonald is chair and professor in the department of Human Centered Design & Engineering and director of the Social Computational Systems (SoCS) Laboratory at the University of Washington. McDonald’s research focuses on the design and implementation of systems that support large-scale collaboration. He has published research on ubiquitous sensing for behavior change, collaboration in distributed contributor systems, collaborative authoring, recommendation systems, and public use of large screen displays. His research interests span Social Computing, Computer-Supported Cooperative Work (CSCW) and Human-Computer Interaction (HCI). McDonald earned his PhD in Information and Computer Science at the University of California, Irvine. At UC Irvine he was part of the Computing, Organizations, Policy and Society (CORPS) group. He worked at FX Palo Alto Laboratory in the Personal and Mobile technology group and at AT&T Labs in the Human Computer Interaction group. McDonald has served as a Program Officer for the Human Centered Computing (HCC), Network Science and Engineering (NetSE), and Social Computational Systems programs at the National Science Foundation (NSF).
Dr. Sean Munson designs, builds, and evaluates systems that nudge people toward socially desirable outcomes while enhancing individual autonomy. In particular, he focuses on applications that help people understand their health and wellness behaviors and to make behavior changes that enhance their health and wellness, and applications that increase the diversity of news and opinions to which people are exposed. He studies the techniques for promoting reflection and the application of social influence theories—including public commitments, social proof, and social comparisons—to technology-mediated settings by studying use of existing tools, building prototypes, and conducting field experiments.

This work helps researchers and designers better understand how to apply social influence, prompt reflection, and help people engage with personal data in their system designs. As technology increasingly mediates daily interactions, it becomes more important to understand how systems persuade or influence their users. Similarly, as tools to collect data about one’s behaviors—e.g., physical activity, diet, spending, and productivity—become more prevalent, people encounter new challenges with understanding and acting on their data.

**UNLOCKING VALUE IN PERSONAL DATA**

Today’s mobile phones and wearables can track a variety of data about our behavior, including location, sleep, schedules, physical activity, and heart rate. Our online and other electronic transactions leave records of music and movie tastes, spending, how we pass our time, and even what we are curious about. People also can use mobile applications to keep journals of information that is harder to automatically capture, such as diet.

**Individual Reflection on Data**

Many people seek to use data about themselves to gain insight into their behavior, to identify actionable changes, and to track progress toward making these changes. Both highly motivated and more casual users of these self-tracking tools struggle to make sense of their data, and both researchers and popular press describe examples of people overwhelmed their data. By studying data reflection practices and building and evaluating new tools, Munson helps people get more value from their data and learns about how people reflect individually and in collaboration with others. With doctoral student Daniel Epstein and Computer Science & Engineering Professor James Fogarty, Munson has studied individual self-tracking practices to develop a new model for how people begin tracking, track, act, and also stop or lapse tracking. They built a data analysis and visualization tool, Cuts, to help people explore their data and identify actionable opportunities for change.

**Sharing Data with Experts**

People also engage experts, such as their doctors, dieticians, or financial planners, to help review their data. In the healthcare setting, both experts and patients leave these interactions dissatisfied with how they interact around data: tools that are best for day to day patient use tend to be too cumbersome for health providers to efficiently review, while tools that are designed for health providers are often confusing or not useful to patients. Munson and HCDE doctoral student Christina Chung are leading an interdisciplinary research project to understand what patients managing weight or irritable bowel syndrome hope to achieve through data sharing and to design tools that help them get these benefits.

**Sharing Data with Peers and Support Networks**

Experts can offer professional information, but people often seek emotional support from peers and their support networks. With doctoral students Daniel Epstein and Christina Chung, HCDE Professor David McDonald, and
collaborators at the University of Michigan, Munson has studied effective—and ineffective—techniques for using personal data to solicit support from peers and support networks. People often do not provide enough context for their support seeking requests, resulting in negative or no reactions. When tools prompt sharers to explain their request or offer some meaning behind the data, though, their posts often elicit emotional support and other offers to help. Further, the conventional wisdom that people should share goals sometimes has negative effects: the prospect of sharing a commitment can actually prevent some people from setting a goal.

Experts are also not always available to consult with people. Munson, HCDE Professor Gary Hsieh, and HCDE doctoral student Elena Agapie, have been developing and testing techniques to help people enlist friends, peers, and strangers to help them develop actionable behavior change plans. Friends can help generate plans that fit better into someone’s life, but strangers offer more diverse suggestions and are more likely to push people to try something out of their comfort zone.

EXPOSURE TO DIVERSITY ONLINE

The Internet gives individuals more choice in information sources. Pundits have raised concerns that individual preferences, and algorithms designed based on those preferences, will lead people to biased information sources that do not include information that might challenge a user’s world view.

Political Diversity

Concerns about siloed information access have been voiced most about politics. Citing the preference described by selective exposure theory—that people prefer information supporting their beliefs and that they avoid counter-attitudinal information—observers warn that people may use these tools to access agreeable information and live in ideological echo chambers, increasing the polarization of different political groups and decreasing society’s ability to solve problems. Munson’s research addresses mixed results within the selective exposure literature. People are neither inherently challenge-averse nor inherently diversity seeking: there are individual differences. To increase challenge-averse individuals’ exposure to diversity, researchers created the Sidelines algorithm, which can generate more representative collections from user results, and built the Balancer extension for the Chrome web browser. Balancer gives its users feedback on the political lean of their online newreading. In a field deployment, Balancer users read more balanced news than those who did not receive this feedback. Recently, Munson and HCDE doctoral student Elena Agapie evaluated whether social cues can change the news that we read.

Gender Diversity in Search Results

Munson and computer science doctoral students Matthew Kay and Cynthia Matuszek studied the representation of men and women in image search results for careers. In a few jobs—including CEO—women were significantly underrepresented in Google image search results. Across all the professions, women were slightly underrepresented on average, and stereotypes about the prevalence of genders in different careers were exaggerated.

The study found that the gender ratio in images that pop up when we type “author,” “receptionist,” or “chef” can influence people’s perceptions about how many men or women actually hold those jobs, at least in the short term showing how search results can affect people’s world views.

EXPLORATIONS / 21
Dr. David Ribes is a sociologist of science and technology, and his research focuses on how science is transforming and transformed by ongoing innovations in information and communication technologies and practices. His research methods are ethnographic, historical-archival, comparative, and participatory.

The majority of Ribes’ research is focused on sociotechnical aspects of scientific research infrastructure (sometimes called eScience or cyberinfrastructure). A common theme of his research is investigating the sustainability of long-term research organizations: how do we support scientific research at the level of policy, social organization and as a matter of practice across years or decades? He has also worked on issues of internet and health information, the role of social science in system design, ‘order’ in Wikipedia, and he has innovated ethnographic methods for investigating large or distributed organizations.

**RESEARCH THEMES**

1. **Technical Work as a Social Activity (or ‘Sociotechnical’)**
   
   Technology development, deployment, and maintenance is often mis-recognized as a solely ‘technical’ endeavor. But it is also a matter of human labor, organization, and social interaction. Consider a bridge: where one person might see only cables and concrete, David Ribes approach also attends to repair people, urban planners, contentious funding decisions, and challenging policy debates. Approaching technology as a sociotechnical phenomenon allows us to grasp its complexities and consequences more thoroughly.

2. **Organizational and Technological Sustainability**
   
   We live in age that is focused on the latest killer app or the next ‘hot’ gadget. But we must also reconcile ourselves with the long trajectories of technological legacies: our apps may be new, but the deep protocol architectures of net are now decades old. How do we reconcile seemingly accelerating technological upheavals with our desire for stable, usable, and accessible resources and services?

3. **Transformations in Knowledge Work**
   
   The introduction of novel information technologies are spawning transformations in the everyday practice of science. As new forms of representation (e.g., data visualization, geographic information systems, knowledge mediation) are introduced, what counts as scientific work will also be changed: does creating metadata ‘count’ towards a professor’s tenure in geoscience? Is a meteorological visualization tool a ‘contribution’ to atmospheric science? Career trajectories and reward structures are shifting before our eyes as we reconsider the balance between research, tool development and data handling.

4. **New Organizational Forms**
   
   Our ability to collaborate and coordinate across time and space is leading to new organizational forms. One example is the rise of ‘big science,’ ‘big data,’ ‘eScience,’ or ‘cyberinfrastructure’ across domains of science that have never before followed these paths. Such projects seek to bring together,
under a single umbrella, the development of computational resources, community building, and cutting edge scientific research. They are usually nationally distributed and highly interdisciplinary. How do we design organizations that can support these diverse forms of activity? What are the consequences of large-scale infrastructure development for the practicing scientist and the production of knowledge?

5. The institutions of science

Science, especially ‘big science’ or research infrastructure, is expensive in terms of time, necessary expertise and financial investment. This presents new challenges for the institutions of science. For example, a tension has emerged between developing infrastructure and supporting novel research. As the leading public agencies supporting US science, the NSF or NIH’s primary mandate is to fund new research. However, in recent years they have dedicated increasing portions of their budgets to the creation of facilities supporting scientific work. Are these changes sustainable? How will it impact the landscape of science funding? These changes are significant and merit scholarly attention.

6. The role of social science in design

Recent large-scale technology initiatives have opened many new opportunities for the direct participation of social scientists in design and science policy. These opportunities pose new challenges for social scientists: what are our available ways of participating? How do we manage tensions between objective research and participatory intervention? What are the ethical and political considerations for action research as social science becomes enmeshed with design and implementation? Ribes’ research extends beyond the usual goals of traditional social science and has afforded him the opportunity to participate in surprising and inventive ways in technology planning and development. The active and effective participation of social science in systems design and deployment is a methodological commitment of his current and future research.

CURRENT PROJECTS: AIDS, ECOLOGY AND MOLECULAR MODELLING RESEARCH INFRASTRUCTURES

Ribes’ current work focuses on the challenge of developing and sustaining research infrastructures: long-term sociotechnical organizations designed to support medical, scientific, and engineering research. For example, Ribes is currently investigating the organizations that have successfully supported research on Ecology, HIV/AIDS and molecular modeling for over 30 years. His work focuses on how these organizations have adapted to changing knowledge and methods in science, as well as modes of communication (e.g., from mail to email to VOIP), and for storing and sharing data (e.g., from flatfiles to the cloud). Ribes’ research approaches infrastructure as a matter of human organization, science policy and the opportunities posed by developments in information and advanced computational technique.

ABOUT DAVID RIBES

Dr. David Ribes is an associate professor in the department of Human Centered Design & Engineering and director of the Infrastructure Studies Lab at the University of Washington. Ribes joined HCDE in August 2015 from Georgetown University where he served as an assistant professor in the Communication, Culture and Technology program. Ribes focuses on the sociotechnical facets of eScience and how research infrastructures can support scientific investigations across changes in technology, policy and social organization. His research and teaching interests lie at the intersection of sociology, philosophy and history, and he is a member of Science and Technology Studies (STS). He is a principal investigator on several National Science Foundation awards and has also been a participant in National Institutes of Health and Sloan Foundation grants studying the activities of scientists, and exploring new patterns of distributed collaboration. He frequently speaks at conferences focused on research infrastructures as well as the organization and production of scientific knowledge. Ribes holds a PhD in Sociology and Science Studies from the University of California in San Diego.
Dr. Daniela Rosner develops projects at the interface of engineering and social science in order to study the workings of technoscience through design. Questions of interest include how design can open creative possibilities overlooked by other modes of investigation, how design might help social researchers communicate in the field, and how social investigation can reveal design as part of local improvisations, partial connections and located accountabilities (Strathern 2005; Suchman 2011). By presenting contrasts, the building process serves to engender new agencies and technological practices, approaching design as a means of social investigation rather than an end unto itself.

ETHNOGRAPHIC STUDIES HACKING & REPAIR

Craft Legacies among Women Hackers
In a first strand of ethnographic research, Rosner examines the work of women "hackers." Popular portraits of hacking have often relied on histories of hobbyist engineering culture rooted in tales of middle-class, well educated and often male technologists. Since 2012, members of a women-operated hackerspace in the East Bay of San Francisco, California, have countered these narratives, revealing women hackerspaces as sites with which to refigure masculine claims to innovation and progress. Drawing on a combination of ethnographic research, interviews, archival research, and design interventions, this first strand of work examines the rise of women-operated hacking practices through the new competencies they bring to life. Failure Club, for example, is a project motivated by a desire to support women's creative pursuits in the face of today's widely accepted narrative of "having it all"—often described in the United States as a women's ability to maintain professional work with the onset of motherhood. Members use the workshop to reframe what it means to hack by drawing out legacies of craftwork and moments of failure. In addition to viewing failure as a productive achievement, members recognized failure as a moment for reflection, identifying personal failures and failures to regulate and transform hacker cultures. These hackerspaces became sites of resistance: hacking the very ontology of hacking.

Ethnographic Studies of Maintenance and Repair
Rosner's second strand of ethnographic research examines overlooked sites of technology maintenance and repair. To examine emerging moments in individual and collective relationships to technology, Rosner turns to local repair movements in the Northern United States, such as “pop-up” fixer collectives where small groups of repair-savvy volunteers help consumers fix their broken electronics. In these settings, Rosner explores the interplay between gender, technology, and competency amid engineering practices. Drawing on ethnographic fieldwork and archival research, she shows how contemporary public sites of repair and their histories complicate gendered divisions of labor and shed light on the tensions between craft values and technological competencies. As fixing practices move from homes to libraries and museums, the work of plaster spackling and hardware tinkering that once occupied back porches and home workshops inhabit new territory in the public attention. In the process, organizers shift masculine pastimes into the public realm and transform what repair work has come to represent—from family responsibility toward societal imperative. Repair, in this sense, becomes an analytic tool with which to produce and sustain multiple political projects, and with which to reconfigure society.
DESIGN RESEARCH ON CRAFT, COMPUTING, AND PUBLIC LIFE

Enhancing the Integration of Craft and Computing

Rosner’s first strand of design research aims to advance fundamental understanding of the creative process in design and engineering. Today thousands of artists, designers, and craftspeople turn to computing resources within and around their work. This research asks how these techniques for digital craft shed light on emerging forms of creativity, engagement, and understanding. To reach this objective, she first conducts fieldwork and data analyses to understand current practices around making and dominant narratives around technological interventions. Drawing on this empirical work, she develops systems for longitudinal field deployments, often in collaboration with her research subjects. Based on analyses of these interventions, her group builds and extends conceptual frameworks for understanding creativity and engagement in digital craft. This investigation contributes toward a long-term research program advancing reflexive, creative practices with digital technologies through situated and responsive design.

Examining the Design and use of Internet of Things Technology in Public Life

In a second strand of design research, Rosner contributes new design-driven perspectives on Internet of Things technologies. The Internet of Things (IoT)—the ubiquitous computing vision of objects imbued with computational capacity, connected to and communicating with one another—has largely been conceived of in relation to industry. The most common example of IoT is tracking goods across supply chains and gathering data along that journey in order to improve logistics. The rapidly growing domain of domestic, or “in-home,” IoT has given rise to new products and services, such as “smart” thermostats, refrigerators, and washing machines. Between industrial and domestic IoT is a domain that has yet to be fully explored and offers a unique set of challenges and opportunities: IoT for public life. Rosner’s students’ Trace app, for example, arose from questions of social connection in GIS routing. Trace generates walking routes based on digital sketches people create and annotate without a map. In addition to creating walking paths, Trace enables people to send their paths to others. When someone draws and shares a shape (e.g., a circle, star, letter) the application produces stretches of a path that correlate to the vector of that shape. Depending on the location of that person and how long they wish to walk, the walk will get drawn across different roads and trails. Building on this project, Rosner combines programs of design prototyping, theoretical development, and empirical investigation within distinctive communities. This integrated approach provides a basis for advancing an empirical and theoretical understanding of the design and use of IoT technologies for public life, that is, for enabling, organizing, and monitoring collective social activities.

ABOUT DANIELA ROSNER

Dr. Daniela K. Rosner is an assistant professor in the department of Human Centered Design & Engineering at the University of Washington and co-director of the Tactile and Tactical (TAT) Design Laboratory with HCDE Professor Beth Kolko. She holds a PhD from UC Berkeley’s School of Information, an MS in Computer Science from the University of Chicago, and a BFA in Graphic Design from the Rhode Island School of Design. Rosner has taught interaction design at the California College of the Arts and worked in design research at Microsoft Research, Adobe Systems, Nokia Research, and as an exhibit designer at the Adler Planetarium and Astronomy Museum. In 2015, Rosner received a five-year Career Award from the National Science Foundation to support her research on computer-assisted fabrication and craft.
Dr. Jan Spyridakis works with students in HCDE’s Internet-Based User Experience Laboratory (IBUXL) to assess how design features of online information affect users’ comprehension, task performance, perceptions, and navigation behavior. She and her students do this by assessing existing website designs, testing users remotely, and developing methods and tools to support remote user research. This past year, Spyridakis focused on multiple projects. She worked with Dr. Robert Watson, a recent HCDE PhD graduate, to investigate the effect of information concepts and visual design elements on software developers’ perceptions of—and performance with—API reference topics as well as the state of open source API documentation, in terms of features that developers say they want versus what they actually produce when they write such documentation. Spyridakis continued her work on her NSF grant to facilitate STEM faculty in organizing leadership workshops to advance STEM faculty diversity and inclusion. She also conducted research in a variety of other areas and authored multiple research papers, detailed below.

**API DOCUMENTATION**

Spyridakis’ doctoral student Robert Watson completed his PhD Dissertation in Spring 2015. Watson’s focus was on API documentation—a critical factor in timely and successful software development. Building on earlier studies conducted in Spyridakis’ IBUXL, Watson studied software developers in an internet-based, remote, user-experience study that evaluated the effect of variations in the information concepts and visual design elements on software developers’ perceptions of—and performance with—API reference topics as well as the state of open source API documentation. The study produced some surprising results—finding that variations in the topics’ visual design do not affect relevance decision-making performance, but have a significant effect on software developers’ assessments of the topics’ credibility and appearance. The study also tested novel approaches to collecting user-experience data in remote studies that will be submitted to conferences in the coming year.

**LEAD IT YOURSELF (LiY!)**

Spyridakis is working with a research team on the LEAD-it-Yourself (LiY!), five-year National Science Foundation sponsored program. The goal of the program is to enable faculty across the nation to access resources and tools for organizing leadership workshops to advance STEM faculty diversity and inclusion, share their own resources, and collaborate with the LiY! community. Spyridakis and HCDE student Susan Evans are active in conducting
user research, usability studies, designing and developing leadership materials and content for the LiY! website, and helping coordinate the Train-the-Trainer workshop, which brings 30 participants to the first LiY! leadership workshop.

RECENT RESEARCH PUBLICATIONS
Spyridakis is involved in three recent research publications:

• Spyridakis worked with Dr. Robert Watson to develop two website stakeholder taxonomies—one concerning the goals of readers who use informational websites and the other concerning the goals of organizations that produce sites. The goal of the taxonomies is to help organizations measure readers’ success with their sites, understand how well their sites support their goals, and author and design better web content to meet their readers’ goals. This investigation is appearing in the Proceedings of HCI International 2015.

• Spyridakis worked on a project where she researched how technical communication (TC) programs could best meet student and faculty needs, given changing technologies, artifacts, and consumer demands, as well as the changing nature of the TC profession and its stakeholders. The editors of the journal of Communication Design Quarterly asked Spyridakis to undertake this investigation. Her research was informed by her experience as department chair who led HCDE’s growth from being the smaller department of Technical Communication and the accompanying programmatic and curricular changes. The investigation and its results were published in the journal in February 2015.

• Spyridakis co-authored a journal article that investigates the emergence of human-centered design (HCD) in research and higher education. The article specifically discusses how HCD has emerged in scholarly work and at the edges of many fields, including Technical Communication. This investigation was part of an invited co-edited special issue of the Journal of Technical Writing and Communication, in which four HCDE alumna participated.

ABOUT JAN SPYRIDAKIS
Dr. Jan Spyridakis is a professor in the department of Human Centered Design & Engineering and director of the Internet-Based User Experience Laboratory at the University of Washington. Her current research interests include internet-based user research methods and assessment of the effect of information design variables on users. Students in Spyridakis’ lab research how design features of online information affect users’ behavior, task performance, comprehension, and perceptions. Her lab has been developing open-source software to support the conduct of remote user testing: WebLabUX, a software package that allows researchers and website stakeholders to measure user behavior and performance on instrumented websites as well as test various site designs. Spyridakis has been honored by receiving eight awards for her research and six for her pedagogy. She is a Fellow in the Society for Technical Communication, and a member of the IEEE Professional Transactions on Communication advisory board.
Research in Dr. Kate Starbird’s Emergent Capacities of Mass Participation (emComp) Lab is situated at the intersection of human behavior, computational systems, and mass participation events. Broadly, they examine how people come together, communicate, organize, and solve problems using online tools and platforms. Specifically, their research takes place within the context of crisis events, contributing to the growing field of crisis informatics. Within that context, they seek to develop and expand understandings of the emerging (and emergent) phenomenon of crowdwork—new configurations of work enabled by online tools—investigated from different perspectives such as digital volunteerism, crowdsourcing and collective intelligence. Increasingly, the researchers are concerned with how online activity is connected (or not) to on-the-ground crisis response, both formal and informal. The emComp Lab is also studying online rumoring during crisis events, paying specific attention to the “work” of the online crowd to identify and correct false rumors.

**RUMORING DURING CRISIS EVENTS**

Rumoring is a common activity during disasters, as people attempt to make sense of incomplete and often inaccurate information. Not surprisingly, online platforms are now playing host to rumoring behavior during crisis events, increasing the speed and scale at which rumors spread. In collaboration with researchers in the UW’s Information School, Starbird’s lab is studying how rumors develop and spread online during crisis events. This project has two goals: 1) to better understand the dynamics of online rumoring; and 2) to create methods for automatically detecting and categorizing online rumors. The team has developed a complex infrastructure to identify events, collect event-related tweets, identify rumors, code tweets related to each rumor for specific rumoring behaviors, and analyze these behaviors within and across rumors.

**Exploratory Study: Rumoring after the 2013 Boston Marathon Bombings**

Starbird’s lab investigated rumoring on Twitter after the 2013 Boston Marathon Bombings, an event that occasioned numerous rumors, including several that falsely accused innocent individuals of perpetrating the crime. Through data collected from Twitter during the week following the event, they identified six rumors and classified every rumor-related tweet according to different rumoring behaviors—e.g. as misinformation, speculation, or correction. Analyzing the temporal “signature” of the different rumor behavior codes over time helped reveal the story of the rumor. For example, the temporal signature in Figure 1, below, shows a rumor that propagated widely with only a tiny correction, a pattern typical of the “Internet meme” type rumors in the set. The team also identified several other significant features of rumor propagation, including URL domains over time, domain diversity, lexical diversity, and geographic signature.

**Rumored Hijacking of WestJet Flight**

A more recent case study involves the rumored hijacking of a WestJet flight in January 2015. The flight was not hijacked, but a hijacking signal was received and reported on a flight tracking website, sparking widespread rumoring. The emComp Lab examined the role of “official” accounts during the Twitter lifecycle of this rumor, including the impact of the @WestJet account, finding their tweets catalyzed a strong correction signal and likely helped to dampen the rumor’s spread.

**Figure 1**
Figure 2 (below, left) shows the overall propagation of the initial rumor that the plane had been hijacked (in blue) and the correction of that rumor (in orange). Figure 3 (below, right) demonstrates how retweets of a small number of accounts, including the official @WestJet account, constituted a large portion of the overall correction signal. Other interesting topics within this ongoing research project include: identifying permutations of rumors, understanding sensemaking behavior in rumor-related tweets, and unpacking user motivations and strategies for correcting tweets related to rumors.

Figure 2

Figure 3

THE ROLE OF ICT IN COMMUNITY RESPONSE TO A LOCAL CRISIS EVENT

On March 22, 2014, a major landslide swept through a small community in northern Washington near the town of Oso. The Oso Slide, as it became known, destroyed dozens of homes and tragically took the lives of 43 residents. In its aftermath, local communities worked to support affected families and emergency responders during an extended period of active response dedicated to finding survivors and recovering bodies. Starbird’s research on this event focuses on these community response efforts, looking at how they were organized and by whom, and investigating what role (if any) ICT use played.

Starbird and her students use a combination of methods, including interviews with emergency responders and local community members and mixed-method analysis of “digital traces” of online interactions on social media platforms such as Twitter and Facebook as well as mainstream media articles and other online sites. Among their initial findings, they note the importance of food provision—i.e. feeding affected community members and responders—and demonstrate how the sharing of food was tightly integrated with the sharing of information about the unfolding event.

ARTICULATING A METHODOLOGY FOR MIXED-METHOD RESEARCH ON “BIG” SOCIAL DATA

Across all of the projects in the emComp Lab, they are developing and evolving a methodology for deeply integrating qualitative, quantitative, and visual methods for interpretative analysis of “big” social data—i.e. data derived from large-scale online interaction. Their research on online rumoring and community response to crisis events examines information generation and propagation, through its digital traces, over time and across users and platforms. In this work, their quantitative analysis describes patterns and anomalies from a high level, and identifies places to drill down deeper and do qualitative analysis. Their qualitative inquiry, in turn, informs quantitative strategies—e.g. helping to uncover new features for statistical analysis. Starbird and her students aim to continue to develop and articulate this methodology to support other researchers in examining large-scale interaction in this and other domains.

ABOUT KATE STARBIRD

Dr. Kate Starbird is an assistant professor in the department of Human Centered Design & Engineering and director of the Emerging Capacities of Mass Participation Laboratory at the University of Washington. The emCOMP Lab examines the dynamics of and applications for massive interaction facilitated by social media and other online platforms. The lab also considers how connected, collective intelligence manifests and can be supported within contexts of emergency and humanitarian response, political disruption, and other events of large-scale interest. Starbird received her PhD in 2012 from the University of Colorado, Boulder. Among her accomplishments, Starbird co-created “Tweak the Tweet,” utilizing the Twitter platform as a two-way communication method to get on-the-ground help where it is most needed. This was first deployed just in time for the Haiti earthquake disaster. Starbird is the Principal Investigator for a National Science Foundation grant for the project, “Detecting Misinformation Flows in Social Media Spaces During Crisis Events.”

KATE STARBIRD
EMAIL kstarbi@uw.edu
TWITTER @katestarbird
WEB hcde.uw.edu/starbird
EMCOMP LAB hcde.uw.edu/emcomp
How can engineering educators support student reflection on experience? What would it mean if an activity designed to support reflection “worked”? How can technology be effectively or creatively leveraged to support reflection? What about versions of these questions where the emphasis is moved beyond formal education to thinking about reflection in professional and personal life? What is reflection? These are questions of significant interest for Dr. Jennifer Turns. In her work as an educator, she has noted the importance of giving students an opportunity to reflect—to look back on and make meaning of experiences, and then use the meaning to guide future action. Experiences such as the less-than-successful test score, the unpleasant team meeting, and the disorienting Co-op assignment can be powerful for learning, particularly when the learners have the chance to reflect on and thus better appreciate the experiences. As a designer, Turns has wondered how we can do better at supporting such reflection. Assignments offered to students in order to engender reflection—reflection activities—do not always work as intended. More generally, technology helps us be more productive but rarely seems to help us be more reflective.

Reflection can be understood as thinking that focuses on making meaning of past experiences in order to inform future action.

Turns is not alone in her interest in reflection and how to support it. In professional contexts, Schon popularized reflection in the *Reflective Practitioner*, and professional education still seeks to help students develop such reflective practice. In education more generally, reflection is considered a critical element of active, engaged pedagogy (although few projects focus specifically on how to support such reflection). Reflection has also emerged as a topic of interest in the Human-Computer Interaction (CHI) community, with recent papers and workshops devoted to the topic. Further, popular interest in topics such as contemplation, mindfulness, and slow technology are highly related to reflection.

In her career, Turns has engaged in varied activities related to reflection. For example, early in her career, Turns’ interest in reflection led her to focus on student construction of preparedness portfolios, a reflection activity in which a student looks across their experiences broadly in order to see how the experiences are relevant to the future. This early interest ultimately resulted in over 20 papers documenting what and how students learn through the reflective activity of constructing such a portfolio. Throughout her career, Turns has tried a myriad of other reflection activities as part of her teaching. For example, she is regularly known to ask students “what, if anything, surprised you” and to assign end-of-term reflections that can be final “what I learned” essays, but may take other forms including songs written, performed, and shared on YouTube. Across these and other activities such as preparedness “pecha kucha” presentations, “draw me a picture of your learning” end of class requests, reflection-boundary-object blog posts, and required posting to online reflection guides, Turns has sought to broaden her understanding of how to support student reflection. In the past two years, this understanding has led to new areas of collaboration, including the opportunity to co-direct (along with HCDE Professor Cynthia Atman) a consortium focused on promoting reflection, opportunities to engage varied communities around reflection, and opportunities to work with graduate students on reflection-related projects.

**GOING BIG: THE CONSORTIUM TO PROMOTE REFLECTION ON ENGINEERING EDUCATION**

In early 2014, Turns and colleague Dr. Cynthia Atman received over four million dollars from the Leona M. and Harry B. Helmsley Charitable Trust to start the Consortium to Promote Reflection in Engineering Education (CPREE). In this project, Turns and her colleagues are working with twelve partner institutions to encourage educators to
implement and evaluate reflection activities in their teaching. The implementation work builds on an earlier phase during which the team collected information on 120 reflection activities already in use at the partner institutions and documented these activities in *Field Guides to Reflection*. The Field Guides are available in both PDF and online formats.

**GOING PUBLIC: COMMUNITY ENGAGEMENTS**

Turns also works to engage her community around reflection. In June 2015, she and her colleagues offered a workshop focused on supporting student reflection at the national engineering education conference. Participants in the sold-out workshop, mostly engineering educators, had the chance to become familiar with reflection activities emerging from the CPREE work and think through how to adapt select activities to their own teaching. Just one month later, Turns traveled to Spain to give a keynote address on reflection at an international conference devoted to engineering education.

**GOING BEYOND EDUCATION: INSPIRED GRADUATE STUDENTS BRINGING NEW PERSPECTIVES**

Turns is not just thinking about reflection through her own work, but also through the projects of students with whom she works. For example, HCDE doctoral student Mania Orand is currently exploring the nature of reflection in the experiences of extended solo travelers. Orand is planning to use insights derived from interviews with travelers to imagine tools and strategies for supporting traveler reflection, be that solo travelers or other types of travelers. The general idea of supporting reflection while on travel is core to a design project Turns and HCDE doctoral student Ahmer Arif are currently considering—the design of a tool to help emerging research or practitioners reflect on their early conference experiences. One component of such a tool would be to help the emerging research or practitioner slow down and process their experience—take time to think about what surprised them, what intrigued them, how to make sense of interactions they observed, etc. The general idea of leveraging technology to help people slow down is a theme in the slow technology movement—a movement that Arif and Turns are looking into with the help of other students in the HCDE department.

With projects such as these, Turns is looking to make advances in the fields of engineering education and human-centered design. She is also after something else. The active, hectic, forward motion of modern life can make it all too easy to be silent about reflection. With this work, Turns and her colleagues are hoping to create real conversation about reflection.
Social Translucence in Online Environments

Zachry is developing a system that enables users of massive online contributor systems such as Wikipedia to understand other users through system-embedded visualizations of those other individuals based on their history of activities in the system itself. Such a system, supporting social translucence in online work environments, is designed to support more productive collaboration by helping people identify valuable contributors. An additional study extends this investigation to understanding voluntary, virtual teaming on the web. This work is sponsored by the National Science Foundation.

SENSEMAKING ABOUT ONLINE INTERACTIONS

In virtual workspaces, which are often geographically distributed and populated by large numbers of interactants, researchers and designers have difficulty arriving at principled understandings of the work people are engaged in. Such knowledge, however, has great potential value for the development of new interaction technologies that could harness the potential contributions of people organized in more intelligent, appealing forms of computational work.

To aid in the process of understanding online interactions, Zachry and his students have developed tools like Qbox, CrediVis, Virtual Team Explorer, GEMviz, Haystack Exchange, and Indicoder.
Modeling Group Behaviors

*Virtual Team Explorer* is a flexible tool to support the analysis and representation of online group behaviors. *Virtual Team Explorer* integrates a series of views associated with computationally derived behavioral patterns, providing insights into group affiliations, territorial and boundary spanning activities, and forms of coordination work. *Virtual Team Explorer* has been used to model team project-scale work in Wikipedia, and contributed to theory that extends to other user-generated content systems like GitHub.

![Diagram](image)

An example representation for WikiProject Chemistry where each mode represents a Wikipedia user. In the live version of the Virtual Team Explorer, you can mouse over each of these nodes to get more information about each user and article represented in the graph.

Visualizing Mediation in Work Activities

*GEMviz* is a tool for researchers to translate data about communicative behaviors of a group of interactants into rule-based models. Such models allow for comparison of multiple interaction episodes, providing analysts with insight into work patterns.

Dr. Zachry and his collaborators also created *Re:Flex*, a web-based application that allows people to explore editor behaviors in Wikipedia. Driven by a toolbar that is integrated into the Wikipedia interface running on a proxied version of the online encyclopedia, *Re:Flex* allows users to investigate the work activities of contributors to Wikipedia since its beginning. Users can explore, for example, the group of editors that a given editor has interacted with most when editing, including the frequency of those co-editing interactions. Or, the user can adjust the settings in *Re:Flex* to discover the categories of articles that a given editor has specialized in while contributing to the encyclopedia.

![Diagram](image)

*Re:Flex* gives visitors to Wikipedia the ability to visualize different types of relationships between editors and their collaborators or the article contributions they have made since the beginning of the popular online encyclopedia.

---

**ABOUT MARK ZACHRY**

Dr. Mark Zachry is a professor in the department of Human Centered Design & Engineering and director of the Communicative Practices in Virtual Workspaces Lab at the University of Washington. His research areas include intelligent interfaces to support virtual interactions and social behavior in computational systems. Zachry’s project areas include a multi-year study of networked knowledge workers on the web, systems for enabling social translucence in social media, and the development of new forms of economic exchange in virtual spaces. With his students in the Communicative Practices in Virtual Workspaces Lab, Zachry has developed such systems as *Virtual Team Explorer*, *CrediVis*, *Re:Flex*, *GEMviz*, *QBox*, and *Haystack Exchange*. He is co-editor of the award-winning collection, *Communicative Practices in Workplaces and the Professions: Cultural Perspectives on the Regulation of Discourse and Organizations*.
<table>
<thead>
<tr>
<th><strong>FACULTY DIRECTORY</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The department of Human Centered Design &amp; Engineering faculty body is composed of 19 core teaching and research faculty, 8 adjunct faculty, 20 affiliate faculty, and 4 emeriti faculty. Below, HCDE's core faculty are listed with their respective research areas.</td>
</tr>
</tbody>
</table>
| **CECILIA ARAGON**  *Associate Professor*  
Human-computer interaction in scientific collaborations; eScience; visualization; visual analytics; eye tracking  
PhD, University of California, Berkeley |
| **JULIE KIENTZ**  *Associate Professor*  
Human-computer interaction; human centered computing; supporting record-keeping and reflection; computing for healthy living and learning  
PhD, Georgia Institute of Technology |
| **ELIZABETH SANOCKI**  *Senior Lecturer*  
User experience research and design; information architecture; human sensation and perception  
PhD, University of Washington |
| **CYNTHIA ATMAN**  *Professor*  
Engineering education; engineering design learning; students as emerging professionals; education research to improve learning  
PhD, Carnegie Mellon University |
| **BETH KOLKO**  *Professor*  
Design for digital inclusion; computer-mediated communication; educational/business/social gaming; information technology  
PhD, University of Texas |
| **JAN SPYRIDAKIS**  *Professor*  
Information design in online spaces; remote user assessment methods; human-computer interaction; international communication  
PhD, University of Washington |
| **BROCK CRAFT**  *Senior Lecturer*  
Physical computing; information visualization; human-computer interaction; learning design; engineering education  
PhD, University College of London |
| **CHARLOTTE LEE**  *Associate Professor*  
Computer supported cooperative work; human-computer interaction; science and technology studies; design processes  
PhD, University of California, Los Angeles |
| **KATE STARBIRD**  *Professor*  
User-centered design; design processes and strategies; human-computer interaction; engineering education; educating reflective practitioners  
PhD, Georgia Institute of Technology |
| **ANDREW DAVIDSON**  *Senior Lecturer*  
Interaction design; human-computer interaction; physical computing; STEM and design education; secondary education outreach  
MS, University of Pennsylvania |
| **DAVID MCDONALD**  *Professor, Chair*  
Computer supported cooperative work; human-computer interaction; large scale information systems  
PhD, University of California, Irvine |
| **LINDA WAGNER**  *Senior Lecturer*  
Design and product strategy, ethnographic research, innovation, user-centered design  
MS, Illinois Institute of Technology |
| **MARK HASELKORN**  *Professor*  
Strategic management of information and communication systems; risk and resilience; safety and security systems; visual analytics  
PhD, University of Michigan |
| **SEAN MUNSON**  *Assistant Professor*  
Social computing; selective exposure and political diversity online; systems to support health and wellness; persuasive technology  
PhD, University of Michigan |
| **JENNIFER TURNS**  *Professor*  
User-centered design; design processes and strategies; human-computer interaction; engineering education; educating reflective practitioners  
PhD, Georgia Institute of Technology |
| **GARY HSIEH**  *Assistant Professor*  
Human-computer interaction; social computing; social media; tailoring motivators; persuasive technology  
PhD, Carnegie Mellon University |
| **DAVID RIBES**  *Associate Professor*  
Science and Technology Studies; Information Studies; Cyberinfrastructures  
PhD, University of California, San Diego |
| **MARK ZACHRY**  *Professor*  
Human-computer interaction; workplace studies; communication design in organizations; rhetoric of technology  
PhD, Iowa State University |
| **MARKUS BRESLIN**  *Associate Professor*  
Social computing; international communication; grand challenges  
PhD, University of California, San Diego |
| **SEAN MUNSON**  *Assistant Professor*  
Social computing; selective exposure and political diversity online; systems to support health and wellness; persuasive technology  
PhD, University of Michigan |
| **DAVID RIBES**  *Associate Professor*  
Science and Technology Studies; Information Studies; Cyberinfrastructures  
PhD, University of California, San Diego |
| **MARK ZACHRY**  *Professor*  
Human-computer interaction; workplace studies; communication design in organizations; rhetoric of technology  
PhD, Iowa State University |
ACADEMIC PROGRAMS

The department of Human Centered Design & Engineering (HCDE) offers four academic programs to teach students how to research human needs and interests as they solve design problems and build engineering solutions. These programs give students the opportunity to pursue areas of specialization and attend classes full time or while working.

BACHELOR OF SCIENCE
The Bachelor of Science in Human Centered Design & Engineering is a flexible major that provides a solid foundation in designing user experiences and interfaces, creating information visualizations, conducting user research, and designing and building web technologies. Students learn to center on human needs and interests as they solve design problems and build engineering solutions. Students have the opportunity to solve real-world problems side-by-side with our award-winning faculty in collaborative teams.

MASTER OF SCIENCE
The Master of Science in Human Centered Design & Engineering fosters students' knowledge and skills in the design and evaluation of technologies and user interfaces. The curriculum, offered in the evening to accommodate both full time and part time students, prepares students for leadership roles in information design, user interface design, user research, human-computer interaction, and related specializations.

DOCTOR OF PHILOSOPHY
The Doctor of Philosophy in Human Centered Design & Engineering provides unparalleled depth and experience for students interested in studying the conception, design, implementation, usability, and evaluation of technologies for specific audiences or user groups. In addition to learning through relevant and contemporary coursework, students work closely with faculty on real-world projects and research questions.

USER-CENTERED DESIGN CERTIFICATE
The graduate certificate in User-Centered Design is an evening graduate-level program for students seeking to explore issues in user research and user-centered design. Students interested in furthering their education with HCDE may apply the 12-credit certificate toward the HCDE Master’s degree.
The department of Human Centered Design & Engineering at the University of Washington in Seattle offers engineering degrees at the undergraduate and graduate level, as well as a graduate certificate program in user-centered design.

PUTTING PEOPLE FIRST, WE RESEARCH, DESIGN, AND ENGINEER INTERACTIONS BETWEEN HUMANS AND TECHNOLOGY. JOIN US.

CHANGE THE WORLD.

RESEARCH LABS AND CENTERS

Center for Collaborative Systems for Security, Safety, & Regional Resilience  DIRECTED BY MARK HASELKORN
Center for Engineering Learning & Teaching  DIRECTED BY CYNTHIA ATMAN
Communicative Practices in Virtual Workspaces Laboratory  DIRECTED BY MARK ZACHRY
Computer Supported Collaboration Laboratory  DIRECTED BY CHARLOTTE LEE
Computing for Healthy Living and Learning Laboratory  DIRECTED BY JULIE KIENTZ
Emerging Capacities of Mass Participation Laboratory  DIRECTED BY KATE STARBIRD
Human-Centered Data Science Laboratory  DIRECTED BY CECILIA ARAGON
Infrastructure Studies Laboratory  DIRECTED BY DAVID RIBES
Internet-Based User Experience Laboratory  DIRECTED BY JAN SPYRIDAKIS
Laboratory for Human Centered Engineering Education  DIRECTED BY JENNIFER TURNS
Laboratory for Influence in SocioTechnical Systems  DIRECTED BY SEAN MUNSON
Prosocial Computing Laboratory  DIRECTED BY GARY HSIEH
Social Computational Systems Laboratory  DIRECTED BY DAVID MCDONALD
Tactile and Tactical Design Laboratory  DIRECTED BY BETH KOLKO & DANIELA ROSNER