ACADEMIC YEAR 2021-2022

CREATE

Year 2 Impact Report

CREATE's mission is to make technology accessible, and to make the world accessible through technology.

HIGHLIGHTS

RESEARCH: CREATE founders and students published 41 papers on accessible technology, 18 of which directly used CREATE support (44%). CREATE faculty continued to pursue high-impact research projects, including using wearables to aid communication, making interaction in virtual reality more accessible to people with motor impairments, and automating the large-scale understanding and repair of inaccessible mobile apps, to name a few. CREATE also continues investigating the effects of early childhood mobility aids on brain development. CREATE founders also received four career-level awards: AAAS Fellow (Ladner), ACM Fellow (Wobbrock), ASSETS 10-year lasting impact award (Mankoff), and ACM SIGCHI Social Impact Award (Mankoff).

EDUCATION: CREATE faculty integrated accessibility into several courses, including an introductory bioengineering course and a Master of Human-Computer Interaction + Design course. Six CREATE Ph.D. students completed their dissertations and three accepted faculty positions at major research universities. CREATE supported students through three mini-grants and an accessibility research seminar, which tackled the important topic of mental health and access. CREATE also brought in four new postdocs through a training grant at the intersection of rehabilitation technology, fabrication and accessibility.

TRANSLATION: CREATE projects deployed on a broad scale included Project Sidewalk, which this year launched in Mexico and Amsterdam; the Pointing Magnifier assistive pointing aid, which this year exceeded 100,000 downloads from third-party sites; and Blocks4All, which supported two Hour of Code events. CREATE translation efforts also included an AI4All summer camp, the production of 13 briefs for the Transportation Data Equity Initiative, and five cities adopting AI for Inclusive Urban Sidewalks, funded by Microsoft's AI4Accessibility.

ADVOCACY: CREATE disseminated inclusive practices for hiring, interviewing, and lecturing within the UW. CREATE faculty wrote policy briefs on biometric data fairness and inclusive lessons learned from pandemic remote learning. CREATE launched a support group for disabled faculty and worked to address inequities faced by disabled students on campus, including a coalition letter sent to the UW administration. CREATE presented on how to best serve students with disabilities to faculty from the School of International Studies and three other units and worked at the state level to address insurance gatekeeping for physical therapy, and at the national level to improve ACM SIGCHI conference accessibility.

OPERATIONS: CREATE formalized its membership beyond its 9-member founding group to include 12 additional faculty and 4 postdocs, who are visible on the CREATE website's People Page. CREATE hired Kathleen Quinn Voss in the role of Public Community Engagement and Partnerships Manager and continues to work with Liz Diether-Martin in the role of Web Content Specialist and Editor. CREATE held its second annual Advisory Board meeting in June 2022.

FINANCE: CREATE reached a new funding milestone this year, with $5,539,747 raised in total. Its industrial affiliates program now has three partners: Microsoft, Google, and Meta. CREATE has continued to spend money in the form of director stipends, research disbursements, and grant matching money. CREATE has also supported the expanded staff, postdoctoral training, and mini-grant programs mentioned above.

Research

CREATE IS FIRST AND FOREMOST A CROSS-CAMPUS RESEARCH CENTER bringing together faculty, students, and postdocs, along with industry and community partners, to achieve impact through research and development of accessible technology projects. CREATE has multiple ongoing research projects that primarily focus on community living and participation through increased access to transportation, mobile/wearable apps, and physical devices (and their fabrication). We believe in the right to equal access and participation and its importance at every life stage. Supplementing these themes are projects in a variety of additional areas, including creating accessible VR/AR experiences, creativity tools, and programming tools. Some featured projects are highlighted below.

Featured Project

Captioning as a Group Communication Tool

Real-time captioning is traditionally thought of as a tool for Deaf and Hard of Hearing (DHH) people, but communication is a group activity. In recent work, CREATE students Emma McDonnell, Steven Goodman, and Ping Liu, along with CREATE Associate Directors Leah Findlater and Jon Froehlich instead propose that captioning should be treated as a technology used by all members of a group, DHH and hearing alike.

To understand interpersonal dynamics around captioning use and how to build future captioning tools, the research team conducted a study with 15 DHH participants. Through interviews and design activities, the team learned that captioning use is impacted by a variety of social, environmental, and technical factors. For example, communication accessibility is shaped by how well people know each other; the extent to which everyone, including hearing people, pays attention to caption quality; and whether groups meet online or in person. Their paper outlines possible captioning designs to foster accessible group behaviors, such as feedback to improve turn-taking, moderate speech rate, and pay attention to caption errors. The paper, titled "Social, Environmental, and Technical: Factors at Play in the Current Use and Future Design of Small-Group Captioning," was published at the 2021 conference on Computer Supported Cooperative Work (CSCW '21), where it received a Best Paper Honorable Mention award and a recognition for Diversity and Inclusion.

RESEARCH OUTCOMES 2021–2022

Here is how CREATE fared with respect to its stated goals from last year's 2020-2021 report. Goals met are denoted with a star.

- ✱ **R1:** To continue to publish prolifically at high-visibility venues.
- ☐ **R2:** To have at least 50% of CREATE's publications formally acknowledge CREATE support (18 of 41 published papers acknowledged CREATE, or 44%).
- ☐ **R3:** To launch at least one new "moonshot" research project involving at least two CREATE faculty.
- ✱ **R4:** To welcome at least two new faculty members and/or postdoctoral researchers into CREATE.
- ✱ **R5:** To provide matching money for at least one successfully funded CREATE research project.
- ✱ **R6:** To be highly visible via conference and keynote presentations, awards, press releases, and project videos, all crucial modes of research dissemination.
- ✱ **R7:** To submit a large center grant or similar (e.g., NIDILRR RERC) describing new research projects that would fund CREATE at a significant level.

Featured Collaboration

Mobile Technology and Early Childhood Development

During the past year, CREATE was thrilled to launch our collaboration with I-LABS (Institute for Learning & Brain Sciences). The goal of this project is to merge CREATE's expertise in accessible technology with I-LABS' expertise on early development and brain imaging to support early mobility and participation for children with disabilities. In 2020, the FDA approved the first powered mobility device for young children with disabilities (age 3 years and younger), the Permobil Explorer Mini. While this technology opens new doors for children with disabilities to move and explore their world, we have limited understanding of how young children with disabilities learn to use assistive technology or how early mobility technologies can be optimized to support development and participation. While extensive prior research has investigated how children learn to crawl and walk, we lack fundamental knowledge of how children who use alternative modes of mobility learn to explore and navigate their environments — and how accessible technology can support their play and exploration.

The CREATE + I-LABS team has obtained IRB approval and launched our clinical trial examining early learning, development, and the neuromechanics of self-initiated movement with the Explorer Mini. CREATE postdoctoral fellow Kim Ingraham is leading these experiments, including in-lab quantitative assessments of movement, muscle activity, language, and navigation. This past fall, with an Explorer Mini in tow, the team traveled to Denver to partner with LUCI, a company that makes semi-autonomous wheelchair technology that aids drivers in avoiding obstacles and tipping and drop-off hazards, and provides the user with device performance feedback. Together, LUCI and our team have developed a custom-sensor suite for the Explorer Mini to track joystick motion, bodyweight support, and navigation. Ingraham also developed a virtual reality game platform to quantify and understand joystick interaction and learning for young children with disabilities.

Two mechanical engineering Ph.D. students, Nicole Zaino and Mia Hoffman, both supported by National Science Foundation Graduate Research Fellowships, have also joined the team. Zaino is examining the neuromechanics of seated and standing postures on motor learning with the Explorer Mini. Hoffman is extending these methods to community deployments with the Explorer Mini and affordable GoBabyGo Ride-On Cars, including integrating measures of community environments from Project Sidewalk (led by CREATE Associate Director Jon Froehlich) to understand the impact of environmental barriers and community accessibility on family use patterns with early powered mobility technology. We have also hired an experienced pediatric assessment partner, Anna Fragomeni, PT, PCS, who will lead the pre- and post-intervention developmental assessments to determine how powered mobility learning may influence developmental domains such as gross and fine motor skills, cognition, communication, socio-emotional engagement, and adaptive behaviors. The team is incredibly excited to push this research forward in the coming year. From CREATE, this collaboration is led by Associate Directors Heather Feldner (Rehabilitation Medicine) and Kat Steele (Mechanical Engineering).

A child uses the Permobil Explorer Mini, the first powered mobility device approved by the FDA for young children with disabilities. ***(Photo courtesy of Permobil)***

Featured Project

Understanding Mobile App Accessibility over Time via Large-Scale Analysis

Although mobile applications have become indispensable tools for access and participation across many contexts, application developers frequently fail to implement necessary accessibility standards. Many factors contribute to such failures, but insights from any single application make it difficult to identify opportunities to improve the overall app ecosystem.

In recent work, CREATE students Raymond Fok and Mingyuan Zhong, together with CREATE alum Anne Spencer Ross, CREATE Associate Director James Fogarty, and CREATE Co-Director Jacob Wobbrock, conducted the first large-scale longitudinal analysis of missing label failures in Android applications. The team developed an Android application crawler, then collected a total of 3,775 snapshots from 312 popular applications over the course of 16 months. Prior large-scale analyses have measured the prevalence of specific accessibility failures and identified patterns that suggest contributors to those failures, but this new data collection is unique in enabling examination of the evolution of individual applications to gain new understanding of accessibility failures and to inform opportunities for improving the accessibility of applications.

Initial analysis focused on missing label failures, wherein developer failure to provide a textual label for an image-based element results in an unhelpful description for people using a screen reader (e.g., "Unlabeled, Button"). Large-scale analyses found that 55.6% of unique image-based elements were inaccessible. We also found no support for common assumptions about the accessibility improvements. The overall prevalence of accessibility failures did not significantly improve over our 16 months of data collection, and accessibility failures were not less common in more popular applications. Our dataset also included inaccessible applications developed by even large and mature software organizations. These results highlight the ongoing need for improvements in accessibility-related developer documentation,

Above are two failure plots enabled by our unique longitudinal dataset, each visualizing a 16-month period of missing label failures in applications published by Zillow: a home-buying application (top), and an apartment rental application (bottom). An empty orange square indicates a unique element observed to have a missing label failure, a solid blue circle indicates a unique element observed as labeled, and a black point indicates the element was not observed in that snapshot. The June 2020 snapshot clearly shows repairs to longstanding missing label accessibility failures. The two applications also share four ViewIdResourceName values, suggesting these repairs may have been the result of a systematic accessibility improvement in shared code.

practices, and tools.

Examining the evolution of accessibility in specific applications from this dataset, we also found patterns that suggest such opportunities. Successful examples, such as a June 2020 repair of accessibility issues throughout two Zillow applications, suggest systematic accessibility improvements and even effective re-use of accessibility implementations. More problematic examples reveal incomplete improvements (i.e., developers initiating some accessibility improvements but failing to detect and address other nearby failures), the introduction of new accessibility failures as part of interface redesigns, and accessibility regressions (i.e., introduction of new failures in previously accessible elements), all suggesting opportunities for potential improvements in the ecosystem of apps and their developers.

The paper, titled "A Large-Scale Longitudinal Analysis of Missing Label Accessibility Failures in Android Apps," was published at the 2022 ACM Conference on Human Factors in Computing Systems (CHI 2022), and CREATE looks forward to continuing this line of research.

Featured Supporter

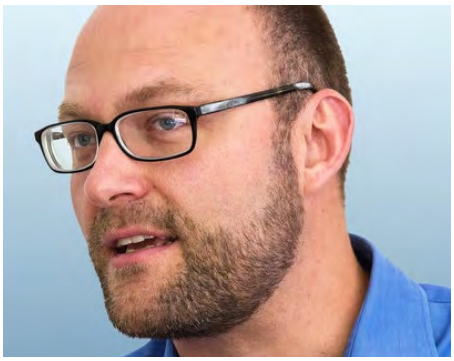
CREATE Supported by Meta to Explore Accessible VR

CREATE is pleased to announce that Meta has become a partner and supporter of the center. Meta is committed to ensuring that the future of human communication and connection is an accessible one. Specifically, Meta has donated a total of $250,000 to support the creation of tools for customizing VR interfaces to the needs of people with disabilities. Hrvoje Benko, Director of Research Science at Meta Reality Labs Research, says, "XR technologies will be the computing platform of the future and this makes it critical that we start working on ensuring that they are accessible to everyone. I hope that CREATE, with its world-class experts in accessibility, can be the vanguard of this important and currently underserved research topic." Dr. Benko has also agreed to serve on the Ph.D. committee of Rachel Franz, an Information School Ph.D. candidate advised by CREATE Co-Director Jacob O. Wobbrock. Franz and Wobbrock are working to improve the accessibility of VR environments for people with motor impairments by building a recommender system capable of matching a user's abilities with the VR interactions best suited to them. Franz's work is also supported by a $75,000 Social Experiences in VR grant from Facebook (now Meta), co-authored with Wobbrock and CREATE Associate Director Leah Findlater.

WHO'S WHO:
DR. NANCY ALAJARMEH FROM JORDAN

Dr. Nancy Alajarmeh and Director for Education Richard Ladner.

Dr. Nancy Alajarmeh joined the University of Washington and CREATE as a visiting scholar and Fulbright Fellow for the academic year 2021-2022. She is an Associate Professor at Tafila Technical University, Jordan. She earned her Ph.D. at New Mexico State University working on non-visual math accessibility. While at the UW, she worked closely with Director for Education Richard Ladner on the accessibility of password managers. The work resulted in two paper submissions, currently under review.


From left: Director for Education Richard Ladner; Co-Director Jacob O. Wobbrock; Co-Director Jennifer Mankoff.

Major Research Awards

CREATE Director for Education Richard Ladner was elected as a 2021 Fellow of the American Association for the Advancement of Science (AAAS). AAAS Fellows are elected based on their contributions to and advancement of science and the scientific community. Ladner was recognized for his career-long advocacy and leadership in advancing science and technology for and by people with disabilities. Ladner joins a class of 564 inductees from around the world, who join a prestigious legacy of inductees dating back to 1874.

CREATE Co-Director Jacob O. Wobbrock was inducted as a 2021 ACM Fellow, which "recognizes the top 1% of ACM Members for their outstanding accomplishments in computing and information technology" (ACM). Wobbrock was inducted, along with 70 others, for his "contributions to human-computer interaction and accessible computing."

CREATE Co-Director Jennifer Mankoff received the SIGACCESS ASSETS Paper Impact Award at ASSETS 2021, the premiere conference on computers and accessibility. This award recognizes one paper every other year that is 10 years old (or older) for its lasting impact. Mankoff's co-authored paper, entitled "Disability studies as a source of critical inquiry for the field of assistive technology," was published in 2010, and ushered in a new awareness of disability studies by computer scientists and designers working in accessibility. Since that time, principles, ideas, and ethics from disability studies have increasingly informed work by researchers in computer accessibility. (As it happens, the 2019 award went to Wobbrock and co-authors, showing CREATE's sustained impact in accessible computing.) Mankoff also received the 2022 ACM SIGCHI Social Impact Award at the flagship conference in human-computer interaction for her contributions to accessibility, mental health, and sustainability, both in research and advocacy. Mankoff's research has included work on accessible interfaces, input, and fabrication; mental health and discrimination; and environmental sustainability. She for 7 years led AccessSIGCHI to make conferences more accessible for people with disabilities. She also did work that led to the creation of an Adjunct Chair for Accessibility at SIGCHI conferences.

RESEARCH GOALS 2022-2023

- **R1:** To continue to produce cutting-edge research discoveries and inventions, leading the accessible technology field in top academic venues like ASSETS, CHI, TACCESS, and similar.
- **R2:** To have at least 50% of the publications authored by CREATE researchers utilize and formally acknowledge CREATE support.
- **R3:** To provide matching money for at least one successfully funded CREATE research project.
- **R4:** To foster research in underserved topics, such as at the intersection of race and disability.

Education

THE CREATE EDUCATION INITIATIVE teaches students about accessibility and supports them in their research and project efforts through mini-grants. It integrates accessibility into the curriculum in multiple departments. In addition, it sponsors lectures and events related to accessibility for students and the general public.

Education Highlight

Integrating Universal Design and Accessibility into an Introductory Bioengineering Course

Alyssa Taylor, Bioengineering, and Han Feng, Human Centered Design & Engineering

Incorporating accessibility concepts into engineering courses is important in order to prepare tomorrow's engineers to take into consideration the needs of a diverse set of users. Many engineering programs do not include these topics in their curricula despite their importance. A recent analysis conducted by Teach Access illustrates this dearth; less than 3% of engineering course descriptions from its member schools referenced "accessibility," "inclusive," "assistive," or "disability" [1]. Our goal is thus to make teaching accessibility topics to undergraduates more manageable by documenting our experience integrating a module on accessibility into an introductory bioengineering course primarily taken by first or second-year students.

We chose a multi-faceted approach that involved: 1) introducing students to Universal Design Principles [2], 2) a panel of students who identify as having disabilities share their experiences and tips regarding accessibility and designing for diverse users, 3) a hands-on activity in which student teams adapted health-care products to be more accessible (e.g., pill splitter and insulin syringe), 4) a week-long individual reflection journal in which students documented experiences or observations with inaccessible products or environments, 5) team-based case analysis of a product, through a lens of inclusivity and how well

EDUCATION OUTCOMES 2021-2022

Here is how CREATE fared with respect to its stated goals from the 2020-2021 report. Goals met are denoted with a star.

- ☐ **E1:** To continue the Student Mini-grant program and award at least four grants of up to $2,000 each.
- ✱ **E2:** To continue the graduate Accessibility Research seminar and tackle topics that address emergent and current issues (such as mental health).
- ✱ **E3:** To co-sponsor DUB seminars by leading accessibility researchers.
- ☐ **E4:** To increase our Ph.D. graduates who focus on accessible technology and disability.
- ✱ **E5:** To have CREATE students participate in the Teach Access Study Away program.
- ✱ **E6:** To continue our series, "Responsible Data Science for Urban Spaces," an accessibility-focused, project-based, multi-quarter course that educates students about bias-free "smart cities" data projects.
- ✱ **E7:** To continue our conversation series, "Reimagining Mobility," featuring local and national leaders in mobility, accessibility, and technology that engages in conversations about mobility as a multifaceted concept, exploring how mobility intersects with other dimensions of access across contexts of research, education, and public policy.
- ✱ **E8:** To make our own campus more accessible, and to share best practices for making educational environments more accessible.

the product addresses Universal Design Principles, and lastly, 6) hands-on remediation of the product analyzed in 5) to make the design more accessible or inclusive, with the ultimate goal of creating a low-fidelity prototype. Students were also introduced to the foundation of usability testing and considerations when designing for accessibility. In the final activity of the module, a design critique session, student teams shared their design ideas and low-fidelity prototype with their peers and received feedback. Teams were required to synthesize the feedback from their peers and propose modifications for their final design concept. After the module, students were assigned a final reflection exercise with the prompt: 1) What did you learn about in this module that resonated most with you? Why? 2) How might any of the topics we discussed in this module apply to your own life and/or future work?

Instructor observation of student engagement during the activities and submitted reflections indicated the students enjoyed the new curriculum and were able to identify how these topics apply to their future lives. Based on student feedback, we recommend instructors offer hands-on activities wherever possible, as this part of our module was popular with the students. Prototyping materials can be inexpensive and incorporate recycled materials, so addition of these activities is more tractable for a wider number of courses. Through written reflections, students reported that the panel was also impactful and engaging and exposed them to new ideas and considerations. We recommend instructors work with partners from their local disability resource office to recruit panelists, and ideally, facilitate the panel itself.

Importantly, student survey data suggest that our novel intervention helped students gain accessibility knowledge and appreciation for considering accessibility topics in engineering design and professional practice. After our intervention, students reported increased confidence in multiple abilities, including being able to: define "accessibility" as the term relates to technology and the media (22% increase), give an example of inclusive or universal design (34% increase), give an example of how accessible technology is used by people with disabilities (34% increase), define the purpose of the Americans with Disabilities Act (51% increase), and explain the Web Content Accessibility Guidelines or other guidelines for accessible design and development (94% increase).

Students from one project group demonstrate their deliverable from the "design for accessibility with universal design" in-class physical prototyping activity.

Instructors of junior level bioengineering courses are excited to build on this foundation to address accessibility of their design and laboratory courses. Based on student data indicating a strong interest in fostering their sense of professional responsibility to participate in inclusive design in their future career (average rating of 4.4/5.0), and the 46% increase after the module in the reported confidence in being able to consider accessibility and universal design during the design process, our efforts had a beneficial impact in helping prepare our students to contribute to accessibility when they enter the workforce.

[1] Teach Access Institutions course list (coded), 2018. Accessed, Jan. 9, 2019.

[2] The Center for Universal Design (1997, April). The Principles of Universal Design, Version 2.0, Raleigh, NC: North Carolina State University.

Supporting Accessibility Education in 2021-2022

The second year of the CREATE Student Mini-grant program supported three student-led research projects:

- "UnlockedMaps: Mapping Real-Time Accessibility of Urban Rail Transit," led by Ather Sharif, a Ph.D. student in the Allen School. A paper was submitted to a conference based on this research.
- "Flipping the Script: Designing Systems to Support Blind Audio Description Scriptwriters," led by Lucy Jiang, an undergraduate student in the Allen School. This research appears in Jiang's senior thesis and was presented at the UW Undergraduate Research Symposium. It will also be a poster presentation at ASSETS 2022.
- "Understanding User Preferences for a Robot Feeding System," led by Amal Nanavati, a Ph.D. student in the Allen School. This research is underway.

One CREATE student mini-grant from last year led by Ana Liu, a master's student in HCDE, led to the publication of a paper titled " 'In this online environment, we're limited': Exploring Inclusive Video Conferencing Design for Signers" at the 2022 CHI Conference.

CREATE Seminar: Held fall, winter, and spring, led by graduate students Kelly Mack and Venkatesh Potluri with support from Kat Steele. Attendance included five students per quarter plus faculty and postdocs. In fall quarter, the seminar attendees read Margaret Price's book "MAD at School: Rhetorics of Mental Disability and Academic Life," which explored the state of academia from the perspective of a faculty member with a mental disability. In winter quarter, there was a series of talks by students, postdocs, and visitors on their own accessibility research. In spring quarter, there was a series of presentations on recent accessibility papers of interest.

Three external accessibility researchers were sponsored by CREATE in weekly DUB Seminars. Kathryn Ringland from the University of California, Santa Cruz, spoke about her research on including autistic youth in playful kinds of social media. Elaine Short from Tufts University spoke about her research on robots that can adaptively help people with disabilities in their day-to-day lives. Marcelo Worsley from Northwestern University spoke about his research on motivating K-8 students from minoritized groups to learn computer science.

NEW EDUCATION PARTNER: HuskyADAPT

HuskyADAPT (for Accessible Design And Play Technology) is a registered student organization at the University of Washington with the mission to foster an inclusive, sustainable, and multidisciplinary community supporting accessible design and play technology. This includes adapting toys for users with diverse needs, designing solutions to accessibility challenges, and engaging with the community. Starting on June 1, 2022, HuskyADAPT will be officially sponsored by CREATE, which will provide a stable source of funding for three years, renewable, to support HuskyADAPT's activities, including workshops and hackathons. CREATE faculty members Kat Steele and Anat Caspi serve on the Board of Advisors for HuskyADAPT.

For the third year, UW students participated in the Teach Access Study Away program, an opportunity for students around the nation to learn about accessibility and to network with people in higher education, industry, and advocacy organizations. Students who complete the program have exclusive access to participate in a Teach Access Career Fair in fall 2022 hosted by some of Teach Access's partner companies. This year, six UW students attended the online program, with two writing a paper about the experience for academic credit.

Thirty-six master's students in the MHCI+D program participated in the Immersion Studio, a week-long design sprint on urban accessibility. The students worked in teams of four to rethink and redesign how interactive maps and tools can support people with disabilities in navigating, exploring, and understanding cities. They followed key steps in the human-centered design process, including: performing user and background research; analyzing data; prototyping the most promising solutions; and iterating based on critique and lightweight user study methods. The program also

included guest speakers and panelists who are experts in accessibility and urban design.

Approximately 50 researchers in urban studies, geography, computer science, public health, and disability studies attended a workshop at the Spatial Data Science Symposium led by Jon Froehlich and titled "The Future of Global-Scale Spatial Data Collection and Analysis on Urban (in)Accessibility for People with Disabilities." The purpose was to reposition urban accessibility as a first-class concern and to discuss data collection techniques, data standards, and visual analytic tools focused on the quality and accessibility of pathways, transit ecosystems, and buildings.

CREATE Ph.D. Graduates

Six CREATE Ph.D. students completed their dissertations and are moving into their careers. They are:

Qisheng Li, advised by CREATE faculty member Katharina Reinecke, completed a dissertation titled "Conducting Online Studies With People With Disabilities." Qisheng will join the Apple Accessibility Research team later this year. Personal web page: https://homes.cs.washington.edu/~liqs/

Momona Yamagami, co-advised by CREATE faculty members Kat Steele and Sam Burden, completed a dissertation titled "Modeling and Enhancing Human-Machine Interaction for Accessibility and Health." She has accepted a faculty position at Rice University in Electrical Engineering. Before starting at Rice next academic year, she will be a CREATE postdoctoral fellow working with Jen Mankoff on a Meta-supported project, Frameworks for diverse EMG gesture recognition. Personal web page: https://momona-yamagami.github.io/

Mingrui Ray Zhang, advised by Jacob O. Wobbrock, completed a dissertation titled, "Towards More Humanlike Communication with Computers." He will join Meta in Fall 2022 in New York City. Personal web page: https://drustz.com/

Megan Hofmann, advised by Jen Mankoff, completed a dissertation titled "Optimizing Medical Making: Applications of generative design for fabrication in healthcare settings." She will be starting at Northeastern as an Assistant Professor next year. Personal web page: https://dfab.uw.edu/portfolio/megan-hofmann

Dhruv Jain, co-advised by Jon Froehlich and Leah Findlater, completed a dissertation titled "Sound Sensing and Feedback Techniques for Deaf and Hard and Hearing People." He is considering faculty position offers from several universities. Personal web page: https://homes.cs.washington.edu/~djain/

Manaswi Saha, advised by Jon Froehlich, completed a dissertation titled "Designing Interactive Data-driven Tools for Understanding Urban Accessibility at Scale." She will join Accenture Labs' Digital Experiences Team as an Associate Principal Researcher in September. Personal web page: https://homes.cs.washington.edu/~manaswi/

EDUCATION GOALS 2022-2023

- **E1:** Continue the Student Mini-Grant program and award at least four grants of up to $2,000 each.
- **E2:** Continue the graduate-level CREATE seminar.
- **E3:** Co-sponsor at least three DUB seminars by leading accessibility researchers.
- **E4:** Continue to produce Ph.D. graduates who focus on accessible technology and disability.
- **E5:** Have CREATE students participate in the Teach Access Study Away program.
- **E6:** Develop a plan to include new accessibility-related courses in the UW curriculum.
- **E7:** Continue to support student groups such as HuskyAdapt and Ability.
- **E8:** Make our own campus more accessible, and share best practices for making educational environments more accessible.
- **E9:** Start working toward the creation of an accessibility education certificate.
- **E10:** Cultivate a new education director to take over in 2023-2024.

Translation

CREATE'S TRANSLATION PLAN HAS TWO MAJOR GOALS.

1. **Promote a Continuum of Innovation** by encouraging researchers to think about and actively engage in pathways for their research to become sustainably deployed even before the research is performed.
2. **Establish appropriate (and cooperative) relationships** between researchers and communities that understand unmet accessibility needs and can provide guidance and direction on how to apply our innovations in real world settings.

Year 2 impact

Our Continuum of Innovation impact this year included two Hours of Code released via Blocks4All, an inclusive and accessible engagement for students with coding and robotics; Anat Caspi and group offered the second instance of AI4ALL, an accessibility focused summer camp for students from underrepresented groups in Computer Science that teaches about Artificial Intelligence and Machine Learning with a focus on the intersection of AI and Ableism. The 2021 summer cohort included a 38% representation of students with disabilities. The Taskar Center for Accessible Technology produced a "Performance Measurement Framework Guidance," published and accepted by the Federal Highway Administration, featuring methods and a pipeline for appropriate evaluations of transit projects addressing the needs of people with disabilities. Amsterdam launched the Amsterdam for All project together with World Enabled, featuring work by CREATE Associate Director Jon Froehlich's Project Sidewalk. The Taskar Center for Accessible Technology produced 13 translation briefs and deployment plans publishing the development of the Transportation Data Equity Initiative in the next 3 years, sponsored by the USDOT JPO. The cities of Los Angeles, CA; Quito, Ecuador; Valparaiso, Chile; Santiago, Chile; Sao Paulo, Brazil launched the AI for Inclusive Urban Sidewalks teams, through a partnership between the Taskar Center's OpenSidewalks and the Global Initiative for Inclusive Information and Communication Technologies, funded by Microsoft's AI4Accessibility.

In Community partnerships, our impact included hiring a public community engagement and

TRANSLATION OUTCOMES 2021–2022

Here is how CREATE fared with respect to its stated goals from the 2020–2021 report. Goals met are denoted with a star.

- ✱ **T1:** To enhance awareness of CREATE to organizations potentially interested in working or partnering with us.
- ✱ **T2:** To enhance awareness of community-related events to CREATE faculty, enabling faculty to build relationships with potential partners.
- ✱ **T3:** To move at least one product into public deployment and to identify at least two candidates for the same within the next 12 months.
- ✱ **T4:** To engage stakeholders and partners to gain input about opportunities to improve measures and preparedness efforts to reduce disparities experienced by people with disabilities during pandemics and other natural disasters.
- ☐ **T5:** To engage six local and global disability advocacy organizations in a joint effort committed to advancing promising disability inclusion policy and practices globally.
- ☐ **T6:** To forge a connection between CREATE and CoMotion, the University of Washington's technology transfer and intellectual property office, fostering mutual awareness.

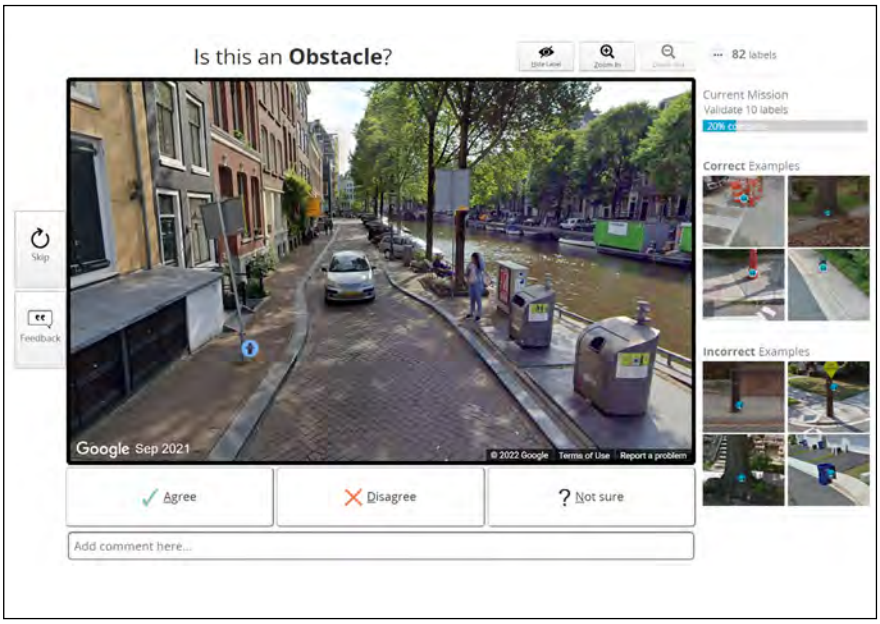
partnerships manager, formulating unified understanding and goals around community engagement and partnerships, establishing processes for engagement and management of community partners, improving consistency in communication across our different compositional labs, allowing for more meaningful outreach through segmentation and increased community control over contact preferences, improving quality of outreach communications via segmentation and engagement foci, creating new partnership collateral tailored to increase awareness among organizations, and increasing social media presence to improve visibility and establish connections.

We organized and participated in community events this past year that ran a wide gamut. We offered mentorship for students from underrepresented groups in Computer Science to learn about accessibility in AR/VR through work at the UW Reality Lab; we were involved in virtual toy hackathons; and we took part in multiple mapping challenges for accessibility in the built environment, featuring work by both the Makeability Lab and the Taskar Center for Accessible Technology.

Featured Project

Project Sidewalk in Mexico and the Netherlands

For individuals with a mobility disability, sidewalks play a crucial role in independence, quality of life, and overall physical activity. However, unlike their road counterparts, there is a lack of high-quality sidewalk datasets and fast, inexpensive, and reliable sidewalk assessment techniques. This limits how sidewalks and sidewalk accessibility can be studied in cities.



Screenshot of the Project Sidewalk user interface in Amsterdam.

In our work, we are exploring a twofold vision: first, to develop reliable, inexpensive, and fast hybrid human+machine learning techniques capable of mapping and assessing every sidewalk in the world — an ambitious goal that we have been working on since 2013 — and second, to leverage this data to enable new pedestrian-oriented mapping tools, to support advocacy and government accountability, and to enable new urban analytics pursuits not previously possible.

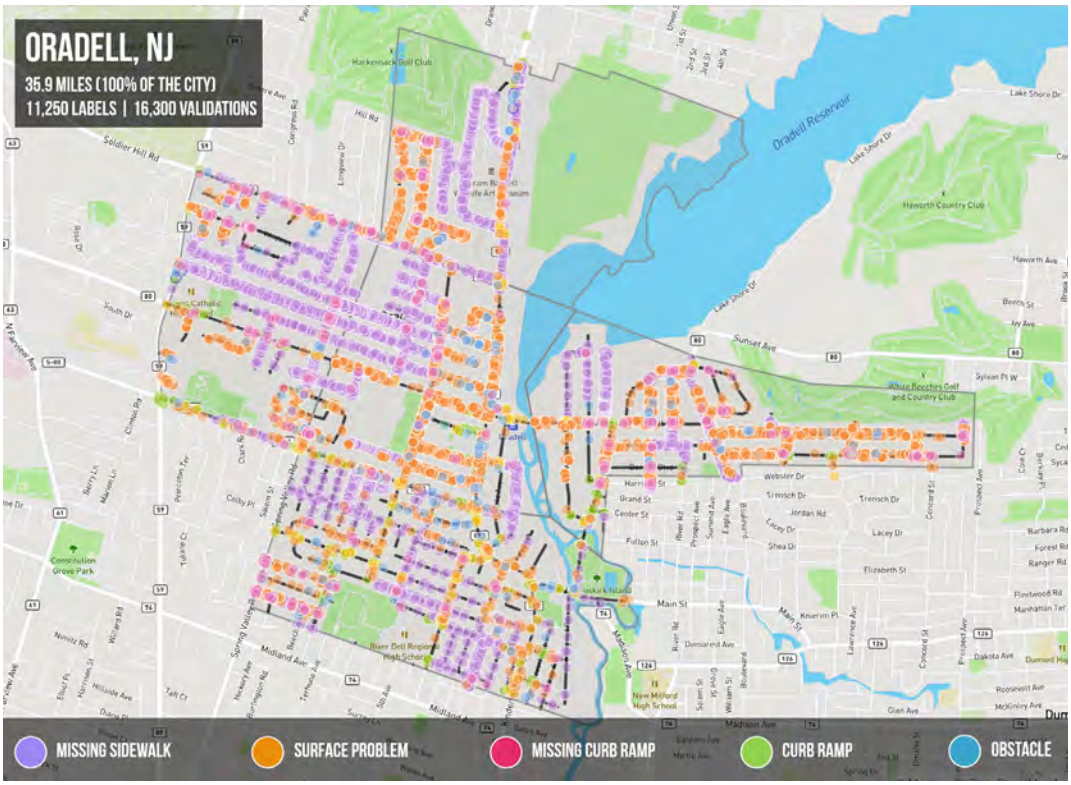
Our latest tool, called Project Sidewalk, uses a combination of remote crowdsourcing, machine learning, and online map imagery to map and assess sidewalk accessibility. With Project Sidewalk, online users remotely label sidewalks and identify accessibility problems by virtually walking through city streets — similar to a first-person, immersive video game. For each label, users provide a severity score and mark relevant tags, and they can also supply open-ended descriptions. Labels are used to create new urban accessibility visualizations, to inform government policy and funding decisions, and to train deep learning networks to assess sidewalks automatically — further scaling our approach. In a 2018 pilot deployment, 1,400 users from across the world virtually audited 2,934-plus kilometers of Washington, D.C., streets, providing 255,000 sidewalk accessibility labels with 92% accuracy.

With support from CREATE, the Pacific NW

Transportation Consortium, UW's Global Innovation Fund, and a newly awarded NSF grant, we have now launched Project Sidewalk in 10 cities, including two in Mexico and one in the Netherlands. These international deployments are the result of close partnerships with NGOs and local governments. In Mexico, we work closely with a pedestrian advocacy organization called Liga Peatonal and in Amsterdam, we collaborate directly with the city government and WorldEnabled.org. Across our 10 deployment sites, our users have contributed over 700,000 geo-located sidewalk accessibility labels. To our knowledge, this is the largest open sidewalk accessibility dataset ever collected.

Our work is making real-world impact. In Newberg, Oregon, we collected 17,386 sidewalk accessibility labels from 300 users. This data was used to successfully advocate for and establish two new sidewalk repair programs by the Newberg City Council and the immediate authorization of $50k for repairs on city property. Similarly, in Mexico, we are working directly with the San Pedro government to improve pedestrian infrastructure and support conversation and awareness about urban accessibility. The San Pedro government said: "Project Sidewalk provides us with data that is essential to improving San Pedro's urban accessibility. With Project Sidewalk, we know the main problems to be solved, how many problems there are, and their location... The results will be used to inform a new Pedestrian Master Plan for our municipality."

Most recently, we have worked with Girl Scouts in New Jersey to deploy in a local community and examine Project Sidewalk as a service-learning vehicle for youth to learn about urban design, equitability, and disability. The girls are not only learning about how to map and assess sidewalk conditions but also plan to present their analyses and findings to the Oradell City Council. On April 28, 2022, the local Oradell City Hall hosted an in-person mapathon, which resulted in mapping over 50% of Oradell, New Jersey, city streets for sidewalks and sidewalk conditions. This work is in collaboration with the Oradell Girl Scouts, the Bergen County Community Council of the National MS Society, and the Hackensack Meridian School of Medicine.



In Oradell, New Jersey, we are working with the Girl Scouts and local organizations to map and assess sidewalk accessibility as a service-learning project. The girls and other community members completed 20 miles of virtual assessments, labeling over 4,604 sidewalk accessibility problems during a mapathon in April and have continued working since then. The figure at left shows color-coded circles of found problems—most commonly, surface problems (orange) and missing sidewalks (purple).

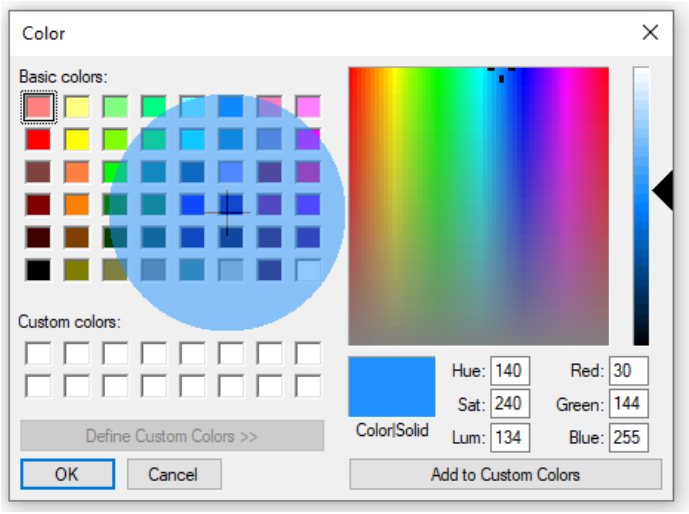
Featured Project

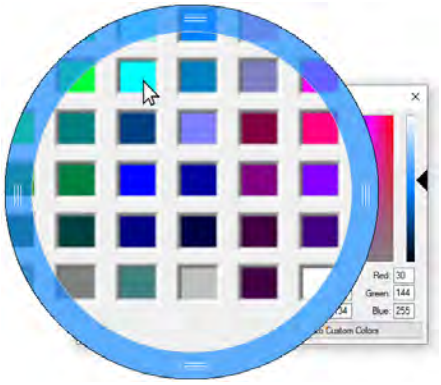
Pointing Magnifier 3

Ever have trouble pointing at those small, pesky targets on your computer screen? Whether it is the tiny close box ("x") in the top-right corner of certain small windows, or the 1-pixel-wide border around sticky notes in Microsoft Outlook, or the small down-arrow beside certain toolbar buttons, our computer user interfaces are full of tiny targets. For people with motor impairments (and everyone, really!), these tiny targets represent a barrier to successfully accessing desktop and laptop computer systems.

The Pointing Magnifier, version 3, is a replacement for the conventional mouse cursor that changes the pointer from the arrow we love to hate to a semi-transparent circle known as an "area cursor." Based on our research published initially in 2010 on enhanced area cursors, the Pointing Magnifier is a product-grade utility that anyone with a Microsoft Windows computer can download, install, and use for free. When the user places the configurable circular area cursor over their desired target — which is much easier to do because of the circle's larger size — a click magnifies everything under the circle as if in a lens. The user then clicks, double-clicks, right-clicks, or drags on whatever (much larger) target they wish within the lens.

The Pointing Magnifier has been featured on many third-party freeware sites, including MajorGeeks.com, UpToDown.com, and OlderGeeks.com. We estimate that it has been downloaded over 100,000 times. Some graphic designers have expressed that besides being useful to people with motor impairments, the Pointing Magnifier helps them achieve pixel-perfect designs when used alongside their favorite digital design tools, like Adobe Photoshop.





The Pointing Magnifier used to magnify a section of a color selection menu. The user places the circular area cursor over their desired target (above) and the area is magnified (left).

TRANSLATION GOALS 2022–2023

- **T1:** Create an engaged Community of Practice, with quarterly meetings, whereby students in accessibility present their research and the community discusses potential translation, deployment, and sustainability goals for those projects.
- **T2:** Create an engaged Community of Practice around accessibility in makerspaces.
- **T3:** Bring at least one CREATE technology in a deployable state to the awareness of at least one community partner, company, or other organization that might have interest.
- **T4:** Continue developing community and corporate partnerships, bringing in at least two of the former and one of the latter by year's end.
- **T5:** Forge a connection between CREATE and CoMotion, the University of Washington's technology transfer and intellectual property office, fostering mutual awareness.

Advocacy

CREATE'S ADVISORY BOARD ASKED US TO CONSIDER how we might contribute to policy in Washington state and beyond. Our approach has been driven by direct need combined with existing efforts, starting with cleaning our own house, so to speak, and extending that more broadly to our academic communities, along with a few broader efforts.

This year for advocacy, we have:

- **Developed more inclusive practices for hiring, interviewing, and delivering lectures.** These are documented, and have been disseminated informally to the Allen School and to the Information School. CREATE faculty have also been asked to consult on inclusive interviewing. The top three accessibility candidates on the job market this year were all people with disabilities (and all affiliated with CREATE faculty in various ways). Two of them, along with an Education faculty member, were interviewed at the UW in various departments this year, and CREATE provided consulting advice on how to make sure their interviews and/or the recruiting process were addressing accessibility needs appropriately.
- **Written several pieces that are primarily advocacy-oriented.** This includes an RFI on biometric data fairness from an accessibility perspective and an "Expanding the Pipeline" article for the CRA's Computing Research News newsletter, which included both an overview and advice on how to keep the most inclusive lessons from pandemic remote learning as we move forward into back-to-work/etc. scenarios. The latter has been published in TACCESS and presented in an AccessComputing partner meeting as well.
- **Been involved in disability-facing groups.** CREATE student Kelly Mack has become a member of the student disability commission, working to improve UW policies around disability. Her research agenda also focuses on these topics. CREATE is also organizing and helping to sponsor a faculty support and advocacy group for disabled faculty around campus.
- **Conducted advocacy/education on the UW campus around the needs of disabled students.** CREATE led the writing of, and co-signed, a letter to UW administration supporting student efforts to increase funding and responsiveness of the Disability Resources for Students office. CREATE faculty Mankoff and Wobbrock have developed multiple iterations of a slide deck educating faculty about how to serve students with disabilities. This has been presented at faculty meetings in the Paul G. Allen School of Computer Science and Engineering, the Henry M. Jackson School of International Studies, and the Electrical and Computer Engineering department. We are scheduled to present in the Biological Physics, Structure & Design department. CREATE student Kelly Mack and others in the Disability Studies Commission also developed a student-facing presentation that focuses on students' rights, and recourses if students are not accommodated.
- **Finally, CREATE faculty helped to advocate for improved policies at the state level and nationally.** At the state level, we worked to improve physical therapy access for state employees on the Regence insurance plan. This advocacy included work with the state Health Authority and UW HR, in response to a plan change that required pre-approval for more than 6 PT appointments. This plan change was "unrolled" shortly afterwards. Nationally, we supported the AccessSIGCHI community's efforts to increase accessibility of SIGCHI supported conferences and services, one of several things leading to Mankoff's social impact award.

ADVOCACY GOALS 2022–2023

- **A1:** Increase the number of CREATE faculty engaged with advocacy work (currently it has been primarily one person, with help from a second).
- **A2:** Increase the number of CREATE students engaged with advocacy work (currently this is primarily one Ph.D. student).
- **A3:** Develop more CREATE-led initiatives, as opposed to relying on the uncoordinated efforts of separate individuals.

Operations

AS A FACULTY-DRIVEN, VOLUNTEER-RUN ORGANIZATION, CREATE strives to operate efficiently and effectively given significant constraints on faculty time. In its second year of operation, CREATE continued to develop and refine its operations and internal processes, prioritizing impact and minimizing bureaucracy. CREATE leadership remained the same as in Year 1, with nine faculty co-founders working together, Mankoff and Wobbrock as center Co-Directors, Ladner as Director for Education, and Caspi as Director for Translation. CREATE also successfully hired a part-time staff member in charge of community partnerships.

Who's Who

Meet Kathleen Quin Voss

Kathleen joined CREATE as its first Public Community Engagement and Partnerships Manager in January 2022. She comes to CREATE following an extensive career in private practice as a music therapist with a focus on early childhood and developmental disabilities. Prompted by a desire for growth, she graduated with a master's degree in Educational and Social Research from the UCL Institute of Education, University of London in 2019. During the early days of COVID-19, her search for ways to help led her to the American Red Cross and a leadership role in the Community Engagement and Partnerships team, where she discovered a passion for making a difference by making connections. Kathleen views her work at CREATE as an amazing opportunity to bring together her skills and experiences, both new and old, to help CREATE grow and flourish.

Meet Sasha Portnova, CREATE ARRT Postdoc

CREATE welcomes Sasha Portnova, Ph.D., the first of its Advanced Rehabilitation Research Training Postdoctoral Fellows, to the UW in summer 2022. Sasha is a Dawg at heart, having received her undergraduate degree in Mechanical Engineering from the UW prior to pursuing her master's degree and Ph.D. in Mechanical Engineering from Northwestern University. Sasha's doctoral research has focused on investigating the application of machine learning techniques in the development of controllers for upper-limb myoelectric prostheses. She also has extensive fabrication experience, building physical interfaces such as 3D-printed open-source orthoses, myoelectric prostheses with printed circuit boards, and custom calibration devices for force sensors in gloves. Sasha says,

OPERATIONS OUTCOMES 2021–2022

Here is how CREATE fared with respect to its stated goals from the 2020-2021 report. Goals met are denoted with a star.

- ✱ **O1:** To revamp and revise the CREATE website to better showcase CREATE work, community, and people.
- ✱ **O2:** To formalize operational definitions of CREATE membership ranks and the visibility of CREATE members on the website.
- ✱ **O3:** To hold at least one productive advisory board meeting, in person if possible.
- ✱ **O4:** To hire a staff member for building and managing community partnerships.

"Joining the CREATE program through this unique fellowship is the perfect opportunity for me to continue acquiring the skills necessary to conduct user-centered need-based research that I intend to continue in my post-graduation years. I am also excited about the opportunity to help grow CREATE's impact in the industry and community by integrating my skill sets."

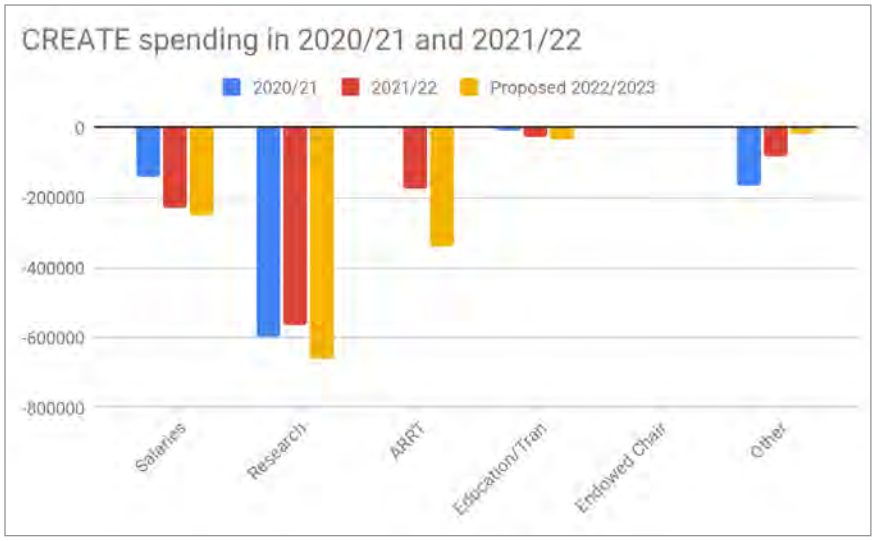
Meet Liz Diether-Martin

Liz joined CREATE to launch the website along with the center's big launch in 2020. Previously the lead of digital content for the UW College of Engineering, she has worked as a technical writer, graphical user interface designer, usability tester, and freelance web specialist. At the College of Engineering, Safeco Insurance, and Active Voice Corporation, she was an evangelist for usability and accessibility, developing training programs to help content and interface developers plan for usability and accessibility from the start. Liz is happy to support and showcase the work of CREATE's leaders in accessibility through the website and CREATE Digest newsletters. She also finds time to discover Central Oregon's best hiking, biking and skiing.

OPERATIONS GOALS 2022-2023

- **O1:** Hiring a **Director of Center Operations** who takes substantial responsibility for running the center and its logistics, freeing faculty to focus on strategic initiatives.
- **O2:** Clarifying the roles and responsibilities of CREATE Associate Directors to better distribute the work of the Center across its faculty and staff.
- **O3:** Revising how CREATE disburses its funds to personnel and events to better accomplish its mission.
- **O4:** Hold our annual advisory board meeting and expand our touchpoints with advisory board members throughout the year.

Finance



Finance Outcomes 2021-2022

CREATE reached a new funding milestone this year, with a total of $5,539,747.10 raised ($75,000 from our industrial affiliates program, and approximately $1 million from NIDILIRR's ARRT program to fund our postdoc trainees). While we are not yet at our original goal of $10,000,000 (see goal F1 below), we see this as excellent progress and are continuing to pursue opportunities to reach that goal this year. Our industrial affiliates program now has three partners: Microsoft, Google and Meta (see goal F2 below), and we are seeking additional partners. Finally, we have continued to disburse research money in the form of director stipends and matching money.

Further, our successful ARRT proposal is beginning to positively impact the spending associated with CREATE. In combination with the I-LABS money, this will help to bring four new postdocs to CREATE's ranks: Kim Ingraham, Sasha Portnova, Momona Yamagami, and Maitrayee Das.

Here is how CREATE fared with respect to its stated goals from the 2020-2021 report. Goals met are denoted with a star.

☐ **F1:** To reach the $10 million fundraising goal established at CREATE's launch.

✱ **F2:** To enroll at least one new industry partner in our paid partners program.

✱ **F3:** To fund seed grants, director stipends, and student mini-grants at least at the same levels as in our first year.

FINANCE GOALS 2022-2023

- **F1:** To increase CREATE's longitudinal sustainability by:
  1) Adding to our portfolio of large government-funded efforts.
  2) Creating an endowed fund that can encourage participation in academia by people with disabilities.
- **F2:** To reach closure on fundraising from Microsoft, our flagship founding partner, so as to secure their naming rights for the center.
- **F3:** To expand the industry affiliates program to include smaller and disability-led companies as well as more major tech leaders in accessibility.
- **F4:** To increase the percentage of money that is given out in response to matching money requests.
- **F5:** To start having targeted seed grant opportunities to encourage specific types of work (such as work at the intersection of race and disability).
- **F6:** To extend CREATE's viability horizon out to seven years instead of our original planned five years.