OFFICE OF RESEARCH

IMPACT

REPORT WINTER 2019

GAME CHANGERS

Academic all-stars
deliver real-world results

University of
CINCINNATI

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Photo credit: Luke Kindle (left); John(na) Jackson (right)

AMPLIFYING COMMUNITY VOICES

In Cincinnati, as in the rest of the United States, women of color stand on the front lines of critical social justice movements. Still, few occupy positions of power in politics or business in the city. For example, of nine Cincinnati City Council members, only two are women and only one is a woman of color.

Despite many signs of growth in our vibrant region, women of color continue to encounter more poverty and more health challenges than their peers. Community-partnered research coordinated by the College of Arts & Sciences' The Cincinnati Project culminated in an exhibition, website, audio archive and book series highlighting these too-often overlooked voices, and their stories.

"What Is and What Can Be: Women of Color and the Struggle for Justice in Cincinnati" illustrates not only the power of their shared stories, but also the impact of sustained, cross-disciplinary collaboration.

Developed with support from grants from local foundations, the project centered around the experiences, visions and voices of women of color in Cincinnati, specifically addressing five questions: What is home? What is community? What is ours? What is fair? What is action? It also prompts visitors to leave comments and stories responding to the question: What is next?

The exhibition, which returns to the Clifton campus this spring, features:

- a limited edition set of nine books with profiles of seven local activists from that Archiving Activism Project of **J.T. Roane**, PhD, assistant professor of Women's, Gender and Sexuality Studies, and **Anjali Dutt**, PhD, assistant professor of Psychology
- a version of an academic study about the impact of violence on black women's sexual health in Cincinnati by **Carolette Norwood**, PhD, associate professor of Women's, Gender and Sexuality Studies
- a study of evictions in the city from a class led by Sociology graduate student **Elaina Johns-Wolfe**.

"By offering this exhibit to the public, and inviting them to add their own stories, we want to promote important scholarly and community work, while providing pathways for progress in policies that perpetuate inequality and inequity," says sociocultural anthropologist **Stephanie Sadre-Orafai**, PhD, who edited the books and co-curated and co-designed the exhibition. An associate professor of anthropology, Sadre-Orafai also co-directs the Critical Visions certificate with collaborators in the College of Design, Architecture, Art & Planning.

"Together, we can increase the impact of our work not only in the academy, but in the community as well," she says.

WELCOME

Welcome to the Office of Research IMPACT Report, in which I am proud to highlight the research across our University of Cincinnati campuses.
At UC, our researchers regularly provide global leadership to address complex challenges, from saving lives through high-tech uses of artificial intelligence to community-engaged collaborations that will build more equitable and sustainable futures.

As we kick off UC's Bicentennial in 2019, our forward-looking investments in faculty and facilities continue to infuse our region with innovation and impact. In a city that's home to nine Fortune 500 companies and 300 foreign-owned firms, we are well-positioned to connect the world of academic discoveries with real-world applications.

In this report, you will read about far-reaching partnerships and powerful collaborations involving our faculty and students who are focused on making a difference in the world. They understand, and we champion, the importance of research across disciplines and connecting colleagues with disparate skill sets to solve today's wicked problems.

In the Office of Research, we not only celebrate our institutional successes, we train, support and encourage our faculty, staff and students to embrace the core values of **Next Lives Here:** innovation, inclusion, and impact. You will see those values reflected in this report and in the tireless efforts of our researchers to expand the minds of their colleagues and students as they pursue their own work.

As an urban public research institution, we also take our responsibility to serve our community, both local and global, seriously. We proudly celebrate how the research and creative activities happening at UC make a difference in Cincinnati and the world.

Patrick Limbach, PhD
Vice President for Research
Ohio Eminent Scholar
Professor of Chemistry

About the Cover:
Reneé Seward, associate professor of graphic communication design in the College of Design, Architecture, Art & Planning, brings real-world learning and research into her classrooms every day. Her focus on using her design skills to increase literacy for people of all backgrounds and abilities has led her to research collaborations with with educators, therapists and doctors. Read more about her word-changing work in our IMPACT cover story, starting on page 6.
PHOTO Andrew Higley/UC Creative Services

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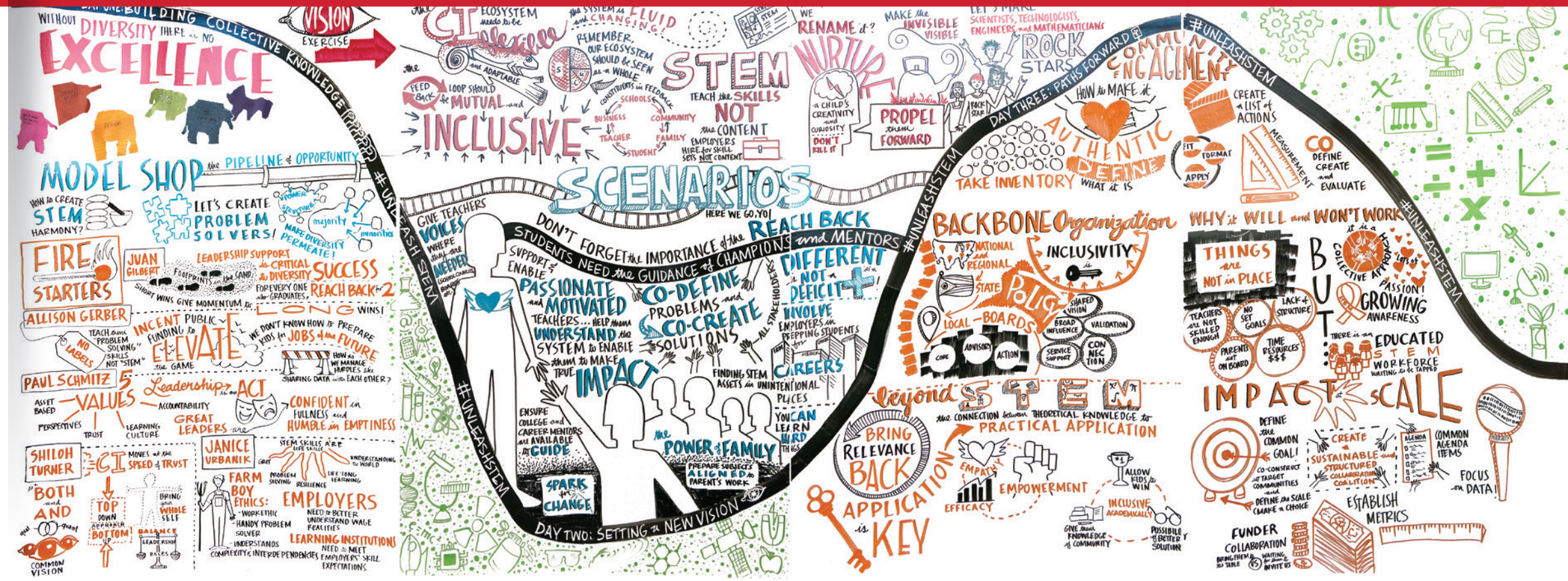
Kathie Maynard, EdD, Associate Dean of Innovations and Community Partnerships



FULL STEAM AHEAD

In sessions organized by Maynard, community leaders and university researchers work together to create new ways to solve complicated community problems that have global impacts.

Kathie Maynard's distinctive title says a lot about the kind of research that has won her hundreds of thousands of dollars of funding from the National Science Foundation. As Associate Dean of Innovations and Community Partnerships in the College of Education, Criminal Justice and Human Services (CECH), Maynard, EdD, leads two regional initiatives focused on reinvigorating STEM education in systemic and sustainable ways.

By approaching STEM education innovation through both community and university initiatives, Maynard has helped build a regional force that includes academic as well as community partners. Their goal? Increasing representation in STEM through innovative and wide-ranging efforts that value context experts (community members) on the same level as content experts (academics).

That expansive work garnered support in the form of a highly competitive NSF INCLUDES grant (Inclusion across the Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science), and Maynard takes INCLUDES literally. So far, she has convened two local and one national **Next Lives Here Social Change Innovation Summits**, with another national summit scheduled for spring 2019.

At the first Next Lives Here Social Change Innovation conference in 2017, Maynard invited national experts from the Annie E. Casey Foundation, the Aspen Institute, and the University of Florida, as well as local leaders from the United Way, Partners for a Competitive Workforce, the Cincinnati Museum Center and Cincinnati Public Schools and departments throughout the University of Cincinnati.

"The Next Lives Here: Social Change Innovation Summit was a collective impact effort from its inception, to design, to implementation," she says. "Nine different partners with over 10 years of experience in collective impact came together to create a conference that actively immersed a cross-sector group in the real work of what it takes to listen, understand, dream, argue and create a different outcome for our kids and our community."

"Through these conferences, we are bringing together the best of the best in collective impact; both locally and nationally," says Maynard. As she works to advance and share community-engaged education and assessment in the STEM fields (Science, Technology, Engineering and Math), she incorporates the power of the Arts (turning STEM into STEAM) to construct new ways of working and understanding across divides.

But the conferences are just the beginning. "We are capturing the ideas, insights and learnings of the convening in a myriad of ways to be shared across the nation and leveraging the networks created during the conference to continue the shared learning and work," she says. "The critical work to be accomplished in order to increase representation in STEM is to move from pipelines to the creation of robust pathways that truly support our nation's children."

173
PARTICIPANTS

75
TOPICS

24
SESSIONS

87
SPEAKERS

RESEARCH + INNOVATION WEEK = SUCCESS

Research with impact infused conversations across campuses during UC's first-ever **Research + Innovation Week** last spring. With two dozen sessions covering 75 topics and nearly 200 participants, the multi-disciplinary events brought together established researchers, experts, students and passionate inventors eager to share ideas and connect.

The theme of the week, produced by the Office of Research, was in keeping with both the university's **Next Lives Here** strategic direction and the United Nations' sustainable development goals. Sessions focused on innovation, industry and infrastructure as ways to enhance quality of life, locally and globally. Thought leaders from across the region shared insights on water quality and purification technologies as well as how to enhance trust and respect in research practices and policies.

"Bringing together researchers, regional and national thought leaders, inventors, entrepreneurs and students allowed us to explore new opportunities for collaborations while sharing exciting and inspiring work happening at the University of Cincinnati," says **Jennifer Krivickas**, Assistant Vice President for Integrated Research and lead organizer for the week. "By all accounts, it was a big success."

She notes that R+I Week also offered opportunities to celebrate faculty excellence, research mentorship and stewardship of research core values through an awards ceremony sponsored by the Office of Research.

Highlights included:

- An acute care research symposium highlighted by multimillion-dollar grant awardees sharing expertise and inspiration
- The UC Innovation Quest Elevator Pitch Competition, where inventors and entrepreneurs pitched their ideas to potential investors
- Sessions focused on practical applications of leveraging technology for inclusive, safe, resilient and sustainable communities.

This year's Research + Innovation Week is scheduled for April 1–6, 2019.

Research + Innovation Week's UC Innovation Quest Elevator Pitch Competition brought inspired inventors together with expert judges.

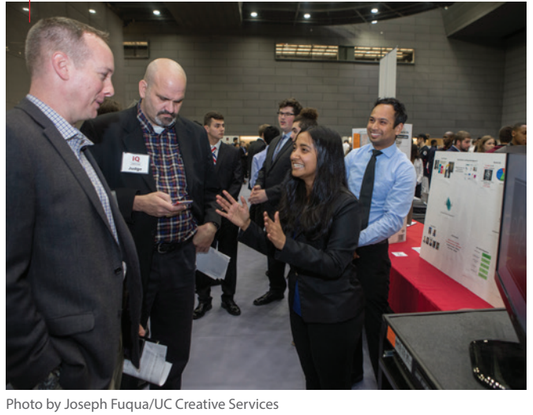


Photo by Joseph Fuqua/UC Creative Services

WATER WORKS

When leaders at the World Bank and the Army Corps of Engineers need advice on the climate change risks facing their water resources investments, they turn to **Patrick Ray,** PhD, assistant professor of environmental and chemical engineering in the College of Engineering and Applied Sciences (CEAS).

That's because Ray, with Casey Brown at the University of Massachusetts, Amherst, literally wrote the book on high-impact, cost-effective water resource management for the World Bank. "**Confronting Climate Uncertainty in Water Resources Project Planning and Design"** has since become the go-to guide thanks to a decision tree framework—outlined in the book—that provides a roadmap for reducing the vulnerability of water projects to change.

The process takes into account data about all kinds of risks to water supplies and water systems, including human activity and changes in geology and climate. It then offers an array of solutions based on project goals and likely risks. Ray's approach, which he began piecing together when he worked as a consultant to the World Bank, earned him a share of the entity's 2015 Knowbel Prize for "Understanding the Impact of Climate Change and Other Risks on Hydropower."

"My strength is translation," says Ray, who started his undergraduate career as a poetry major after studying drama in high school. He specializes in working across disciplines, making engineering processes clear to economists and policymakers.

He sums up the key to that complicated work in one word: empathy. "You have to understand what people care about, and, more than that, you have to internalize it and really care about that yourself," says the 2018 A. Ivan Johnson Outstanding Young Professional of the American Water Resources Association.

With more than $1 million in grants and awards to support his academic work—including awards from the National Science Foundation, the World Bank, the Army Corps of Engineers, the University Center for Atmospheric Research and the California Department of Water Resources—Ray is a sought-after manager for climate risk assessments around the globe. He has worked on water projects in Mexico, East Africa, South Asia and the Middle East as well as in the United States, and relishes offering his graduate students opportunities to gain hands-on experience in global water projects.

"This is a new moment in water management," he says. "The work we are doing is high-impact, and I can say that we are really making a difference in the world."

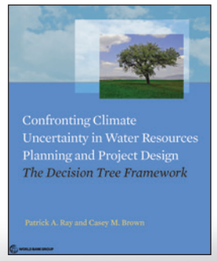


Photo by Andrew Higley/UC Creative Services

WORDS' WORTH

Communication Design professor takes graphic approach to solve systemic problems

When **Reneé Seward** faces a challenge, she finds inspiration—and solutions—in design.

"I am a curious person, and when I see problems I want to solve them," says the Cincinnati native and graduate of Winton Woods High School.

The associate professor of graphic communication design learned about the career that has become her profession by solving a common teenage challenge. When her mother insisted she find a summer job and offered up fast-food work as an option, Seward took a different route. Though she was only 15 years old, she talked her way into a summer program for minority students then hosted by the College of Design, Architecture, Art & Planning, and landed a design internship with the City of Cincinnati.

At her paid job with the city, she helped design a logo and signage for the "Queen City Tour." The experience, which also included weekly trips to UC's Clifton campus, redirected her life's trajectory.

"That's when I knew I wanted to be a graphic designer," she says.

Seward enrolled in and graduated from DAAP, then pursued graduate studies at North Carolina State University, where she encountered her next career-defining challenge. When she heard a friend's young son, who is dyslexic, describe his difficulty with reading as a problem with how the letters looked on the page, she had an idea. What if, she thought, she could use communication design strategies to help with more than just his reading skills?

In search of answers, she spent time listening and learning at a private school for students with dyslexia and attention deficit and hyperactivity disorder (ADHD). Within that controlled, lab-like environment, she had room to experiment. "I just started making things and getting feedback," she says. She watched teachers' multisensory approaches and learned students' strengths as well as challenges. She saw techniques that worked well in the small, private setting, then determined to design a solution that could work on a larger scale to improve the lives of students who faced similar challenges but did not have private-school resources.

She decided to create a multisensory approach to reading that would work inside a digital space—to put hands-on learning inside a screen—a concept she imagined and designed in the pre-iPad age. Seward explains: "I hypothesized on the way touchscreen technology would impact education and reading."

> Even though I started my research around dyslexia, it is now broadened to anybody who is an early reader."

After graduate school, Seward was offered a job at her undergraduate alma mater. She moved back to Cincinnati, bringing along her research into designing for literacy. Her focus expanded as she combined forces with **Allison Breit-Smith**, PhD, an associate professor in the College of Education, Criminal Justice and Human Services (CECH), as well as Educational Pyschologist **Beth O'Brien**, PhD, and **Ben Meyer**, an interactive design specialist. "Even though I started my research around dyslexia, it is now broadened to anybody who is an early reader," Seward says.

Her CECH colleagues encouraged Seward to reach out to local schools, where, with educational researchers' support, she found partners eager to put her ideas into action. She has a soft spot for Mt. Washington Elementary School, where she has been beta-testing her literacy technology designs in after-school programs since 2011.

"Their partnership with See Word Reading has been important in the journey as we worked together to help kids read better," she says. She is quick to point out that her "ride or die" school welcomed her even before she had a full working tool to test.

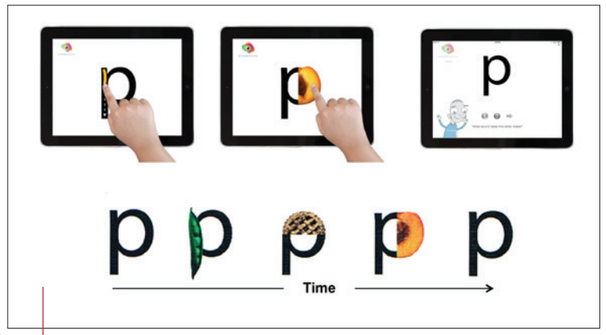
"What was great is that I could get the kids' feedback," she says. "I went to every session, along with the educators from CECH, and we would observe. Then I would go back with the programmer and we would redo some things, then bring it back to the next session. It was a totally collaborative experience with the kids there and the designers and the educators working towards making something that would fit like a glove for the kids as well as for the teachers."

CECH researchers embraced Seward's transdisciplinary approach. "They were like co-designers with me," Seward says. "It was fun for us because, as we were understanding how to collaborate with each other, we also hired students from speech pathology [in the College of Allied Health Sciences] to be our teachers while we were the observers."

What Seward envisioned in North Carolina as observational research evolved into a real-world product in Cincinnati—and that product needed a name. While the eponymous "See Word Reading" may seem like it was the inevitable choice, Seward notes with a laugh that it was suggested by a friend.

Today, See Word Reading includes a suite of research-based literacy apps for iPads, including interactive tracing and spelling activities as well as engaging stories. There are both teacher and parent versions available online, both of which are targeted to preschool, Kindergarten and other early readers. "The integrity of what we built is based on educational research," says Seward, who points to promising early research results.

Cincinnati students who have used See Word Reading increased their abilities to recognize and work with sounds, what educators call "phonological awareness"—an essential building block for reading. In addition, they improved in their spelling and their writing.



Seward's See Word Reading app provides early readers with clear and relatable pronunciation cues.

Photo by Jay Yocis/UC Creative Services

> "The integrity of what we built is based on educational research."

Early successes have already earned Seward praise as a "rising tech star" and attracted investment interest. So far, See Word Reading has won the 2015 Cincinnati Innovates competition, a University of Cincinnati Venture Lab Grant and an Excellence in Academics Award from the Ohio Department of Education.

Even as she continues to build, refine and plan for the future of See Word Reading, Seward remains focused on finding new ways to use her design skills to improve communication and understanding. In fall 2018, she presented preliminary designs for two new, interactive font technologies to rave reviews at an international typography conference in Portland, Oregon. "There are more products coming that expand the opportunity to help anyone with literacy and even learning a new language using font technologies," she says.

As she heads into a new year, Seward, who teaches undergraduate courses and serves as the program coordinator for DAAP's Graphic Communication Design program, is adding yet another systemic design challenge to her agenda.

She's part of a new, multi-million dollar research grant from the National Institutes of Health awarded to primary investigators in the College of Allied Heath Sciences and the College of Arts & Sciences. The project turns ultrasound-powered speech therapy into a game for young patients with speech disorders. Long-time speech disorders' investigator **Susanne Boyce**, PhD, recruited Seward to help design the new device and interface for the high-tech therapy tool after learning about her cross-disciplinary successes.

As the sole designer on a team of rehabilitation specialists and medical staff, Seward brings a distinct perspective to the project, which was awarded NIH funding on its first attempt—a rare accomplishment and a testament to the strength of both the team and its novel approach.

For Seward, the new project brings new opportunities to use her design skills to make a positive impact both on and off campus, including the students and colleagues she inspires along the way.

> I worked with an anthropologist to understand how to motivate people to be creative, to think differently and to appreciate the importance of emotional intelligence."

READY FOR LAUNCH

Kelly Cohen uses data, AI to power smart interventions

Today, Aerospace and Mechanical Engineering Professor, interim Department Head and Brian H. Rowe Endowed Chair **Kelly Cohen,** PhD, manages multiple high-profile research projects amounting to millions of dollars. From novel unmanned aerial systems (UAS) technology to new concussion diagnosis protocols, the award-winning professor's research takes him across UC campuses and around the world.

Just 12 years ago, Cohen was a 45-year-old retiree who had never held an academic post, much less taught a class. He joined the College of Engineering and Applied Science as an untenured associate professor after a successful career working on Unmanned Aerial Systems (UAS), more commonly known as drones, in Israel and later with the United States Air Force Academy exploring the multi-disciplinary interactions between fluids and controls. He had led research teams initiating and implementing technological road-maps. Moreover, he's had a boundless curiosity that inspired him to, among other accomplishments, complete his advanced degrees while working full-time as an engineer.

"All of my graduate studies came purely because I wanted to develop and grow, while working as an aeronautical engineer," says Cohen, whose drive to improve the way the world works has led to groundbreaking research as well as a new generation of transdisciplinary thinkers, learners and doers.

From his first days on the Clifton campus, Cohen realized his diverse background with government and industry gave him advantages in the classroom and beyond. "I learned the importance of teamwork and inspiring people," he says of his pre-UC life. "I worked with an anthropologist to understand how to motivate people to be creative, to think differently and to appreciate the importance of emotional intelligence."

Some of his background was procedural—he ran meetings and built successful collaborations. But it is his energy and positive focus on possibilities that sparks students' passions. "I try to connect what we study with the real world," he says. "I give open-ended, research-oriented problems. There is no one right solution. That has worked well."

"There is something in the way he explains that makes you pursue the most challenging ambitions you have," says **Javier Viaña**, who is pursuing his Master's in Aerospace and Mechanical Engineering. Cohen is his advisor as well as professor. "All his inspirational lectures have a great and positive effect on everybody."

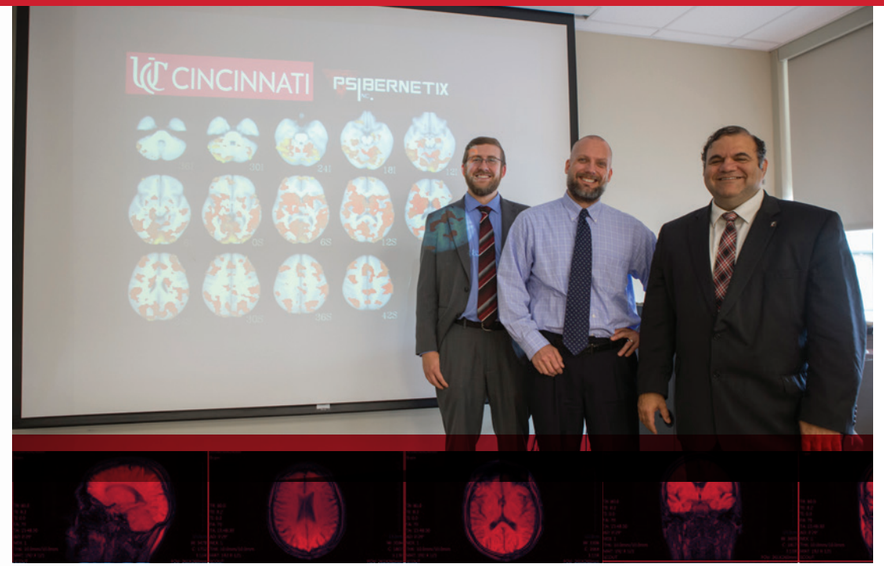
Within two years of starting at UC, Cohen was racking up teaching awards and guiding his students in research projects—many of which focus on some of his favorite topics, like computational intelligence, UAS and "fuzzy logic," an approach that mimics how the human brain operates: it utilizes linguistic decision-making developed, using Darwin's principle of survival of the fittest, by incorporating large stores of data, which can achieve accurate and computationally efficient predictive models.

His projects with his collaborators at UC and excellent team of staff and students have resulted in millions of dollars in research funding, both internal and external, $6 million within the last few years alone thanks to his work with collaborators on novel UAS/AI applications.

Once he attained full professor status in 2014, he sought an exceptionally unusual sabbatical appointment for a CEAS professor: He asked to be assigned to the UC College of Medicine.

While on the sabbatical, Cohen explored ways to use the fuzzy logic he'd employed with UAVs

> "In these applications, we can exploit the information to its utmost and bring about a positive impact on society."



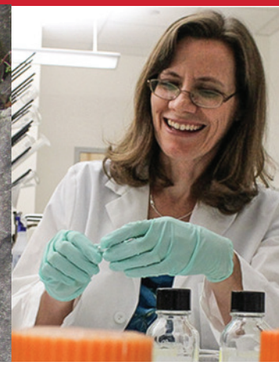
to improve patient outcomes. First he targeted bi-polar disorder, in part because of the large data sets already collected by researchers in UC College of Medicine Department of Psychiatry, specifically **David Fleck**, PhD, and **Caleb Adler**, MD in the Center for Imaging Research. Cohen learned that while some patients respond well to treatment with lithium, others may experience serious side effects. With help from Fleck and Adler, Cohen gathered enough data to be able to use Artificial Intelligence (AI) to determine which patients should not, and which patients should, receive the drug based on fuzzy logic predictions. In a proof of concept study with **Nicholas Ernest**, PhD, one of Cohen's doctoral students and founder of the AI start-up Psibernetix, the AI system was 100 percent accurate about which patients would respond to lithium and therefore should be prescribed it, while accurately identifying patients who might develop side-effects and should not be treated with the drug.

After the success of that initial work with the College of Medicine, Cohen turned his efforts to additional diagnostic applications of fuzzy logic. In another collaboration with Ernest, Cohen is partnering with his post-doc, **Anoop Sathyan**, PhD, and **Adam Kiefer**, PhD, and his team from Cincinnati Children's Hospital Medical Center to predict concussion recovery rates by crunching a wide range of data points, collected in an augmented reality environment, from young athletes.

The results of Cohen's research continue to show remarkable promise across an increasingly broad-based set of problems, fueling his ever-evolving thoughts on improving systems—and lives—leveraging the power of AI.

"Kelly Cohen's work will have a positive impact because he cares about solving the most urgent global problems that are large in scale, solvable and neglected," says Jennifer Krivickas, Assistant Vice President of Integrated Research. "Kelly understands the importance of professional flexibility and has the ability to pivot as he considers new multi-disciplinary frameworks through which to approach problem-solving."

For his part, Cohen plans to continue extending the reach of his AI research. "I'm not restricting myself to medicine," he says. "I plan on broadening my fuzzy AI to a wider range of applications including agriculture, aero-mechanical component design, space exploration, skin care products, ship collision avoidance and sports education. In these applications, we can exploit the information to its utmost and bring about a positive impact on society. That is what I want to do."



SEEDING THE FUTURE

On craggy cliffs and steep hillsides in Hawaii, endangered plant species have found a precarious refuge from extinction. **Theresa Culley**, PhD, Professor of Biological Sciences, aims not only to protect them, but also to expand their footprint into new hospitable environments.

Working with rare Hawaiian plants has inspired Culley, who serves as head of the largest department in the University of Cincinnati's largest college—the College of Arts and Sciences—since her undergraduate days at the University of California at Irvine. Colonization wiped out most of Hawaii's native plant species, she explains, with survivors taking root where sugar cane farmers and their animals dared not tread. Keeping them alive not only supports the ecosystems of their pollinators, it also helps preserve the culture of native Hawaiians whose traditions and ceremonies often included colorful native plants.

"Lyon Arboretum (on O'ahu) has been collecting samples of these critically endangered species before they go extinct with the idea of reintroducing them into the wild," says Culley. "The challenge with these particular plant species is that you can't just grab their seeds like you would with any other. These are called exceptional plant species and they cannot be conserved using conventional seed banking mechanisms."

Enter the wonder of cryopreservation, or storing tissue at low temperatures to keep it revivable. The Center for Conservation and Research of Endangered Wildlife (CREW) at the Cincinnati Zoo & Botanical Garden specializes in the unconventional method. CREW's CryoBioBank stores thousands of plant seeds and tissues as a way of protecting gene diversity—think of it as a kind of genetic insurance.

Thanks to a new federal grant obtained by the Zoo from the Institute of Museum and Library Services, Culley and students in her lab will build on a partnership with CREW's Valerie Pence and experts at the Lyon Arboretum. Culley will also be reunited with one of her former students—Megan Philpott, a recent UC PhD who conducted research in Hawaii as an undergraduate and now works with CREW.

The UC team will use samples from the Lyon Arboretum and work with island botanists to locate and collect samples of species so rare there may be fewer than 20 in existence. Pence and her team at the Cincinnati Zoo can then propagate samples in test tubes and provide Culley's team a safe supply for genetic testing. Genetic information they document then becomes essential pieces of the conservation puzzle.

"We are using genetics to analyze the plants to try to figure out what the Lyon Arboretum has saved, how many samples they have and are those samples related to each other," says Culley, who notes that closely related plants produce weaker offspring. "That helps us understand what's the best combination of plants to actually put back out into the wild."

For Culley, the rewards of the complicated conservation process are both exciting and important. First, she gets to expose her students—both undergraduate and graduate—to the kind of scientific work that inspired her career. Beyond that, she says, the work they are doing has a lasting global impact.

"You are on the front line helping to save a species from extinction," she says.

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UC RESEARCH AT A GLANCE

FY 2018

TOP 20
U.S. public institutions among World's Most Innovative Universities
Reuters 2018

$7.5M
in industry-sponsored research

#32
patent ranking in the U.S. among urban universities
The Brookings Institution

877
Sponsored awards

#35
in research volume among U.S. public universities
National Science Foundation

$424M
Sponsored award funding to UC & affiliates