UMSI research from 2020 CHI proceedings

University of Michigan School of Information faculty and PhD students have earned five Best Paper and six Honorable Mention designations at the 2020 ACM CHI Conference on Human Factors in Computing Systems.

Best Paper awards go to the top one percent of accepted papers at ACM CHI, the premiere international conference on Human-Computer Interaction. Honorable mention awards go to the top five percent of accepted papers.

This year's conference was to take place April 25-30 in Honolulu, Hawaii, but organizers recently canceled it due to the COVID-19 pandemic.

In addition to these eleven papers, UMSI faculty and students had nearly seventy additional research papers, workshops, posters, panels and journals accepted.

See below for a complete list of UMSI research. School of Information faculty, students and researchers are listed in bold, and the names of other University of Michigan scholars are italicized.

Papers

Best Paper Award
Paper: "MRAT: The Mixed Reality Analytics Toolkit"
Michael Nebeling, *Maximilian Speicher*, **Xizi Wang**, **Shwetha Rajaram**, **Brian D. Hall**, **Zijian Xie**, *Alexander R. E. Raistrick*, *Michelle Aebersold*, **Edward G. Happ**, *Jiayin Wang*, *Yanan Sun*, *Lotus Zhang*, *Leah E. Ramsier*, **Rhea Kulkarni**

Significant tool support exists for the development of mixed reality (MR) applications; however, there is a lack of tools for analyzing MR experiences. We elicit requirements for future tools through interviews with 8 university research, instructional, and media teams using AR/VR in a variety of domains. While we find a common need for capturing how users perform tasks in MR, the primary differences were in terms of heuristics and metrics relevant to each project. Particularly in the early project stages, teams were uncertain about what data should, and even could, be collected with MR technologies. We designed the Mixed Reality Analytics Toolkit (MRAT) to instrument MR apps via visual editors without programming and enable rapid data collection and filtering for visualizations of MR user sessions. With MRAT, we contribute flexible interaction tracking and task definition concepts, an extensible set of heuristic techniques and metrics to measure task success, and visual inspection tools with in-situ visualizations in MR. Focusing on a multi-user, cross-device MR crisis simulation and triage training app as a case study, we then show the benefits of using MRAT, not only for user testing of MR apps, but also performance tuning throughout the design process.

Best Paper Award
Paper: "Creating Augmented and Virtual Reality Applications: Current Practices, Challenges, and Opportunities"
Narges Ashtari, Andrea Bunt, Joanna McGrenere, **Michael Nebeling**, Parmit K. Chilana

Augmented Reality (AR) and Virtual Reality (VR) devices are becoming easier to access and use, but the barrier to entry for creating AR/VR applications remains high. Although the recent spike in HCI research

on novel AR/VR tools is promising, we lack insights into how AR/VR creators use today's state-of-the-art authoring tools as well as the types of challenges that they face. We interviewed 21 AR/VR creators, which we grouped into hobbyists, domain experts, and professional designers. Despite having a variety of motivations and skillsets, they described similar challenges in designing and building AR/VR applications. We synthesize 8 key barriers that AR/VR creators face nowadays, starting from prototyping the initial experiences to dealing with "the many unknowns" during implementation, to facing difficulties in testing applications. Based on our analysis, we discuss the importance of considering end-user developers as a growing population of AR/VR creators, how we can build learning opportunities into AR/VR tools, and the need for building AR/VR toolchains that integrate debugging and testing.

Best Paper Award
Paper: "Critical Race Theory for HCI"
Ihudiya Finda Ogbonnaya-Ogburu, Angela D.R. Smith, Alexandra To, **Kentaro Toyama**

The human-computer interaction community has made some efforts toward racial diversity, but the outcomes remain meager. We introduce critical race theory and adapt it for HCI to lay a theoretical basis for race-conscious efforts, both in research and within our community. Building on the theory's original tenets, we argue that racism is pervasive in everyday socio-technical systems; that the HCI community is prone to "interest convergence", where concessions to inclusion require benefits to those in power; and that the neoliberal underpinnings of the technology industry itself propagate racism. Critical race theory uses storytelling as a means to upend deep-seated assumptions, and we relate several personal stories to highlight ongoing problems of race in HCI. The implications: all HCI research must be attuned to issues of race; participation of underrepresented minorities must be sought in all of our activities; and as a community, we cannot become comfortable while racial disparities exist.

Best Paper Award
Paper: "Designing Trans Technology: Defining Challenges and Envisioning Community-Centered Solutions"
Oliver L. Haimson, Dykee Gorrell, *Denny L. Starks*, *Zu Weinger*

Transgender and non-binary people face substantial challenges in the world, ranging from social inequities and discrimination to lack of access to resources. Though technology cannot fully solve these problems, technological solutions may help to address some of the challenges trans people and communities face. We conducted a series of participatory design sessions (total N = 21 participants) to understand trans people's most pressing challenges and to involve this population in the design process. We detail four types of technologies trans people envision: technologies for changing bodies, technologies for changing appearances / gender expressions, technologies for safety, and technologies for finding resources. We found that centering trans people in the design process enabled inclusive technology design that primarily focused on sharing community resources and prioritized connection between community members.

Best Paper Award
Paper: "texSketch: Active Diagramming through Pen-and-Ink Annotations"
Hariharan Subramonyam, *Colleen Seifert*, **Priti Shah**, **Eytan Adar**

Learning from text is a constructive activity in which sentence-level information is combined by the reader to build coherent mental models. With increasingly complex texts, forming a mental model becomes challenging due to a lack of background knowledge, and limits in working memory and attention. To address this, we are taught knowledge externalization strategies such as active reading and diagramming. Unfortunately, paper-and-pencil approaches may not always be appropriate, and software solutions create friction through difficult input modalities, limited workflow support, and barriers between reading and diagramming. For all but the simplest text, building coherent diagrams can be tedious and

difficult. We propose Active Diagramming, an approach extending familiar active reading strategies to the task of diagram construction. Our prototype, texSketch, combines pen-and-ink interactions with natural language processing to reduce the cost of producing diagrams while maintaining the cognitive effort necessary for comprehension. Our user study finds that readers can effectively create diagrams without disrupting reading.

Best Paper Honorable Mention
Paper: "Interpreting Interpretability: Understanding Data Scientists' Use of Interpretability Tools for Machine Learning"
Harmanpreet Kaur, Harsha Nori, Samuel Jenkins, Rich Caruana, Hanna Wallach, Jennifer Wortman Vaughan

Machine learning (ML) models are now routinely deployed in domains ranging from criminal justice to healthcare. With this newfound ubiquity, ML has moved beyond academia and grown into an engineering discipline. To that end, interpretability tools have been designed to help data scientists and machine learning practitioners better understand how ML models work. However, there has been little evaluation of the extent to which these tools achieve this goal. We study data scientists' use of two existing interpretability tools, the InterpretML implementation of GAMs and the SHAP Python package. We conduct a contextual inquiry (N=11) and a survey (N=197) of data scientists to observe how they use interpretability tools to uncover common issues that arise when building and evaluating ML models. Our results indicate that data scientists over-trust and misuse interpretability tools. Furthermore, few of our participants were able to accurately describe the visualizations output by these tools. We highlight qualitative themes for data scientists' mental models of interpretability tools. We conclude with implications for researchers and tool designers, and contextualize our findings in the social science literature.

Best Paper Honorable Mention
Paper: "Community Collectives: Low-tech Social Support for Digitally-Engaged Entrepreneurship"
Julie Hui, Nefer Ra Barber, Wendy Casey, Suzanne Cleage, Danny C. Dolley, Frances Worthy, **Kentaro Toyama**, **Tawanna R. Dillahunt**

With the rise of social media, entrepreneurs are feeling the pressure to adopt digital tools for their work. However, the upfront effort and resources needed to participate on these platforms is ever more complex, particularly in underresourced contexts. Through participatory action research over two years in Detroit's Eastside, we found that local entrepreneurs preferred to become engaged digitally through a community collective, which involved (a) resource-connecting organizations, (b) regular in-person meetings, (c) paper planning tools, and (d) practice and validation. Together, these elements combined to provide (1) awareness and willingness to use digital tools, (2) regular opportunities to build internet self-efficacy, and (3) ways to collectively overcome digital obstacles. We discuss our findings in the context of digital engagement and entrepreneurship, and outline recommendations for digital platforms seeking to better support economic mobility more broadly.

Best Paper Honorable Mention
Paper: "A Probabilistic Grammar of Graphics"
Xiaoying Pu, **Matthew Kay**

Visualizations depicting probabilities and uncertainty are used everywhere from medical risk communication to machine learning, yet these probabilistic visualizations are difficult to specify, prone to error, and their designs are cumbersome to explore. We propose a Probabilistic Grammar of Graphics (PGoG), an extension to Wilkinson's original framework. Inspired by the success of probabilistic programming languages, PGoG makes probability expressions, such as P(A|B), a first-class citizen in the language. PGoG abstractions also reflect the distinction between probability and frequency framing, a concept from the uncertainty communication literature. It is expressive, encompassing product plots,

density plots, icon arrays, and dotplots, among other visualizations. Its coherent syntax ensures correctness (that the proportions of visual elements and their spatial placement reflect the underlying probability distribution) and reduces edit distance between probabilistic visualization specifications, potentially supporting more design exploration. We provide a proof-of-concept implementation of PGoG in R.

Best Paper Honorable Mention
Paper: "An Empirical Comparison of Technologically Mediated Advertising in Under-connected Populations"
Mustafa Naseem, Sacha St-Onge Ahmad, Agha Ali Raza, Bilal Saleem, Jay Chen
Information and Communication Technology interventions have the potential to improve outcomes in health and other development sectors in low-income settings. Large-scale impact, however, remains the central challenge for the HCI4D community as significant and diverse resources are typically required to scale such interventions beyond the pilot stage. In contrast, voice-based entertainment services accessible over simple phones, designed for similarly low-income, low-literate populations manage to scale 'virally' to tens of thousands of users with little to no advertising cost. Our study compares the outcomes of using voice-based entertainment to spread a maternal-health hotline against conventional advertisement channels including paper flyers, posters, radio, TV, social media and robocalls. Through an 11-week deployment in Pakistan where the hotline reached 21,770 users over 32,625 calls, we find that the entertainment service outperformed other channels on all popular user acquisition metrics, with the exception of robocalls, which lead in terms of spread.

Best Paper Honorable Mention
Paper: Examining Adoption and Abandonment of Security, Privacy, and Identity Theft Protection Practices
Yixin Zou, Kevin Roundy, Acar Tamersoy, Saurabh Shintre, Johann Roturier, **Florian Schaub**

Users struggle to adhere to expert-recommended security and privacy practices. While prior work has studied initial adoption of such practices, little is known about the subsequent implementation and abandonment. We conducted an online survey (n=902) examining the adoption and abandonment of 30 commonly recommended practices. Security practices were more widely adopted than privacy and identity theft protection practices. Manual and fully automatic practices were more widely adopted than practices requiring recurring user interaction. Participants' gender, education, technical background, and prior negative experience are correlated with their levels of adoption. Furthermore, practices were abandoned when they were perceived as low-value, inconvenient, or when users overrode them with subjective judgment. We discuss how security, privacy, and identity theft protection recommendations and tools can be better aligned with user needs.

Best Paper Honorable Mention
Paper: "Callisto: Capturing the "Why" by Connecting Conversations with Computational Narratives"
April Yi Wang, Zihan Wu, **Christopher Brooks**, **Steve Oney**

When teams of data scientists collaborate on computational notebooks, their discussions often contain valuable insight into their design decisions. These discussions not only explain analysis in the current notebook but also alternative paths, which are often poorly documented. However, these discussions are disconnected from the notebooks for which they could provide valuable context. We propose Callisto, an extension to computational notebooks that captures and stores contextual links between discussion messages and notebook elements with minimal effort from users. Callisto allows notebook readers to better understand the current notebook content and the overall problem-solving process that led to it, by making it possible to browse the discussions and code history relevant to any part of the notebook. This is particularly helpful for onboarding new notebook collaborators to avoid misinterpretations and duplicated work, as we found in a two-stage evaluation with 32 data science students.

Paper: "It's a scavenger hunt: Usability of Websites' Opt-Out and Data Deletion Choices"
Hana Habib, Sarah Pearman, Jiamin Wang, **Yixin Zou**, Alessandro Acquisti, Lorrie Faith Cranor, Norman Sadeh, **Florian Schaub**

We conducted an in-lab user study with 24 participants to explore the usefulness and usability of privacy choices offered by websites. Participants were asked to find and use choices related to email marketing, targeted advertising, or data deletion on a set of nine websites that differed in terms of where and how these choices were presented. They struggled with several aspects of the interaction, such as selecting the correct page from a site's navigation menu and understanding what information to include in written opt-out requests. Participants found mechanisms located in account settings pages easier to use than options contained in privacy policies, but many still consulted help pages or sent email to request assistance. Our findings indicate that, despite their prevalence, privacy choices like those examined in this study are difficult for consumers to exercise in practice. We provide design and policy recommendations for making these website opt-out and deletion choices more useful and usable for consumers.

Paper: "Optimizing for Happiness and Productivity: Modeling Opportune Moments for Transitions and Breaks at Work"
Harmanpreet Kaur, Alex C. Williams, Daniel McDuff, Mary Czerwinski, Jaime Teevan, Shamsi Iqbal

Information workers perform jobs that demand constant multitasking, leading to context switches, productivity loss, stress, and unhappiness. Systems that can mediate task transitions and breaks have the potential to keep people both productive and happy. We explore a crucial initial step for this goal: finding opportune moments to recommend transitions and breaks without disrupting people during focused states. Using affect, workstation activity, and task data from a three-week field study (N=25), we build models to predict whether a person should continue their task, transition to a new task, or take a break. The R-squared values of our models are as high as 0.7, with only 15% error cases. We ask users to evaluate the timing of recommendations provided by a recommender that relies on these models. Our study shows that users find our transition and break recommendations to be well-timed, rating them as 86% and 77% accurate, respectively. We conclude with a discussion of the implications for intelligent systems that seek to guide task transitions and manage interruptions at work.

Paper: "Race, Gender and Beauty: The Effect of Information Provision on Online Hiring Biases"
Weiwen Leung, Zheng Shang, Daviti Jibuti, Jinhao Zhao, Maximilian Klein, **Casey Pierce**, **Lionel Robert**, Haiyi Zhu

We conduct a study of hiring bias on a simulation platform where we ask Amazon MTurk participants to make hiring decisions for a mathematically intensive task. Our findings suggest hiring biases against Black workers and less attractive workers, and preferences towards Asian workers, female workers and more attractive workers. We also show that certain UI designs, including provision of candidates' information at the individual level and reducing the number of choices, can significantly reduce discrimination. However, provision of candidate's information at the subgroup level can increase discrimination. The results have practical implications for designing better online freelance marketplaces.

Paper: "2Across: A Comparison of Audio-Tactile and Screen-Reader based Representations of a Crossword Puzzle"
Hrishikesh V. Rao, **Sile O'Modhrain**

Crosswords are a popular recreational game that relies on the spatial relationship between words. As a player answers clues, they begin to organize words to form an intersecting grid. A good non-visual representation should convey the interrelation of words and support the user in building a practical spatial

image of the crossword grid. This paper looks at two approaches to representing a crossword puzzle for visually impaired users: a screen reader based crossword, and an audio-tactile crossword puzzle. We evaluate the designs in a study with 10 visually impaired participants. The audio-tactile representation was found to support the practical use of the crossword's spatial structure while the screen reader based puzzle leveraged participant's prior experience in navigating websites. The paper discusses critical aspects of our study and presents a perspective on the use of multimodal interfaces for such spatial applications.

Paper: "Collaborative Aspects of Collecting and Reflecting on Behavioral Data"
Gabriela Marcu, Allison N. Spiller

Direct observation of behavior provides a unique type of data for reflecting on during a process of behavioral intervention. This study focuses on practitioners who specialize in operationalizing, recording, and monitoring behavior using data collection through paper-and-pencil or, increasingly, mobile computing. Applying an action research approach, we conducted fieldwork to understand observational data collection among practitioners providing children with special education support for behavioral needs. We present a model of collaborative data collection, which describes how practices are situated in the process of collecting data that are useful for reflection by teams of practitioners. We discuss how computer-assisted data collection could promote more systematic and rigorous practices, and design considerations for the collaborative aspects of collecting and reflecting on behavioral data. This study builds on research describing the practices of individuals who track their own behavioral data, and improves our understanding of informal documentation practices in organizations.

Paper: "Crowdsourced Detection of Emotionally Manipulative Language"
Jordan S. Huffaker, *Jonathan K. Kummerfeld,* Walter S. Lasecki, **Mark S. Ackerman**

Detecting rhetoric that manipulates readers' emotions requires distinguishing intrinsically emotional content (IEC; e.g., a parent losing a child) from emotionally manipulative language (EML; e.g., using fear-inducing language to spread anti-vaccine propaganda). However, this remains an open classification challenge for both automatic and crowdsourcing approaches. Machine Learning approaches only work in narrow domains where labeled training data is available, and non-expert annotators tend to conflate IEC with EML. We introduce an approach, anchor comparison, that leverages workers' ability to identify and remove instances of EML in text to create a paraphrased "anchor text", which is then used as a comparison point to classify EML in the original content. We evaluate our approach with a dataset of news-style text snippets and show that precision and recall can be tuned for system builders' needs. Our contribution is a crowdsourcing approach that enables non-expert disentanglement of social references from content.

Paper: "Digital Ventriloquism: Giving Voice to Everyday Objects"
Yasha Iravantchi, Mayank Goel, Chris Harrison

Smart speakers with voice agents are becoming increasingly common. However, the agent's voice always emanates from the device, even when that information is contextually and spatially relevant elsewhere. Digital Ventriloquism allows smart speakers to render sound onto everyday objects, such that it appears they are speaking and are interactive. This can be achieved without any modification of objects or the environment. For this, we used a highly directional pan-tilt ultrasonic array. By modulating a 40 kHz ultrasonic signal, we can emit sound that is inaudible "in flight" and demodulates to audible frequencies when impacting a surface through acoustic parametric interaction. This makes it appear as though the sound originates from an object and not the speaker. We ran a study in which we projected speech onto five objects in three environments, and found that participants were able to correctly identify the source object 92% of the time and correctly repeat the spoken message 100% of the time, demonstrating our digital ventriloquy is both directional and intelligible.

Paper: "How Well Do People Report Time Spent on Facebook? An Evaluation of Established Survey Questions with Recommendations"
Sindhu Kiranmai Emala, Moira Burke, Alex Leavitt, **Nicole B. Ellison**

Many studies examining social media use rely on self-report survey questions about how much time participants spend on social media platforms. Because they are challenging to answer accurately and susceptible to various biases, these self-reported measures are known to contain error -- although the specific contours of this error are not well understood. This paper compares data from ten self-reported Facebook use survey measures deployed in 15 countries (N = 49,934) against data from Facebook's server logs to describe factors associated with error in commonly used survey items from the literature. Self-reports were moderately correlated with actual Facebook use (r = 0.42 for the best-performing question), though participants significantly overestimated how much time they spent on Facebook and underestimated the number of times they visited. People who spent a lot of time on the platform were more likely to misreport their time, as were teens and younger adults, which is notable because of the high reliance on college-aged samples in many fields. We conclude with recommendations on the most accurate ways to collect time-spent data via surveys.

Paper: "Improving Crowd-Supported GUI Testing with Structural Guidance"
Yan Chen, **Maulishree Pandey**, *Jean Y. Song*, Walter S. Lasecki, **Steve Oney**

Crowd testing is an emerging practice in Graphical User Interface (GUI) testing, where developers recruit a large number of crowd testers to test GUI features. It is often easier and faster than a dedicated quality assurance team, and its output is more realistic than that of automated testing. However, crowds of testers working in parallel tend to focus on a small set of commonly-used User Interface (UI) navigation paths, which can lead to low test coverage and redundant effort. In this paper, we introduce two techniques to increase crowd testers' coverage: interactive event-flow graphs and GUI-level guidance. The interactive event-flow graphs track and aggregate every tester's interactions into a single directed graph that visualizes the cases that have already been explored. Crowd testers can interact with the graphs to find new navigation paths and increase the coverage of the created tests. We also use the graphs to augment the GUI (GUI-level guidance) to help testers avoid only exploring common paths. Our evaluation with 30 crowd testers on 11 different test pages shows that the techniques can help testers avoid redundant effort while also increasing untrained testers' coverage by 55%. These techniques can help us develop more robust software that works in more mission-critical settings not only by performing more thorough testing with the same effort that has been put in before but also by integrating them into different parts of the development pipeline to make more reliable software in the early development stage.

Paper: "Learning from Positive Adaptations of Pediatric Cancer Patients to Design Health Technologies"
Sun Young Park, **Woosuk Seo**, Andrew B.L. Berry, *Hyeryoung Kim*, *Sanya Verma*, *Sung Won Choi*, **Ayse G. Buyuktur**

The diagnosis of cancer brings about significant changes in the life of a child. In addition to physical pain, pediatric patients face psychological and social challenges. At the same time, some patients also have positive experiences with and attitudes toward their illness and treatment. Drawing on 19 semi-structured interviews with pairs of pediatric cancer patients and their parental caregivers, we examined patients' perspectives on their experience of living with cancer. We identified four salient themes in patients' positive experiences: future-oriented thinking, developing strong personal bonds and relationships, gaining knowledge and life experience, and developing self-management and coping skills. Collectively, the patients' positive experiences indicate that they adapt to their new lives through an evolving process. Based on this process, we provide design implications for health technologies to support and promote positive experiences during illness and treatment.

Paper: "Private Responses for Public Sharing: Understanding Self-Presentation and Relational Maintenance via Stories in Social Media"
Penny Trieu, Nancy K. Baym

With nearly two billion users, social media Stories—an ephemeral format of sharing—are increasingly popular and projected to overtake sharing via public feeds. Sharing via Stories differs from Feeds sharing by removing the visible feedback (e.g. "likes" and "comments") which has come to characterize social media. Given the salience of responses visibility to self-presentation and relational maintenance in social media literature, we conducted semi-structured interviews (N = 22) to explore how people understand these processes when using Stories. We find that users have lower expectations for responses with Stories and experience lower pressure for self-presentation. This fosters more frequent sharing and a sense of daily connectedness, which strong ties can find valuable. Finally, the act of viewing takes on new significance of signaling attention when made known to the sharer. Our findings point to the importance of effort and attention in understanding responses on social media.

Paper: "Digital Technology, Meditative and Contemplative Practices, and Transcendent Experiences"
Robert B. Markum, **Kentaro Toyama**

Meditative and contemplative practices are common among U.S. adults, but the impact of digital technology use on these practices and on associated transcendent experiences is poorly understood. Through semi-structured interviews with sixteen experienced practitioners from a variety of traditions, we find that practitioners consider digital technology to be a mixed blessing. While they see its practical value, they are wary of its stimulation-based effects and find minimal usefulness in commercial meditation apps. They also feel that digital technology use may interfere with possible transcendent experiences. The practitioners, however, applied insights from their respective practices to strategically mitigate digital technology's negative effects in three ways: limiting its use to instrumental purposes, using technology interactions as grist for self-reflection, and integrating technology itself into a site for practice. Specific design recommendations are discussed.

Paper: "Do I Look Like a Criminal? Examining how Race Presentation Impacts Human Judgement of Recidivism"
Keri Mallari, Kori Inkpen, Paul Johns, Sarah Tan, *Divya Ramesh*, Ece Kamar

Paper: "Explore, Create, Annotate: Designing Digital Drawing Tools with Visually Impaired People"
Maulishree Pandey, **Hariharan Subramonyam**, Brooke Sasia, **Steve Oney**, **Sile O'Modhrain**

People often use text in their drawings to communicate their ideas. For visually impaired people, adding textual information to tactile graphics is challenging. Labeling in braille is a laborious process and clutters the drawings. Audio labels provide an alternative way to add text. However, digital drawing tools for visually impaired people have not examined the use of audio for creating labels. We conducted a study comprising three tasks with 11 visually impaired adults. Our goal was to understand how participants explored and created labeled tactile graphics (both braille and audio), and their interaction preferences. We find that audio labels were quicker to use and easier to create. However, braille labels enabled flexible exploration strategies. We also find that participants preferred multimodal interaction commands, and report hand postures and movements observed during the drawing process for designing recognizable interactions. Based on our findings, we derive design implications for digital drawing tools.

Paper: "Fragile Masculinity: Men, Gender, and Online Harasssment"
Jennifer D. Rubin, **Lindsay Blackwell**, *Terri D. Conley*

Harassment is a persistent problem in contemporary online environments, with women disproportionately experiencing its most severe forms. While critical scholars posit that online gender harassment may be linked to men's anxieties about fulfilling normative masculine gender roles, this relationship has not been examined by empirical research. We survey 264 young men between the ages of 18-24 about their masculinity anxieties and their perceptions of harassment directed at a woman on Twitter. We find that men who perceive themselves as less masculine than average men report higher endorsement of harassment. Further, we find that the relationship between masculinity anxieties and harassment endorsement is mediated by men's adherence to masculine norms and toxic disinhibition. We interpret these results through the lens of social media's specific affordances, and we discuss their implications for technology designers and other practitioners who wish to better detect, prevent, and remediate online harassment by accounting for the role of gender.

Paper: "Officers Never Type: Examining the Persistence of Paper in e-Governance"
Megh Marathe, Priyank Chandra

The Global South has seen a proliferation of e-governance initiatives aimed at digitizing governmental service delivery. However, paper continues to remain the primary medium of bureaucracy. During ethnographic fieldwork at the CM Helpline, a state-wide e-governance initiative in central India, we observed that even tech-savvy bureaucrats who fully supported both the initiative and its paper-to-electronic transition ensured that paper continues to persist in abundance. Drawing upon scholarship from HCI, anthropology, and science & technology studies, we theorize this contradiction to uncover the circulations of power between people, paper, and electronic systems. We suggest that designers should recognize that new systems often disempower existing actors. The process of transition should integrate new systems into the existing ecosystem and plan for the graceful retirement of older technologies. In addition to machine errors, systems should be resilient to human errors. Finally, new systems should attend to sociocultural and historical specificities.

Paper: "Patriarchy, Maternal Health and Spiritual Healing: Designing Maternal Health Interventions in Pakistan"
Maryam Mustafa, **Amna Batool**, Beenish Fatima, Fareeda Nawaz, **Kentaro Toyama**, Agha Ali Raza

We examine the opportunities and challenges in designing for maternal health in low-income, low-resource communities in patriarchal and religious contexts. Pakistan faces a crisis in maternal health with a maternal mortality ratio of 178 deaths per 100,000 live births, as compared to the developed-country average of just 12 deaths per 100,000. Through a 6-month long qualitative, empirical study we examine the prevalent beliefs and practices around maternal health in Pakistan, the access women have to health-care, the existing religious practices that influence them and the agency they exert in their own health-care decision making. We reveal the rampant misinformation among mothers and health workers, house-hold power dynamics that impact maternal health and the deep link between maternal health and religious beliefs. We also show how current maternal health care interventions fit poorly into this context and discuss alternate design recommendations for meeting the maternal health needs of these women.

Paper: "Positive Feedback and Self-Reflection: Features to Support Self-efficacy among Underrepresented Job Seekers"
Tawanna R. Dillahunt, **Joey Chiao-Yin Hsiao**

Technologies play a key role in finding employment in today's job market. However, the majority of those who are unemployed, e.g., individuals who have limited education or who are racial and ethnic minorities, are not well supported by existing digital employment tools. Therefore, we conducted an 8-month

randomized field experiment to evaluate two tools—Review-Me and Interview4—designed to address these job seekers' key employment needs. We used the Theory of Planned Behavior to examine the tools' effects on three factors influencing job seekers' job search intention: job search self-efficacy, subjective norms, and job search attitudes. Our interview data suggested that the tools positively affected all factors, but our survey results were mixed. Interview results suggest that these trends were caused by positive feedback and self-reflection. We contribute ways to integrate these two features into future tools for, and techniques to increase study retention among, underrepresented job seekers.

Paper: "Prior Setting in Practice: Strategies and Rationales Used in Choosing Prior Distributions for Bayesian Analysis"
Abhraneel Sarma, **Matthew Kay**

Bayesian statistical analysis is steadily growing in popularity and use. Choosing priors is an integral part of Bayesian inference. While there exist extensive normative recommendations for prior setting, little is known about how priors are chosen in practice. We conducted a survey (N = 50) and interviews (N = 9) where we used interactive visualizations to elicit prior distributions from researchers experienced withBayesian statistics and asked them for rationales for those priors. We found that participants' experience and philosophy influence how much and what information they are willing to incorporate into their priors, manifesting as different levels of informativeness and skepticism. We also identified three broad strategies participants use to set their priors: centrality matching, interval matching, and visual mass allocation. We discovered that participants' understanding of the notion of"weakly informative priors"—a commonly-recommended normative approach to prior setting—manifests very differently across participants. Our results have implications both for how to develop prior setting recommendations and how to design tools to elicit priors in Bayesian analysis.

Paper: "QMaps: Engaging Students in Voluntary Question Generation and Linking"
Iman Yeckehzaare, Tirdad Barghi, **Paul Resnick**

Generating multiple-choice questions is known to improve students' critical thinking and deep learning. Visualizing relationships between concepts enhances meaningful learning, students' ability to relate new concepts to previously learned concepts. We designed and deployed a collaborative learning process through which students generate multiple-choice questions and represent the prerequisite knowledge structure between questions as visual links in a shared map, using a variation of Concept Maps that we call "QMap." We conducted a four-month study with 19 undergraduate students. Students sustained voluntary contributions, creating 992 good questions, and drawing 1,255 meaningful links between the questions. Through analyzing self-reports, observations, and usage data, we report on the technical and social design features that led students to sustain their motivation.

Paper: "Synthesized Social Signals: Computationally-Derived Social Signals from Account Histories"
Jane Im, *Sonali Tandon*, Eshwar Chandrasekharan, *Taylor Denby*, **Eric Gilbert**

Social signals are crucial when we decide if we want to interact with someone online. However, social signals are typically limited to the few that platform designers provide, and most can be easily manipulated. In this paper, we propose a new idea called synthesized social signals (S3s): social signals computationally derived from an account's history, and then rendered into the profile. Unlike conventional social signals such as profile bios, S3s use computational summarization to reduce receiver costs and raise the cost of faking signals. To demonstrate and explore the concept, we built Sig, an extensible Chrome extension that computes and visualizes S3s. After a formative study, we conducted a field deployment of Sig on Twitter, targeting two well-known problems on social media: toxic accounts and misinformation. Results show that Sig reduced receiver costs, added important signals beyond conventionally available ones, and that a few users felt safer using Twitter as a result. We conclude by reflecting on the opportunities and challenges S3s provide for augmenting interaction on social platforms.

Paper: "The Human in Emotion Recognition on Social Media: Attitudes, Outcomes, Risks"
Nazanin Andalibi, **Justin Buss**

Emotion recognition algorithms recognize, infer, and harvest emotions using data sources such as social media behavior, streaming service use, voice, facial expressions, and biometrics in ways often opaque to the people providing these data. People's attitudes towards emotion recognition and the harms and outcomes they associate with it are important yet unknown. Focusing on social media, we interviewed 13 adult U.S. social media users to fill this gap. We find that people view emotions as insights to behavior, prone to manipulation, intimate, vulnerable, and complex. Many find emotion recognition invasive and scary, associating it with autonomy and control loss. We identify two categories of emotion recognition's risks: individual and societal. We discuss findings' implications for algorithmic accountability and argue for considering emotion data as sensitive. Using a Science and Technology Studies lens, we advocate that technology users should be considered as a relevant social group in emotion recognition advancements.

Paper: "XRDirector: A Role-Based Collaborative Immersive Authoring System"
Michael Nebeling, **Katy Lewis**, **Yu-Cheng Chang**, **Lihan Zhu**, **Michelle Chung**, **Piaoyang Wang**, **Janet Nebeling**

Immersive authoring is an increasingly popular technique to design AR/VR scenes because design and testing can be done concurrently. Most existing systems, however, are single-user and limited to either AR or VR, thus constrained in the interaction techniques. We present XRDirector, a role-based collaborative immersive authoring system that enables designers to freely express interactions using AR and VR devices as puppets to manipulate virtual objects in 3D physical space. In XRDirector, we adapt roles known from filmmaking to structure the authoring process and help coordinate multiple designers in immersive authoring tasks. We study how novice AR/VR creators can take advantage of the roles and modes in XRDirector to prototype complex scenes with animated 3D characters, light effects, and camera movements, and also simulate interactive system behavior in a Wizard of Oz style. XRDirector's design was informed by case studies around complex 3D movie scenes and AR/VR games, as well as workshops with novice AR/VR creators. We show that XRDirector makes it easier and faster to create AR/VR scenes without the need for coding, characterize the issues in coordinating designers between AR and VR, and identify the strengths and weaknesses of each role and mode to mitigate the issues.

Workshops

Workshop: "What's Race Got To Do With It? Engaging in Race in HCI 1/3"
Angela D.R. Smith, Alex A. Ahmed, Adriana Alvarado Garcia, Bryan Dosono, **Ihudiya Finda Ogbonnaya-Ogburu**, Yolanda Rankin, Alexandra To, **Kentaro Toyama**

There is an urgent and ongoing need to engage critically with race in human-computer interaction. In this workshop, we consider two intertwining aspects: first, how HCI research and practice should engage with race; second, how the HCI community itself can become more racially inclusive and equitable. The workshop offers a safe space for HCI scholars and practitioners to discuss how their experiences with race and racism impact their research and work life. Insights from critical race theory will inform the discussion. Workshop participants will draft a set of guidelines for research and a set of recommendations for SIGCHI leadership and the CHI community.

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Workshop: “Conversational Agents for Health and Wellbeing 1/4"
A. Baki Kocaballi, Juan C. Quiroz, Liliana Laranjo, Dana Rezazadegan, Rafal Kocielnik, Leigh Clark, Q. Vera Liao, **Sun Young Park**, Robert J. Moore, Adam Miner

Conversational agents have increasingly been deployed in healthcare applications. However, significant challenges remain in developing this technology. Recent research in this area has highlighted that: i) patient safety was rarely evaluated; ii) health outcomes were poorly measured, and iii) no standardised evaluation methods were employed. The conversational agents in healthcare are lagging behind the developments in other domains. This one-day workshop aims to create a roadmap for healthcare conversational agents to develop standardised design and evaluation frameworks. This will prioritise health outcomes and patient safety while ensuring a high-quality user experience. In doing so, this workshop will bring together researchers and practitioners from HCI, healthcare and related speech and chatbot domains to collaborate on these key challenges.

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Workshop: “Exploring Potentially Abusive Ethical, Social and Political Implications of Mixed Reality Research in HCI 1/4"
Jan Gugenheimer, Mark McGill, Samuel Huron, Christian Mai, Julie Williamson, **Michael Nebeling**

In recent years, Mixed Reality (MR) headsets have increasingly made advances in terms of capability, affordability and end-user adoption, slowly becoming everyday technology. HCI research typically explores positive aspects of these technologies, focusing on interaction, presence and immersive experiences. However, such technological advances and paradigm shifts often fail to consider the "dark patterns", with potential abusive scenarios, made possible by new technologies (cf. smartphone addiction, social media anxiety disorder). While these topics are getting recent attention in related fields and with the general population, this workshop is aimed at starting an active exploration of abusive, ethical, social and political scenarios of MR research inside the HCI community. With an HCI lens, workshop participants will engage in critical reviews of emerging MR technologies and applications and develop a joint research agenda to address them.

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Workshop: “IslamicHCI: Designing with and within Muslim Populations 1/4"
Maryam Mustafa, Shaimaa Lazem, Ebtisam Alabdulqader, **Kentaro Toyama**, Sharifa Sultana, Samia Ibtasam, Richard Anderson, Syed Ishtiaque Ahmed

In recent years there has been a growing body of work from the CHI communities that looks at designing for inclusivity and for the unique and specific constraints of diverse populations. This has included but is not limited to, work on designing within patriarchal contexts, designing around issues of gender and sexual orientation and designing around literacy. In tandem, local HCI initiatives such as ArabHCI [3] have emerged to address the misrepresentation of these populations in HCI research, highlighting the fact that Western originated design methods would require delicate adaptations to suit non-Western

cultural contexts. With the same approach towards inclusivity and co-existence the aim of this workshop is to bring together HCI researchers and practitioners who engage in studies and interventions within Muslim majority communities around the world. The goal is to understand the Muslim identity and perceptions around it, the unique constraints and limitations within Muslim communities and to identify core issues and concerns within these populations. We will explore the following themes: refugees and islamophobia; Muslim feminism and Digital financial services.

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Panels

Panel: "SurveillanceCapitalism@CHI: Civil Conversation around a Difficult Topic"
Alan Borning, Batya Friedman, Jofish Kaye, **Cliff Lampe**, Volker Wulf

A large portion of the software side of the global information technology infrastructure, including web search, email, social media, and much more, is in many cases provided free to the end users. At the same time, the corporations that provide these services are often enormously profitable. The business model that enables this involves customized advertising and sometimes behavior manipulation, powered by intensive gathering and cross-correlation of detailed personal information. These companies provide some great products and services at no upfront cost to the end users. But the model has a dark side as well, with negative impacts for privacy, autonomy, human dignity, and democracy. The purpose of this panel is to provide a civil forum for the CHI community as a whole to discuss this business model, including its advantages and disadvantages, and its impacts on CHI and HCI and society more generally, with an eye toward responsible innovation.

Panel: "Transparency in Qualitative Research: Increasing Fairness in the CHI Review Process"
Poorna Talkad Sukumar, Ignacio Avellino, Christian Remy, Michael A. DeVito, **Tawanna R. Dillahunt**, Joanna McGrenere, Max L. Wilson

Transparency in process and its reporting is paramount for establishing the rigor of qualitative studies. However, the CHI conference receives submissions with varying levels of transparency and oftentimes, papers that are more transparent can be inadvertently subjected to more scrutiny in the review process, raising issues of fairness. In this panel, we bring together researchers with diverse qualitative work experiences to present examples of transparency-related initiatives and their corresponding review responses. We aim to work towards setting standards for transparent reporting in qualitative-work submissions and increasing fairness in the review process. We focus on the challenges in achieving transparency in qualitative research and current workarounds to overcome frictions in the reviewing process through engaging discussions involving panelists and the audience.

Panel: "CHI 2030: The Future is Wide Open"
Helena M. Mentis, Regan L. Mandryk, Tovi Grossman, **Cliff Lampe**, Jessica Colnago

What is the future of the CHI conference? What will it look like in 2030? In this panel, we will present some data on the current state of the CHI conference - from paper submissions to attendance - and the initial findings on what our community has said is their 'ideal' CHI conference. We will then make wild predictions about the future of CHI and encourage audience discussion on the form that the conference and academic publishing could take in the future.

Journals

Journals: Music, Search, and IoT: How People (Really) Use Voice Assistants

Tawfiq Ammari, Jofish Kaye, Janice Tsai, Frank Bentley

Voice has become a widespread and commercially viable interaction mechanism with the introduction of voice assistants (VAs), such as Amazon's Alexa, Apple's Siri, Google Assistant, and Microsoft's Cortana. Despite their prevalence, we do not have a detailed understanding of how these technologies are used in domestic spaces. To understand how people use VAs, we conducted interviews with 19 users, and analyzed the log files of 82 Amazon Alexa devices, totaling 193,665 commands, and 88 Google Home Devices, totaling 65,499 commands. In our analysis, we identified music, search, and IoT usage as the command categories most used by VA users. We explored how VAs are used in the home, investigated the role of VAs as scaffolding for Internet of Things device control, and characterized emergent issues of privacy for VA users. We conclude with implications for the design of VAs and for future research studies of VAs.

Journals: "Gendered by Design: A Duoethnographis Study of Personal Fitness Tracking Systems"
Marika Cifor, **Patricia Garcia**

Using fitness trackers to generate and collect quantifiable data is a widespread practice aimed at better understanding one's health and body. The intentional design of fitness trackers as genderless or universal is predicated on masculinist design values and assumptions that do not result in "neutral" devices and systems. Instead, ignoring gender in the design of fitness tracking devices marks a dangerous ongoing inattention to the needs, desires, and experiences of women, as well as transgender and gender non-conforming persons. We utilize duoethnography, a methodology emphasizing personal narrative and dialogue, as a tool that promotes feminist reflexivity in the design and study of fitness tracking technologies. Using the Jawbone UP3 as our object of study, we present findings that illustrate the gendered physical and interface design features and discuss how these features reproduce narrow understandings of gender, health, and lived experiences.

Case Studies

Case Study: "Balancing Learner Experience and User Experience in a Peer Feedback Web Application for MOOCs"
Nathan Magyar, *Stephanie R. Haley*

Educational technology practitioners at the University of Michigan created a web application called the Gallery Tool, which provides a space for learners to share their work and receive feedback on it. After piloting the tool in two online courses for seven months, we interviewed learners from these courses. We found that learners most often used the Gallery Tool to "check all the boxes" of the course or to find inspiration for their own assignments. They liked its aesthetic and ease of use, but low levels of feedback activity decreased its value to them. As a result, it typically had a neutral impact on their course experience. Our findings are most relevant to other educational technology practitioners, as they reveal insights for balancing and improving learner experience and user experience in web applications for massive open online courses.

Case Study: "Creating and Evaluating a Goal Setting Prototype for MOOCs"
Nathan Magyar, Xuenan Xu, Molly Maher

This case study focuses on the design and evaluation of a goal setting web application for use in online courses. Our process included background research, competitive analysis, internal feature brainstorming, persona creation, a Lightning Decision Jam, and high-fidelity prototyping [2]. We assessed our design using e-Learning System Evaluations and usability tests [1]. Key takeaways include: (a) the Lightning

Decision Jam is an engaging, inclusive, and helpful exercise for narrowing down a project's scope; (b) e-Learning System Evaluations elicit more detailed feedback than usability tests, but they may not be well-suited for testing prototypes with limited functionality; and (c) the conversational nature of usability tests may lead to more ideas for new features, but these tests do not give participants the opportunity to think deeply before providing feedback. These findings have implications for user experience designers and researchers, as well as those interested in new brainstorming and system evaluation methods.

Posters

Poster: LB151: "ViewPoint: Student Experiences with Technology Supporting Role-Based Educational Simulations"
Rebecca M. Quintana, Chris Quintana, Jacob Fortman, Elisabeth R. Gerber

We examine the experience of students who used ViewPoint to participate in a technology-supported, role-based simulation in a large university course, where graduate students designed and built a simulation about the college admissions process for undergraduate students. We focus on the user experience with ViewPoint—a web application to author, structure, and manage role-based simulations. Users noted four ways that ViewPoint supported their experience: it provided convenient and equitable access to resources, facilitated communication among roles, created focus through its self-contained environment, and mirrored real-world tasks through its interface. Users noted two dimensions to consider for future support of role-based simulations: maintaining the conceit of the simulation narrative and creating awareness of auxiliary information streams.

Poster: LBW020: "Otto: An Autonomous School Bus System for Parents and Children"
Jackie Ayoub, *Brian Mason*, *Kamari Morse*, *Austin Kirchner*, *Naira Tumanyan*, *Feng Zhou*

Technological advances in autonomous transportation systems have brought them closer to road use. However, little research is reported on children's behavior in autonomous buses (ABs) under real road conditions and on improving parents' trust in leaving their children alone in ABs. Thus, we aim to answer the research question: "How can we design ABs suitable for unaccompanied children so that the parents can trust them?" We conducted a study using a Wizard-of-Oz method to observe children's behavior and interview both parents and children to examine their needs in ABs. Using an affinity diagram, we grouped children's and parents' needs under the following categories: entertainment, communication, personal behavior, trust and desires. Using an iterative human-centered design process, we created an Otto system, a smartphone app for parents to communicate with their children and a tablet app for children to entertain during the ride.

Poster: LBW137: "Expectations and Trust in Automated Vehicles"
Qiaoning Zhang, *X. Jessie Yang*, **Lionel Robert**

A lack of trust is a major barrier to the adoptions of Automated Vehicles (AVs). Given the ties between expectation and trust, this study employs the expectation-confirmation theory to investigate trust in AVs. An online survey was used to collect data including expectation, perceived performance, and trust in AVs from 443 participants which represent U.S. driver population. Using the polynomial regression and response surface methodology, we found that higher trust is engendered when perceived performance is higher than expectation, and perceived risk can moderate the relationship between expectation confirmation and trust in AVs. Results have important theoretical and practical implications.

Poster: LBW298: "Predicting Takeover Performance in Conditionally Automated Driving"
Na Du, *Feng Zhou*, Elizabeth Puvler, *Dawn Tilbury*, **Lionel Robert**, Anuj Pradhan, *X. Jessie Yang*

In conditionally automated driving, drivers decoupled from operational control of the vehicle have difficulty taking over control when requested. To address this challenge, we conducted a human-in-the-loop experiment wherein the drivers needed to take over control from an automated vehicle. We collected drivers' physiological data and data from the driving environment, and based on which developed random forest models for predicting drivers' takeover performance in real time. Drivers' subjective ratings of their takeover performance were treated as the ground truth. The best random forest model had an accuracy of 70.2% and an F1-score of 70.1%. We also discussed the implications on the design of an adaptive in-vehicle alert system.

Poster: LBW301: "Combining Participatory and ESM: A Hybrid Approach to Collecting Annotated Mobility Data"
Hsiu-Chi Chang, Yung-Ju Chang, **Mark W. Newman**, Chih-Hsin Lin

Collecting continual labeled activity data entails considerable effort from users to label a series of activity data. We propose Checkpoint-and-Remind (CAR), a hybrid approach that combines participatory (PART) and context-trigger ESM labeling (ESM). Checkpoint-and-Remind has the advantage of user control but reduces users' burden in recording activities. Meanwhile, it features a context-trigger mechanism of ESM as a backup to remind users of labeling. Our preliminary evaluation of CAR with nine participants, who collected and labeled their mobility activity data for 15 weekdays, showed that compared with PART and ESM, participants collected a larger amount of annotated mobility data using CAR. In addition, participants had a higher annotation rate when using CAR than when using ESM. Our results show that the hybrid approach that combines manual and automated recording is promising. Our future work is validating these results and measure more metrics related to compliance with more participants.

Poster: LBW318: "Modeling Trust Dynamics in Human-robot Teaming: A Bayesian Inference Approach"
Yaohui Guo, Chongjie Zhang, *X. Jessie Yang*

In this work, we proposed a personalized trust predictor for modeling trust dynamics in human-robot teaming. The proposed method models trust by a Beta distribution to capture the three properties of trust dynamics, which takes the performance-induced positive attitude and negative attitude as parameters. The model learns the prior distribution of the parameters from a training dataset, and estimates the posterior distribution based on a short training session and occasionally reported trust feedback. The experiments showed that the proposed method accurately predicted people's trust dynamics, achieving a root mean square (RMS) of 0.0724 out of 1.

Poster: LBW 323: "Trust Dynamics in Human-AV (Automated Vehicle) Interaction"
Ruikun Luo, Jian Chu, *X. Jessie Yang*

Despite many benefits of automated driving, such as reducing fuel consumption, traffic congestion and crashes, a lack of trust hinders the adoption of automated vehicles (AVs). Prior research focused on people's trust in AVs based on AVs' overall performance. The present study is focused on people's trust change in AVs over time in a sequential decision making context. We conducted a human-in-the-loop experiment with 16 participants in a virtual 3D environment wherein participants acted as passengers riding an AV. We manipulated two independent variables: level of stochasticity (high vs. low) and source of stochasticity (external vs. internal). Dependent variables included participants' moment-to-moment trust in AVs and post-experiment trust. Our results revealed that when the stochasticity was due to internal

errors (e.g. AV's sensor errors) as compared to external errors (e.g. traffic jams or road blocks), participants' trust in AVs decreased more significantly. Also, the larger the cost due to an error, the larger the trust decrement.