USC Viterbi
SPRING 2020

On August 21, 2019, USC Viterbi reached a historic milestone:

HALF OF ITS ENTERING CLASS WERE WOMEN

A LOOK AT THE FEMALE FACULTY, ALUMNI AND STUDENTS WHO BROUGHT US HERE

EQ-ING THE BRAIN

Sparked by Her DJ Experience, **Jenny Treweek** Works to Reverse-Engineer Depression, PTSD, and Drug Addiction.

By Daniel Druhora

Jenny Treweek's life as a DJ seemed fantastic. By day, she was a graduate student under a fume hood, examining brain tissue suspended in test tubes and modeling how drug addiction changes the brain. At night, she cracked her knuckles and took her post behind a motherboard of buttons that sent trance-inducing beats straight into temporal lobes while confetti rained down, dancers leaped to the ceiling and lasers shot across the dance floor. If it felt like a fantasy, it's because it was one.

"I just remember being freaked out seeing people addicted to drugs in that scene, overdosing," she said, recalling a brilliant M.D.-Ph.D. student she worked with dying from a methamphetamine overdose. It made her wonder: "How could smart, fully functioning people fall into the trap of becoming addicted to drugs? What is it that takes over?"

To find out, Treweek, the WiSE Gabilan Assistant Professor of Biomedical Engineering, will soon move to her new home in the USC Michelson Center for Convergent Bioscience, one of the few facilities in the world dedicated to the convergence of engineering, physical and life sciences.

Treweek personifies convergence. She combines her background in chemistry, economics, systems neuroscience, optogenetics—a technique that uses light to control cells in living tissue—biomedical engineering and even music to examine the physiological function of stress-related neuropeptide circuits involved in drug addiction, depression and PTSD.

"I'm not just interested in novel drug therapies but in identifying maladaptive circuit behaviors in the brain, and then envisioning new technologies that could modify the signaling patterns that give rise to symptoms," she said.

Scientists have long known that music reduces stress, pain and symptoms of depression. It improves cognitive and motor skills, spatial-temporal learning and neurogenesis – the brain's ability to produce neurons. But the same music that stimulates some people to dance may move others to tears, depending on how the human body's greatest DJ—our brain—EQs molecular level neural processes.

One major group of neurons that Treweek has studied for years is corticotropin-releasing factor (CRF) neurons.

"Think of them as the mastermind ensemble cells responsible for the body's stress response," she said. As it turns out, CRF neurons also play a major role in drug and alcohol addiction, PTSD and depression.

Treweek believes that if she can model CRFs' signaling patterns in the brain, she could give doctors the ability to switch those signals off and on. Using minimally invasive technology, such as lasers, doctors would be able to temporarily turn off a specific group of brain cells, such as CRFs, to reverse drug-seeking behavior and even reduce the physical symptoms of withdrawal.

Another of her lab's missions is developing the chemistry for tissue engineering, or better ways to image tissue and obtain deeper molecular information on brain tissue.

"Normally when you image tissue, you get only one form of information—the protein content, RNA or single targets," Treweek said. "I want more multidimensional information."

She wants to see the protein, the transcriptional profile, as well as the connectome: a comprehensive map of specific neural connections that reflect a particular disease state. She is also partnering with researchers at USC Keck and USC Pharmacy to design wireless wearable devices that will provide unprecedented insight into how PTSD and sleep disorders form in the human brain.

"From this understanding, we will be able to see how we can modulate these circuits to slowly pull people out of addiction and disease symptom by symptom," she said.

> "How could smart, fully functioning people fall into the trap of becoming addicted to drugs? What is it that takes over?

Jenny Treweek is using the power of convergent bioscience to gain new insights into the brain's neurons that play a major role in drug and alcohol addiction, PTSD and depression.

PHOTO: CHRISTINA BOEMIO

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COVER ILLUSTRATION: KAT GOODLOE

CAROL FOLT, USC's 12th President, Wants to Leverage the Power of STEM

SHE AIMS TO FOSTER INTERDISCIPLINARY RESEARCH AMONG ENGINEERS, SCIENTISTS AND OTHERS TO ADDRESS SOCIETY'S MAJOR CHALLENGES.

By Marc Ballon

USC President Carol Folt (second from left) with USC Viterbi Professor Andrea Armani and her students.

USC President Carol L. Folt believes in the power of STEM (Science, Technology, Engineering and Math) to improve society in myriad ways.

That's why she wasted no time in connecting with USC Viterbi researchers and students when she became USC's president in July 2019.

Within her first few weeks, for example, she visited the labs of faculty members Andrea Armani, the Ray Irani Chair in Chemical Engineering and Materials Science, and Eun Ji Chung, a biomedical engineer and the USC Viterbi School of Engineering's Dr. Karl Jacob Jr. and Karl Jacob III Early Career Chair. Consistent with Folt's strong belief in the value of research to improve society, she asked the faculty members about their work projects, many of which could potentially advance medical research and care.

She also peppered Armani's and Chung's students with questions, curious to learn what the labs' undergraduates and graduate students cared about. Armani, who helped invent a portable optical diagnostics system that can perform rapid malaria screenings in low-resource environments in only 10 minutes, is a World Economic Forum Young Global Leader; Chung was recently named a Biomedical Engineering Society Rising Star in Cellular Molecular Bioengineering.

In the many months since, Folt has underscored the importance of opening access to a college education to more students. That came to fruition in February, when Folt announced several moves to make a USC education more affordable, including expanding financial aid so that undergraduate students from families earning $80,000 or less a year can attend the university tuition-free.

An ecologist by training, Folt—who serves as a professor of preventive medicine, biological sciences, and civil and environmental engineering—has long demonstrated a commitment to interdisciplinary collaboration to solve society's major challenges.

In Folt's vision, Trojan engineers, scientists and others would continue to work together to find ways to improve the air, slow climate change and make cities more livable. She hopes to lower barriers among researchers of different disciplines to facilitate the free flow of ideas to spark innovation. One example of this spirit of collaboration is the USC Michelson Center for Convergent Bioscience, which she has said "really epitomizes USC's interdisciplinary work."

"USC is a world-class global research university, and I am deeply grateful to the USC community and its leaders for giving me the privilege of serving as its president."

Folt has called furthering sustainability a top priority. Among her goals is taking effective action to lower the carbon, water and waste footprints of the USC campuses and the L.A. region. Her values parallel those of USC Viterbi Dean Yannis C. Yortsos, who has long believed that engineers have a moral imperative to improve the environment, among other ambitious tasks.

She has also signaled strong support for women and underrepresented minorities at USC and beyond. Underscoring her commitment to diversity, she met with members of Women in Science and Engineering within her first week of arriving at USC. She has long been an advocate for growing inclusion within STEM fields.

While serving as chancellor at the University of North Carolina at Chapel Hill—her previous leadership post—the diversity of students grew significantly. About 20 percent of UNC-Chapel Hill students were in the first generation of their family to attend college. The university also attracted its most academically accomplished classes ever.

"Carol Folt's entire career, as both a faculty member and leader, embodies a commitment to all aspects of academic excellence while always putting people first," said Yaniv Bar-Cohen, past president of the USC Academic Senate and professor of clinical pediatrics and medicine at the Keck School of Medicine of USC, after the announcement of her presidency last year.

Folt is optimistic about USC's future. "USC is a world-class global research university, and I am deeply grateful to the USC community and its leaders for giving me the privilege of serving as its president," said Folt when the USC Board of Trustees announced her selection as president in March 2019. "The opportunities and potential I see ahead for USC are extraordinary."

Alicia Di Rado, USC University Communications' editorial director, contributed to this story.

PHOTO: GUS RUELAS

ACHIEVING GENDER PARITY

As recently as 20 years ago, there were just three tenured women faculty in engineering here at USC, and the entering undergraduate class was barely 10 percent female. It wasn't just at USC; this trend was global and persistent.

Today, thanks to the accelerating changes around us and relentless efforts to change the conversation about engineering, the picture has changed dramatically. In fall 2019, USC Viterbi, for the first time in its history, achieved gender parity in its entering class, and exactly 50 percent of the incoming first-year students were women. This has continued a systematic, ascending trend over the last several years that is changing the face of engineering at USC. USC Viterbi has the largest number of women engineering graduate students in the nation. And all our students today, regardless of gender, benefit from the exceptional teaching and research of our faculty, which now includes 37 women on the tenured or tenure-track levels—a more than 10-fold increase in just two decades.

There are many reasons for this dramatic and exhilarating turn, but none greater than the changing nature of engineering and technology—and the shift in the conversation about it. But I would be remiss if I did not mention the fundamental support to our mission during the last 20 years of the USC WiSE program (Women in Science and Engineering). Established by an anonymous gift, WiSE has provided support for all our efforts to attract, nurture and grow extraordinary engineering talent. Consider: In the last 12 years, 12 USC Viterbi faculty have earned the TR 35 distinction (a list of the world's leading innovators under the age of 35, named by the *MIT Technology Review*). Eight of these USC Viterbi faculty are women. And in the last two years, two of our graduate students, also women, were named to this very selective list. WiSE has been a strong partner that has helped create a thriving ecosystem that has culminated in this and myriad other successes.

At USC Viterbi, we have also advocated for some time now the concept of Engineering+, namely that engineering today empowers all disciplines, from medicine to communications to education to the arts. We have been positioning engineering as the quintessential foundation for everything related to Maslow's hierarchy of needs (for individuals, the society or the planet), whether in sustainability, health, security or simply the joy of life. And yes, engineers are essential contributors to the joy of life! This is dramatically changing the conversation about engineering.

We also stress the importance of developing the mindsets—along with knowledge and skills, of course—that underlie the need for constant innovation and renewal. And we understand that the extraordinary power of technology can have immense beneficial impacts on society. This change in the conversation is articulated in all our engineering education and research, in all our programs (from the Society of Women Engineers, or SWE, to AthenaHacks) and in all our outreach, including our thriving K-12 program. It is for these reasons that USC Viterbi has increasingly attracted extraordinary talent, from all parts of the country and around the world: diverse, bright, representative of the whole society and responding with imagination to its needs.

To celebrate these wonderful milestones, this issue of USC Viterbi magazine is dedicated to all Viterbi women and to their achievements in moving engineering education, research, impact and innovation to their next chapters. That could be through inspiring stories—such as Randi Burley's journey to engineering education or Penelope Hocking's pursuit of PAC-12 soccer honors while a student in computer science—through extraordinary research accomplishments and distinctions, or through university leadership, including the USC presidencies of Wanda Austin and Carol Folt.

Yannis C. Yortsos,
Dean USC Viterbi School of Engineering

General (Ret.) Ellen M. Pawlikowski named Judge Widney Professor at USC

Pawlikowski, nationally recognized as a leader in science and engineering, joined the USC Viterbi School of Engineering faculty in fall 2019.

By USC Viterbi Staff

This fall, General (Ret.) Ellen M. Pawlikowski became a Judge Widney Professor at the University of Southern California (USC). The title is named for one of USC's founders, Judge Robert Maclay Widney, and reserved at USC for eminent individuals from the arts, sciences, professions, business, and community and national leadership.

Pawlikowski, who is currently a member of the Raytheon Company Board of Directors, served for over 40 years in the military, reaching the rank of four-star general, only the third woman to achieve the highest rank in the Air Force.

She has a bachelor of science degree in chemical engineering from the New Jersey Institute of Technology, and a Ph.D. in chemical engineering from the University of California, Berkeley. General Pawlikowski's career has spanned a wide variety of technical management and leadership positions. In her last assignment, she served as the Commander of Air Force Materiel Command at the Wright-Patterson Air Force Base. General Pawlikowski oversaw all Air Force technology development, aircraft systems and sustainment, and installation management, leading 80,000 people with an annual budget of $60 billion. She is nationally recognized for her leadership in the science and engineering community, is a member of the National Academy of Engineers and an Honorary Fellow of the American Institute of Aeronautics and Astronautics.

"General Pawlikowski is an extraordinary person who has dedicated her life to serving her country. Her contributions in science and engineering are equally impressive," said USC President Carol L. Folt. "I am excited about the role she will play in the formation of the next generation of military leaders by engaging with USC's ROTC programs, and share her experiences with our student veterans as they transition to civilian leadership roles."

At the USC Viterbi School of Engineering, she co-teaches a Systems Architecting and Engineering (SAE) course with Professor Azad Madni, with a specific emphasis on systems architecting case studies.

"We are delighted to welcome General Ellen Pawlikowski to our faculty," said Yannis C. Yortsos, dean of the USC Viterbi School of Engineering. "Her expertise in complex systems and in the architecting of new processes will be of invaluable help to our educational and research endeavors. Her remarkable accomplishments make her an outstanding role model for all our students."

General Pawlikowski said of her appointment: "I am delighted and honored to join the Trojans! I look forward to sharing my experiences with the students in Viterbi School and help prepare them to face the complex technical and engineering challenges of today's hyper-connected world. I also appreciate USC's long-standing commitment to student veterans and the ROTC programs and I'm looking forward to engaging with those students in the fall. "

Added Madni, the Systems and Architecting Engineering program director: "The SAE program prides itself in bridging systems theory and practice. Gen. Ellen Pawlikowski's background and experience will be invaluable in bringing real world case studies into the classroom."

USC VITERBI ACHIEVES GENDER PARITY IN ITS ENTERING CLASS

Women now comprise 50% of the entering undergraduate class, a historic record for USC Engineering.

By Marc Ballon

As a high school student, Siena Applebaum toured some of California's finest engineering schools. She felt underwhelmed, finding some of them filled with narrowly focused students, while others lacked diversity.

So when Applebaum received acceptance letters from several top-flight universities, including UC Berkeley, UCLA and USC, she knew exactly where she wanted to go: Troy.

"At USC Viterbi, we can become multifaceted people and have non-engineering minors such as dance, work in research labs, and even start companies," said Applebaum, now a senior majoring in mechanical engineering. "We're helping to shatter stereotypes of engineers as one-dimensional, which I think is really appealing to women."

Applebaum has taken advantage of her time at USC. She has interned at Microsoft Corporation, Honeywell and Apple Inc.; served as a USC Viterbi Ambassador; worked in Professor Paul Ronney's lab; traveled to Lesvos, Greece, as part of a five-member student team that built a low-cost shower system to help refugees; and represented the United States as part of Marlink—an all-female team of USC Viterbi undergraduates that is developing underwater wireless communication technology—at the Global Grand Challenges Summit student competition finals in London.

USC Viterbi's welcoming environment, emphasis on hands-on education inside and outside the classroom and commitment to "changing the conversation about engineering, what engineering is, who we are and what engineers look like," in the words of Dean Yannis C. Yortsos, has led to increasing gender parity at the school. Women now comprise 50% of the first-year undergraduate class at USC Viterbi, a school record.

At the graduate level, the school has almost 2,000 women in its master's and doctoral programs, among the most in the nation.

"As a creative and innovative discipline, with substantial societal impact, engineering benefits tremendously from the rich diversity and multitude of views, mindsets and novel approaches brought to the field by the increasingly diverse student body," Yortsos said. "This is worth cherishing and celebrating."

USC Viterbi's welcoming environment, emphasis on hands-on education inside and outside the classroom and commitment to "changing the conversation" about engineering has led to increasing gender parity at the school.

USC Viterbi's progress toward greater gender diversity received a major boost in 2000, when an anonymous donor gave the university $20 million, a gift that led to the creation of the Women in Science and Engineering (WiSE) program. Additionally, the Norris Foundation has supported the Viterbi Women in Engineering program each year since 2008.

Under Yortsos' leadership, the school has become an international leader in championing the Grand Challenges, the 14 most pressing global problems identified by the National Academy of Engineering—ranging from cleaner water to sustainable energy. USC Viterbi's role in supporting them has made it more attractive to diverse groups of students across the nation.

In recognition of the school's commitment to equity, diversity and inclusion, USC Viterbi received in 2017 the American Society for Engineering Education President's Award, a rare distinction for an engineering school.

The excellence of the school's faculty has also made USC Viterbi increasingly appealing to women. Since 2009, the *MIT Technology Review* has singled out 12 of the school's junior faculty, including eight women, as among the world's top innovators under the age of 35. In 2018, Niki Bayat became the first USC doctoral student named a TR-35.

"Viterbi's commitment to 'changing the conversation' signals recognition of historical inequities of underrepresented populations in engineering and our aim to put equity and inclusion at the core of all that we do," said Brandi Jones, who became the school's first vice dean for diversity and strategic initiatives in 2016. "I am elated to be a part of the Viterbi community at such a historic time, and I look forward to promoting an equity-minded approach to broaden participation of women in engineering."

WOMEN

@USC VITERBI / Stats You Should Know

By Daniel Druhora

58% (96 OUT OF A TOTAL OF 163)

PERCENTAGE OF WOMEN IN USC VITERBI'S GRAND CHALLENGES SCHOLARS PROGRAM.

50

Percentage of women in last fall's entering undergraduate class, a historic record for the USC Viterbi School of Engineering.

$20 million

Amount gifted by an anonymous donor in 2000 that led to the creation of the Women in Science and Engineering (WiSE) program.

1,133%

INCREASE IN THE NUMBER OF FEMALE TENURED OR TENURE-TRACK FACULTY AT USC VITERBI SINCE THE WiSE GIFT IN 2000 (FROM 3 TO 37). THE SCHOOL NOW HAS 69 FULL-TIME WOMEN FACULTY MEMBERS.

9

USC VITERBI WOMEN SINGLED OUT BY THE *MIT TECHNOLOGY REVIEW* SINCE 2009 AS AMONG THE WORLD'S TOP INNOVATORS UNDER THE AGE OF 35.

1,870

WOMEN ENROLLED IN MASTER'S AND DOCTORAL ENGINEERING PROGRAMS AT USC, AMONG THE HIGHEST IN THE NATION.

$68,250,982

RESEARCH AWARDS BY FEMALE RESEARCH FACULTY (FYS 16/17–18/19)

62 research sponsors; 149 awards; 17 women faculty receiving $1 million+ over this period.

$6.13 MILLION

Amount awarded to Ellis Meng, USC Viterbi professor of biomedical engineering and electrical and computer engineering, and Dong Song, USC Viterbi research associate professor of biomedical engineering, to co-lead a BRAIN Initiative project over five years to develop devices that will significantly enhance our understanding of the brain.

4 ☆ ☆ ☆ ☆

STARS RECEIVED BY RETIRED GEN. ELLEN M. PAWLIKOWSKI, who became a Judge Widney Professor at USC in the fall of 2019. Pawlikowski, who served more than 40 years in the military and is only the third woman to achieve the highest rank in the U.S. Air Force, was inducted into the National Academy of Engineering in 2014.

10 Minutes it takes USC Viterbi Professor Andrea Armani's portable optical diagnostics system (PODS) to perform rapid malaria screenings in low-resource environments.

2019 Year the USC chapter of the National Society of Black Engineers won Chapter of the Year under the leadership of female president Shana Douglass ('19, ME).

400 Women who attended USC Viterbi's 3rd annual AthenaHacks, an all-female hackathon designed to support and foster a community of women in tech. With over 15 participating schools, over 100 mentors, and sponsorship from Google, Microsoft, Facebook and Bloomberg, 2019's AthenaHacks was the group's largest hackathon to date.

THE Investigators

THESE USC VITERBI RESEARCHERS ADDRESS SOME OF THE BIGGEST PROBLEMS FACING HUMANITY, AS WELL AS ADVANCING THE BASIC SCIENCE OF OUR WORLD.

Pictured left to right: professors Alice Parker, Kelly Sanders, Cristina Zavaleta, Phebe Vayanos and Yolanda Gil

Andrea Armani

Ray Irani Chair in Chemical Engineering and Materials Science

RESEARCH FOCUS

We are inventing new diagnostics to improve healthcare, developing new light-emitting materials to advance imaging of living cells and tissue, and creating new types of lasers for quantum-based cryptography. And there are many other problems that we are solving.

RECENT NEWS

We recently discovered that by creating a single oriented monolayer of molecules on the surface of one of our devices, we can improve the lasing performance by 40×. This improvement arises from a completely new physical phenomenon and reduces the power consumption of the laser.

Nora Ayanian

Assistant Professor of Computer Science

Andrew and Erna Viterbi Early Career Chair

RESEARCH FOCUS

How can we make teams of robots better, stronger and more resilient to changes within the team and in their environment?

RECENT NEWS

I'm excited by our work on speeding up path planning for navigating large (100+) teams of robots in cluttered and complex environments and its applications in warehousing and urban drone delivery. It's a balance between typical robotics approaches that can handle small numbers (fewer than 10 robots) with high fidelity and typical AI approaches that handle hundreds without considering real robot challenges.

Burçin Becerik Gerber

Professor of Civil and Environmental Engineering and Director of the Center for Intelligent Environments

RESEARCH FOCUS

I'm trying to create an unprecedented world where there is a productive, symbiotic relationship between a built environment and its citizens, one in which buildings and humans can interact and collaborate for social good (see pg. 26).

RECENT NEWS

Examining how the individual minds of humans and machines (in this case, buildings) interact with one another to determine the ways these two entities coevolve and co-adapt to one another. One example: we developed several levels of automation for providing the best thermal comfort conditions in offices and tested them in real-life offices. Our goal is to map automation levels to user acceptability to promote the highest level of symbiosis.

Amy Childress

Distinguished Professorship in Science and Engineering and Professor of Civil and Environmental Engineering

RESEARCH FOCUS

My team and I seek holistic and realistic solutions to the problem of finite water and energy resources.

RECENT NEWS

I recently began a new project that proposes system-scale evaluation of integrating potable reuse systems with desalination systems for high beneficial use of wastewater with low-energy requirements. By bridging experimental design with integration considerations, this project offers a novel framework for reducing energy and environmental impacts of future desalination systems.

Eun Ji Chung

The Dr. Karl Jacob Jr. and Karl Jacob III Early Career Chair

RESEARCH FOCUS

We are designing biomaterials and nanomedicine strategies to deliver drugs to diseased sites without dilution into off-target sites in a manner that is easily self-administered by patients.

RECENT NEWS

We have found that certain nanocarriers can be the depot to the kidney based on their physical and chemical properties, which offer the potential to load nearly any drug for a plethora of kidney diseases.

Heather Culbertson

WiSE Gabilan Assistant Professor and Assistant Professor of Computer Science and Aerospace and Mechanical Engineering

RESEARCH FOCUS

One big question I am trying to solve is how to create realistic and complex touch sensations using minimal actuators and mechanically simple designs.

RECENT NEWS

The research result that most excited me was when we discovered that we could use simple speaker actuators to create complex sensations by using haptic illusions created through individual timing and control.

Ewa Deelman

Research Professor of Computer Science

Research Director of Scientific Computation Technologies at ISI

RESEARCH FOCUS

My research focuses on conducting computer science research and software development to advance cyberinfrastructure for science.

RECENT NEWS

The work of my group on the Pegasus Workflow Management System contributed to the first ever direct detection of gravitational waves, where the LIGO scientists used it to execute ~107 million computational tasks across distributed resources. Also, our work with the USC Southern California Earthquake Center supports their workflows to generate physics-based probabilistic seismic hazard maps of California. These can be used by civil engineers and disaster planners to build safer structures and plan responses to earthquakes.

Bistra Dilkina

WiSE Gabilan Assistant Professor and Assistant Professor of Computer Science

RESEARCH FOCUS

Developing AI methods that can help address important sustainable development goals, such as protecting biodiversity and ecosystems, as well as making our cities and infrastructures resilient to natural disasters and climate change.

RECENT NEWS

One recent result that excites me is showing how we can leverage data-driven machine learning models to create frameworks to quantitatively study the less obvious, indirect effects of sea-level rise through forced migration patterns. The work highlights the fact that adaptation measures to sea-level rise are a global impact issue and further understanding is needed to inform important decisions.

PHOTO (LEFT): JENNICA MAE ABRAMS

Stacey Finley

Associate Professor of Biomedical Engineering

Gordon S. Marshall Early Career Chair in Engineering

RESEARCH FOCUS

I am using mathematical modeling to understand what drives tumor growth from the inside out: how biochemical reactions inside of cells allow tumors to get their own blood supply, efficiently use nutrients and evade the immune system.

RECENT NEWS

I am excited about our latest research to study the tumor ecosystem involving cancer cells and immune cells. We are building a detailed model of the dynamic interactions between cells. It is exciting to realize that our mathematical modeling can help clinicians better understand cancer and develop more effective immunotherapies.

Kallirroi Georgila

Research Associate Professor of Computer Science

RESEARCH FOCUS

The underlying concept behind my research is how to learn human behavior patterns from human-machine interaction data to make natural language dialogue systems more human-like, robust to errors and misunderstandings, and adaptive to different types of users and applications.

RECENT NEWS

An exciting recent finding was that using machine learning to optimize the tutoring strategies of an intelligent tutoring system for interpersonal skills training resulted in increased student confidence levels after interacting with the system. This result is exciting because it shows that AI and, specifically, dialogue systems can make a difference in real-world applications such as tutoring students.

Yolanda Gil

Research Professor of Computer Science and Spatial Sciences

Associate Division Director for Research of Intelligent Systems Division at ISI

RESEARCH FOCUS

Can we create AI scientists that can do independent research?

RECENT NEWS

We have created a framework for cancer data analysis that uses AI planning to search for proteins and genes in a more systematic and efficient manner than existing methods. We can also easily compare different methods and find critical differences that make them more effective.

Leana Golubchik

Stephen and Etta Varra Professor of Computer Science and Electrical and Computer Engineering

RESEARCH FOCUS

We work on design and evaluation of large scale distributed systems, with an emphasis on analysis techniques needed for rapid evaluation of design ideas that lead to insight about systems' performance and reliability.

RECENT NEWS

Deep learning has made substantial strides in many applications. However, an important missing piece is that these frameworks do not assist users with provisioning and sharing cloud resources. To this end, our recent results in performance prediction and scheduling algorithms guide resource allocation to facilitate greater exploration of deep learning models.

Malancha Gupta

Professor of Chemical Engineering and Materials Science and Chemistry

Jack Munushian Early Career Chair

RESEARCH FOCUS

My research group is currently focused on designing sustainable hydrophobic coatings for membrane and textile applications.

RECENT NEWS

We recently found that we can systematically control the depth of polysiloxane coatings into porous materials: one side of the porous material remains hydrophilic and the other side is rendered hydrophobic. These types of asymmetric Janus materials with tailored surface chemistries have many applications in diagnostics and filtration.

Julie Higle

Professor of Industrial and Systems Engineering

RESEARCH FOCUS

Most of my work involves models and methods that support decision making under uncertainty, most recently in support of medical decision making for public health.

RECENT NEWS

I get a kick out of creating mathematical and computational models that can help to transform limited disease data into insights about diseases that are otherwise asymptomatic.

Andrea Hodge

Arthur B. Freeman Professor of Chemical Engineering and Materials Science and Aerospace and Mechanical Engineering

RESEARCH FOCUS

The overarching goal of our research is to develop methodologies to synthesize new materials with nanoscale microstructures and unravel their new properties and behaviors.

RECENT NEWS

We recently discovered how to control gradient microstructures at the nanoscale by producing a superalloy with four different types of complex microstructures within—a new way to develop materials that have the potential to exhibit many different behaviors in one single sample. It could open the door for new, thermally stable and stronger nanoscale materials.

Eva Kanso

Professor of Aerospace and Mechanical Engineering

Zohrab A. Kaprielian Fellow in Engineering

RESEARCH FOCUS

We work on the physics of living systems. Our goal is to understand how organisms exploit, and at the same time are constrained by, physics (see pg. 38).

RECENT NEWS

Our recent work on sea star locomotion, where we analyze gait transitions from crawling to bouncing. It is a fascinating example of how mechanics facilitates coordination, potentially reducing the computational demand on the sea star's distributed nervous system.

Mercedeh Khajavikhan

Associate Professor of Electrical and Computer Engineering

IBM Early Career Chair

RESEARCH FOCUS

Our group aims to develop a platform based on nonlinear oscillators that is capable of modeling complex systems from social networks to the brain.

RECENT NEWS

In 2017, we were one of the first groups that demonstrated an enhanced sensitivity in non-Hermitian systems that were biased at exceptional points. The possibility of increasing sensitivity, a property that prior to our work was considered a fixed quantity, using some of the unique properties of non-Hermitian systems is not only exciting, but it also has far-reaching implications.

Aleksandra Korolova

WiSE Gabilan Assistant Professor and Assistant Professor of Computer Science

RESEARCH FOCUS

I aim to understand societal impacts of algorithms and AI and enable data-driven innovation while respecting societal values, such as privacy and fairness.

RECENT NEWS

We were able to demonstrate the role ad delivery algorithms play in perpetuating discrimination and shaping political messaging in targeted advertising systems. Scientifically, it was exciting to be able to show the role of algorithms without access to Facebook's data or algorithms; furthermore, I'm motivated to find solutions to the novel questions this raises for researchers, Facebook, and policymakers: how to audit for and address these effects.

Kristina Lerman

Research Associate Professor of Computer Science

Project Leader at ISI

RESEARCH FOCUS

I am trying to use data to answer socially important questions: how can networks be configured to amplify the spread of beneficial information, but stop the spread of bad information? Can we use open-source data to monitor human happiness?

RECENT NEWS

A recent paper identifies some of the counterintuitive properties of networks: the "majority illusion" effect, where a trait or an opinion can be rare in the network overall, but it may appear to many people as if many of their friends have that trait or opinion. It's rampant on the Twitter follower network.

Yan Liu

Associate Professor of Computer Science and Electrical and Computer Engineering

Philip and Cayley MacDonald Endowed Early Career Chair

RESEARCH FOCUS

We are working on developing novel machine learning models to address important and pressing challenges in our society, such as predicting how coronavirus spreads over space and time.

RECENT NEWS

We have developed novel machine learning algorithms that can interpret how deep neural networks work and have been successfully implemented in Facebook advertising systems.

Gale Lucas

Research Assistant Professor of Computer Science and Civil and Environmental Engineering

RESEARCH FOCUS

What aspects of the technology—virtual agents, VR training, smart buildings, etc.—affect how much we use, accept, trust, like and feel connected to that technology?

RECENT NEWS

The research finding that excites me the most is that people open up more about their mental and financial health to virtual humans than real humans. These results have implications for ways that technology can help us when stigma and evaluation concerns get in the way of us opening up to other people.

Maja Matarić

Chan Soon-Shiong Chair and Distinguished Professor of Computer Science, Neuroscience, and Pediatrics

RESEARCH FOCUS

How can we get AI and robotics to be used more for helping people (augmentation) rather than replacing people (automation)?

RECENT NEWS

We recently analyzed the unique dataset we collected from deploying our socially assistive robots as tutors in 17 homes of families with one or more children with autism, for a month or longer at a time. The data yielded unique insights about what it takes to use machine learning/AI to help a truly diverse population such as autism (see pg. 44).

Megan McCain

Assistant Professor of Biomedical Engineering and Stem Cell Biology and Regenerative Medicine

Chonette Early Career Chair

RESEARCH FOCUS

We fabricate a variety of surfaces and devices for engineering human muscle cells into tissues that can be used to study diseases and serve as a testbed for developing new drugs.

RECENT NEWS

Recently, we fabricated a fluidic device to keep explanted zebrafish hearts alive and functional from several days to weeks. Our collaborators at CHLA then used our device to image an injured zebrafish heart as it regenerated in real time, giving us a window into new therapies for human heart repair.

Ellis Meng

Professor of Biomedical Engineering and Electrical and Computer Engineering

RESEARCH FOCUS

My long-term question is: can we come up with a new device to treat hydrocephalus that is equivalent to a cure? We are taking baby steps towards that goal today.

RECENT NEWS

My passion is finding unique problems in medicine that have no satisfactory clinical solutions today and leading the charge to change existing paradigms by introducing new medical device technology solutions through my research. It is an incredible privilege to have the opportunity to impact the lives of patients and also be so intellectually challenged, engaged and disruptive.

Jelena Mirkovic

Research Associate Professor of Computer Science

Research Team Leader at ISI

RESEARCH FOCUS

We are working on protecting various targets—networks, servers, infrastructure services—from denial-of-service attacks.

RECENT NEWS

In our FRADE project on protecting Web servers from DDoS attacks, we were able to identify both naive and sophisticated attackers, and filter their traffic within 10 to 15 seconds.

Urbashi Mitra

Professor of Electrical and Computer Engineering and Computer Science

Gordon S. Marshall Chair in Engineering

RESEARCH FOCUS

How to design algorithms that jointly optimize communications, sensing and control. This is valuable for designing wireless networks where AUVs collaborate in large-scale ocean sensing or microbial fuel cells produce the most electricity possible.

RECENT NEWS

We have new results on methods for localizing multiple targets in space; the targets emanate some kind of signal that can be received at a small number of locations. These signals only need to have some simple properties, and so our methods work in all manners of environmental conditions (e.g., underwater, where there is no GPS).

Mahta Moghaddam

William M. Hogue Professorship in Electrical and Computer Engineering and Professor of Electrical and Computer Engineering

RESEARCH FOCUS

We are contributing to the understanding, prediction and adaptation strategies for global climate change, and in particular, issues related to water scarcity, via microwave remote sensing technologies.

RECENT NEWS

It was very exciting to confirm our hypothesis that we can "see" through the subsurface, with high resolution, using long-wavelength radars. This has significant implications for our ability to track changes in the Arctic permafrost, to enable precision agriculture, and to help military logistics (see pg. 30).

Maral Mousavi

Assistant Professor of Biomedical Engineering

RESEARCH FOCUS

How do we make diagnostic and analytical devices accessible and affordable? How do we use technology to improve patient outcomes and innovate in the healthcare field?

RECENT NEWS

My research group looks for creative methods and materials to design devices. We get excited when we find the answers hidden in plain sight; for example, we are utilizing ubiquitous materials such as yarn and paper, materials that we interact with on a daily basis, for creating low-cost microfluidic biomedical devices for point-of-care analysis.

Alice Parker

Dean's Professor of Electrical and Computer Engineering

RESEARCH FOCUS

How does neural coding in artificial neurons (the signaling between neurons) convey meaning?

RECENT NEWS

We were able to show that electronics modeling astrocytes (other cells in the brain) detect synaptic failure and encourage other electronic neural connections to boost strength so signaling can continue. As a corollary, we showed that electronic neurons can signal with different spike shapes to indicate the source of the spiking. Together, combining these ideas, we showed that after synaptic failure existing electronic neurons can assume signaling roles.

Michelle Povinelli

Gabilan Distinguished Professorship in Science and Engineering and Professor of Electrical and Computer Engineering and Physics and Astronomy

RESEARCH FOCUS

How can we use micro-scale patterning to change how objects sense and emit light and heat?

RECENT NEWS

Recently, we've designed specialty microparticles that could be used for temperature-regulating paint. Ultimately, we'd like to replace energy-intensive heating and air conditioning systems with paint for applications on satellites and even automobiles.

Feifei Qian

WiSE Gabilan Assistant Professor and Assistant Professor of Electrical and Computer Engineering

RESEARCH FOCUS

How can bio-inspired robots achieve agile locomotion on challenging terrains such as soft sand, snow and earthquake rubbles by generating the desired responses from the environment?

RECENT NEWS

We found that by smartly colliding into obstacles, our legged and snake-like robots can exploit obstacle disturbances to effectively locomote and navigate in cluttered environments. This new framework of viewing obstacles as opportunities changes the need for robots to carefully avoid all contacts and perturbations.

Kelly Sanders

Assistant Professor, Sonny Astani Department of Civil and Environmental Engineering

Dr. Teh Fu Yen Early Career Chair

RESEARCH FOCUS

How can we maximize our utilization of renewable energy, such as solar panels, without using expensive batteries and storage options?

RECENT NEWS

We are looking at strategies to enable electricity customers to serve as "virtual batteries" to help manage variable renewable energy sources by shifting usage from times of high fossil fuel usage to times of high renewable energy availability. Changing electricity customer behavior is an exciting alternative because it avoids the costs associated with batteries and all of the upstream environmental impacts of battery production.

Maryam Shanechi

Assistant Professor of Electrical and Computer Engineering and Biomedical Engineering

Andrew and Erna Viterbi Early Career Chair

RESEARCH FOCUS

My lab develops neurotechnology to restore lost motor and emotional function in millions of patients with neurological and neuropsychiatric disorders.

RECENT NEWS

We have provided the first demonstration that mental states such as mood can be decoded from brain activity. We have also developed models of how electrical stimulation changes brain activity. Using these models, we are now developing alternative therapies that would regulate disease symptoms in neuropsychiatric disorders.

Shaama Sharada

WISE Gabilan Assistant Professor and Assistant Professor of Chemical Engineering and Materials Science

RESEARCH FOCUS

We are using computer simulations to identify practical, yet energy-efficient and sustainable means to convert anthropogenic carbon dioxide into useful compounds.

RECENT NEWS

We're excited about the fact that we do not need the typical toxic, heavy metal compound to carry out light-assisted CO_2 conversion. We find that certain organic molecules are highly tunable to achieve a wide range of chemical reactivity, but their susceptibility to degrade hampers widespread use. We are now using simulations to determine mechanisms of degradation of these molecules to find new, more robust candidates to convert CO_2.

Katherine Shing

Associate Professor of Chemical Engineering and Materials Science

RESEARCH FOCUS

Industrial catalysis using enzymes is challenging due to slow kinetics. Recent experimental data indicates that the addition of surfactants can significantly enhance the enzyme activity, but the mechanism of such enhancement is not clear.

RECENT NEWS

Using atomistic molecular dynamics simulations, it was found that the photo-responsive surfactant azo-TAB interacts with the enzyme lysozyme by selectively adsorbing on certain sites on the enzyme, resulting in changes in both the size and dynamics of the enzyme catalytic cavity. These detailed molecular-level studies allow the customization of enzyme-surfactant pairing.

Sze-chuan Suen

Assistant Professor of Industrial and Systems Engineering

RESEARCH FOCUS

How can we use quantitative models for disease and health systems to best inform health policy and medical decision making?

RECENT NEWS

It is very exciting to be able to use and design new modeling and optimization approaches to help patients and health systems improve their health outcomes, reduce costs and better allocate their resources. It is very satisfying to be able to bring traditional industrial engineering and operations research techniques to the field of healthcare.

Jennifer Treweek

WiSE Gabilan Assistant Professor and Assistant Professor of Biomedical Engineering

RESEARCH FOCUS

One of my research goals is to pioneer technologies that enable the visualization of depression-associated neuroadaptations across multiple spatial and temporal scales (see inside cover).

RECENT NEWS

Recently published tissue-clearing and labeling methodologies, when combined with advanced imaging systems, have enabled high-resolution and high-content information retrieval from intact multicellular systems—whether that be from whole organs or from entire biological niches, such as microbial biofilms embedded in human tissues. Our newfound ability has the potential to provide tremendous insight into the mechanisms of disease.

Alejandra Uranga

WiSE Gabilan Assistant Professor of Aerospace and Mechanical Engineering

RESEARCH FOCUS

My research aims at finding ways to make aviation environmentally sustainable: can we get there and how?

RECENT NEWS

By investigating the use of electrical components as major parts of the propulsion system for aircraft, my research group has identified missions for which electrification can reduce the on-board energy consumption by a significant amount: 20% to 60% depending on battery technology. If we are willing to change how we design aircraft and how we fly, there might actually be a way for aviation to become environmentally sustainable within the next two decades.

Phebe Vayanos

Assistant Professor of Industrial and Systems Engineering and Computer Science

RESEARCH FOCUS

How can we harness the power of artificial intelligence for social good to help support the most vulnerable?

RECENT NEWS

I am working in partnership with policymakers at the Los Angeles Homeless Services Authority to help mitigate homelessness in L.A. County. We are redesigning the policy for allocating scarce housing resources to those experiencing homelessness.

Renyuan Xu

WiSE Gabilan Assistant Professor and Assistant Professor of Industrial and Systems Engineering

RESEARCH FOCUS

To help people make better decisions in stochastic environments involving uncertainty and competition.

RECENT NEWS

I have a huge passion for formulating real-world decision-making problems into mathematical models, deriving analytical solutions, and designing efficient algorithms to solve these problems. People make decisions all the time. I feel incredibly content when my research can help them better understand the situations they are facing and improve the outcomes of their decisions.

Cristina Zavaleta

WiSE Gabilan Assistant Professor and Assistant Professor of Biomedical Engineering

RESEARCH FOCUS

How can we improve cancer detection by using nanoparticle-based imaging contrast agents?

RECENT NEWS

We were really excited to find that the commercial dyes we encounter every day, used to color our foods, drugs and cosmetics, have a multitude of optical imaging properties that we can exploit for cancer imaging. We are currently incorporating these "colorful" dyes into various nanoparticle constructs to evaluate their potential to specifically target and sensitively detect cancer cells.

THE Classroom Innovators

THESE FULL-TIME TEACHING FACULTY ARE USING EVERYTHING FROM IMPROV THEATER TO CLASSROOM POLLING TO CONNECT WITH USC VITERBI STUDENTS.

Left to right: USC Viterbi faculty Elisa Warford, Trina Gregory, Amy Rechenmacher and Elisabeth Arnold Weiss

Elisabeth Arnold Weiss

Associate Professor of Practice, Engineering Writing Program

FAVORITE ASPECT OF TEACHING AT USC VITERBI

The students, of course! They are the reason we are here.

TEACHING INNOVATION

I spearheaded the Improv for Engineers co-curricular innovation to inject improv theater and comedy techniques into the engineering writing curriculum. We teach students how to communicate in a dynamic, interpersonal environment and to leverage social phenomena to accelerate technical learning.

Sandra Batista

Senior Lecturer, Department of Computer Science

FAVORITE ASPECT OF TEACHING AT USC VITERBI

My favorite aspect of teaching at Viterbi is all of the wonderful interactions I have with such smart, engaged students. We have so much fun solving problems together.

TEACHING INNOVATION

For the introductory discrete mathematics course offered by the computer science department (CSCI 170), I have introduced collaborative clinics in which students solve problems together in teams with a member of a course staff with a ratio of about four to six students per course staff member.

Claire Bono

Senior Lecturer, Department of Computer Science

FAVORITE ASPECT OF TEACHING AT USC VITERBI

I like helping students one-on-one in office hours.

TEACHING INNOVATION

I use classroom polling to increase student engagement and get immediate feedback on student understanding. In addition, I have a classroom of largely international students who are sometimes more hesitant to speak up in class, so this gives them a way to participate anonymously.

Helen Choi

Lecturer, Engineering Writing Program

FAVORITE ASPECT OF TEACHING AT USC VITERBI

In my department, we focus on building dynamic learning communities that are responsive to student needs and our rapidly changing society—who wouldn't love that?

TEACHING INNOVATION

With help from a Viterbi colleague, I integrated a Wikipedia writing assignment into my WRIT 340 sections so that students' writing has real-world impact. Now students can share their engineering expertise with an audience of millions and contribute to the world's understanding and appreciation of critical engineering information.

Elizabeth Fife

Associate Professor of Practice, Engineering Writing Program

FAVORITE ASPECT OF TEACHING AT USC VITERBI

Working with our Ph.D. students on their conference presentations, journal papers, proposals and dissertations gives me a first-hand look into how the skills they learn in class are directly applied to their work and their lives.

TEACHING INNOVATION

As a take-off point in developing their academic "voice," students write and lead discussion on materials from outside areas to build their communication facility on the debates inside their field, as well as perspective on the ethical and societal consequences of their work.

Trina Gregory

Senior Lecturer, Information Technology Program

FAVORITE ASPECT OF TEACHING AT USC VITERBI

I love when I can see on the students' faces that they understand the material and can put it into practice.

TEACHING INNOVATION

Throughout my programming courses, I get input from the students and live code using the appropriate environment, such as PyCharm or Xcode. I like to call this "improv coding," and it's a fun way to engage the students while still covering the required materials. I also incorporate tangible objects into class such as food and other physical objects to represent abstract concepts in programming.

Lessa Kay Grunenfelder

Senior Lecturer, Mork Family Dept. of Chemical Engineering and Materials Science

FAVORITE ASPECT OF TEACHING AT USC VITERBI

The best thing about teaching at USC is getting to know the students and following their successes after graduation.

TEACHING INNOVATION

In my introductory materials science course (MASC 310), I created a series of hands-on and software-based investigations to provide students with concrete examples and context for the content covered in the course. Each class period incorporates one of these activities, which students complete in groups.

Shalini Gupta

Lecturer, Daniel J. Epstein Department of Industrial and Systems Engineering

FAVORITE ASPECT OF TEACHING AT USC VITERBI

Fostering experimental learning by encouraging diversity and inclusivity.

TEACHING INNOVATION

My teaching demonstrates a combination of modeling novelty and technical depth, and therefore fits well in a variety of courses.

Yalda Khashe

Lecturer, Daniel J. Epstein Department of Industrial and Systems Engineering

FAVORITE ASPECT OF TEACHING AT USC VITERBI

As a USC graduate, I am proud of being part of such a diverse and dynamic community.

TEACHING INNOVATION

Class lectures are posted beforehand as study aids, to dedicate more class time to application than lecture, which strongly encourages students to participate. I stress pre- and post-assessment as "waypoints" among classroom sessions to gauge the continued learning process, and scenario-based questions to develop student ability to recognize a relevant concept and assess the feasibility of use, including how it can fail.

PHOTO (LEFT): JENNICA MAE ABRAMS

Nayeon Kim

Lecturer, Information Technology Program

FAVORITE ASPECT OF TEACHING AT USC VITERBI

I love that so many Viterbi students are intrinsically motivated to learn and challenge themselves—they don't back down when things are hard and want to learn for learning's sake.

TEACHING INNOVATION

I stopped using so many slides in my lectures and started to give more examples. Students can read slides on their own, but I think applying concepts to real life is when students learn best and get the most value. In my lectures, we code together and create real-life examples like the Coachella website, a T-shirt customizer tool, a simplified IMDB site and more.

Arpi Mardirossian

Senior Lecturer, Information Technology Program

FAVORITE ASPECT OF TEACHING AT USC VITERBI

Fostering a passion for data analytics and machine learning in students with diverse backgrounds and interests.

TEACHING INNOVATION

Since we all learn best among friends, tinkering and iterating, I incorporate collaborative methods of teaching into my classroom by hosting datathons where students work in teams to identify a problem, gather data and perform data analysis to gain insights about the problem and its solutions.

Sarah Mojarad

Lecturer, Engineering Writing Program

FAVORITE ASPECT OF TEACHING AT USC VITERBI

My favorite aspect of teaching at Viterbi is the freedom to experiment in the classroom and explore new ways of invoking critical thinking in students.

TEACHING INNOVATION

I've created an assignment that demonstrates the impact and reach of students' contributions to Wikipedia. Students choose an article from a list of approved engineering concepts and spend weeks improving the page and interacting with other editors. Thus far, the contributions of USC Viterbi students have been viewed 8.3 million times.

Amy Newlove Schroeder

Lecturer, Engineering Writing Program

FAVORITE ASPECT OF TEACHING AT USC VITERBI

My favorite aspect of teaching at Viterbi is engaging with students about controversial ethical issues in science and technology, facilitating class discussion and exchanging ideas, challenging accepted wisdom and participating in energetic discourse.

TEACHING INNOVATION

My primary innovation while working at Viterbi has been the development of a general education seminar focused on science, literature and ethics. This freshman-level course grew out of my experience teaching ethics in my Communication for Engineers classes; it is one of only two humanities-based general education courses housed in Viterbi.

Harly Ramsey

Senior Lecturer, Engineering Writing Program

FAVORITE ASPECT OF TEACHING AT USC VITERBI

The students are sharp and engaged.

TEACHING INNOVATION

In teams, students create podcasts about engineering topics. We have a series of workshops in class and students learn the expectations for various genres. The "chat show" format is the most popular genre, and students do a great job of incorporating researched scholarly material in the context of a heightened conversation.

Amy Rechenmacher

Associate Professor of Practice, Sonny Astani Department of Civil and Environmental Engineering

FAVORITE ASPECT OF TEACHING AT USC VITERBI

My favorite aspect of teaching at USC in Viterbi is the students: they are all very bright and very driven. I am truly very humbled to be in their presence.

TEACHING INNOVATION

I have incorporated several different "active learning" methods into my classrooms. The results have been transformative for everyone: class time is much more active and lively; average grades are up; and students are much more engaged, which in turn makes me more excited to be with them.

Martha Townsend

Senior Lecturer, Engineering Writing Program

FAVORITE ASPECT OF TEACHING AT USC VITERBI

My favorite aspect of teaching in Viterbi is the students, of course—smart, flexible, forward-thinking and kind.

TEACHING INNOVATION

My proudest teaching innovation is not just for my classroom but for all of our Engineering Writing Program classrooms and indeed all of Viterbi: Viterbi Conversations in Ethics, our online student-written, student-edited, student-run magazine dedicated to thoughtful discussion of ethics in engineering. It can be seen at vce.usc.edu.

Kendra Walther

Senior Lecturer, Information Technology Program

FAVORITE ASPECT OF TEACHING AT USC VITERBI

I love introducing students to the joy of programming in my introductory classes and the wonderful colleagues in ITP that share my passion for teaching and learning.

TEACHING INNOVATION

I constantly try new things in my classroom, including using Google Forms to capture opinions, codes, and questions during lecture and active learning activities using POGIL. I also think it's important to discuss effective learning strategies, designing technology for people of all abilities, and mental healthiness within the class setting.

Elisa Warford

Associate Professor of Practice, Engineering Writing Program

FAVORITE ASPECT OF TEACHING AT USC VITERBI

My favorite aspect of teaching for Viterbi is the smart, hard-working students I get to work with.

TEACHING INNOVATION

I developed and teach a course called Ethics of Science and Technology. It's given students the opportunity to think critically about the role of technology in society and to understand the ethical implications of the technologies they'll be working on.

Faculty Accolades

MAHTA MOGHADDAM
National Academy of Engineering, Elected Member

BEHROKH KHOSHNEVIS
National Academy of Engineering, Elected Member

MARK THOMPSON
National Academy of Engineering, Elected Member

GIANLUCA LAZZI
National Academy of Inventors Fellow

NEIL SIEGEL
National Academy of Inventors Fellow

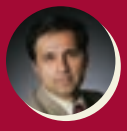
GISELE RAGUSA
Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring

DANIEL MCCURRY
NSF CAREER Award

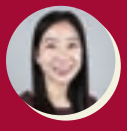
MITUL LUHAR
NSF CAREER Award

QIMING WANG
NSF CAREER Award

HAIPENG LUO
NSF CAREER Award



MARK HUMAYUN
2020 IEEE Medal for Innovations in Healthcare Technology



EUN JI CHUNG
BMES 2020 Rising Star Junior Faculty Award

A 12-YEAR ODYSSEY FROM FINE ARTS TO ELECTRICAL ENGINEERING

Randi Burley's path to engineering has been anything but traditional.

By Ben Paul

In many ways, Randi Burley's experience at USC Viterbi is much like that of her fellow undergrads. The junior in the Ming Hsieh Department of Electrical and Computer Engineering wakes up and rushes (or skateboards) to class. She meets friends for study sessions, participates in student activities, goes to office hours, and has a part-time job. But to consider her experience traditional would be a huge mistake.

Twelve years ago, Burley was a bright-eyed freshman at UCLA who had grown up in the Baldwin Hills neighborhood of Los Angeles. She wanted to pursue engineering like her aunt, a successful African-American engineer. Unfortunately, getting an engineering degree today often has as much to do with circumstances as it does with ability.

"I was struggling with my course load, working 20-plus hours a week to pay for expenses and attending tutoring to catch up in math. All while acclimating to life on campus," Burley said. "I was one of those students who had the passion and talent to become an engineer. What I didn't have was the support, time, training or money needed to become an engineer."

What Burley did have was a love for design and creativity. She grudgingly gave up on engineering and instead passionately threw herself into pursuing a fine arts degree. Six years later, in 2014, she was a small-business owner with a gallery in Los Angeles. At the height of her success, Burley hosted traveling artists, some of whom went on to become major cultural icons.

Around the same time, she was invited to the University of California, Santa Barbara's Media Arts and Technology program's year-end show, which encourages artists and engineers to combine their areas of expertise. Burley found one creation, the AlloSphere, particularly inspiring. The three-story sphere projected scientific simulations and data visualizations in beautiful new ways. Suddenly, nearly 10 years after she first enrolled at UCLA, Burley felt like that bright-eyed freshman again. "I remembered the promise I made to myself that I wouldn't give up on engineering," she said.

What junior Randi Burley learned on her winding path back to engineering has given her a unique perspective.

That meant re-enrolling in junior college at the age of 28. It meant exercising skills in STEM subjects that hadn't been used in years. It meant all-night study sessions and an intimate familiarity with office hours schedules. Math became Burley's strongest subject and last year USC Viterbi admitted her as a transfer student.

Burley's winding path back to engineering may be nontraditional, but looking back on it now, she wouldn't have it any other way.

"Thirteen years ago, I had to give up on engineering," Burley said. "Today, at the age of 30, I realize how lucky I am. Would I have seen engineering as a service to the community if I hadn't struggled through college myself? Would I have been able to approach engineering with a business mindset if I hadn't spent time as a business owner? Would I have been able to see the beauty and creativity in engineering if I hadn't spent time as an artist?"

Burley's experience has inspired her to be more than just an engineer. Just as she was supported by others, she wants to help ensure that the next generation of young women has a path to engineering as well.

PHOTO: CHRISTINA BOEMIO

A DAY IN THE LIFE

The tools, inspirations and routines that help USC Viterbi's standout students, staff and professors thrive.

By Avni Shah

Brandi P. Jones

VICE DEAN FOR DIVERSITY AND STRATEGIC INITIATIVES

Associate Professor of Engineering Education Practice

Wake-Up Time

5:00 a.m.

3 Must-Do's Before Starting the Day

1 Pray
2 Meditate
3 Take vitamins

Most Productive Time of Day

Morning

How I Approach a Hard Problem

I use a mind map (a diagram used to visually organize info) to structure my thoughts before I create a plan of action.

Most Productive Place to Work

Home or a cozy coffee shop with Sinatra playing in the background.

Favorite Aspect of My Job

Guiding and supporting people in challenging situations.

Biggest Challenge in My Role

Working against systemic inequality.

Indispensable Apps, Tools or Websites

Saints Football app, Apple Music, Medium Daily Read app

Procrastination Sources

Countless emails and text messages

Top Three Organizational Strategies

1 Mind map
2 Keep a to-do list
3 Outline priorities

Daily Inspiration

"When you get, give. When you learn, teach."
Maya Angelou

Currently on My Reading List

Change Your Questions, Change Your Life, by Marilee Adams.

Office Must-Haves

Lots of photos.

Advice for Your Younger Self

Self-care is central to success.

Worst Advice You've Ever Received

"Fake it till you make it."

Technology or Product You Wish You'd Invented

Amazon

Best Daily Habit

Meditation

Worst Daily Habit

Too much mobile screen time.

Biggest Future Career Goal

Write a screenplay.

Best Career Moment

Being recognized as a "Woman of the Year" finalist by the California Institute of Technology.

How I Know If It's Been a Good Day

I'm able to rest well.

Music to Engineer To

Sinatra

Time I Go to Bed

Depends on the day.

Gabrielle van der Velde-Kraft

PRESIDENT, SOCIETY OF WOMEN ENGINEERS

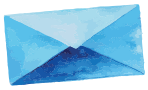
USC Viterbi Senior, Mechanical Engineering

"I know it's been a good day when I can't keep a smile off of my face."

Wake-Up Time

If I'm working out, 7:00 a.m., if not, by 8:30 a.m.

3 Must-Do's Before Starting the Day



1. Check emails and Slack, and respond to any messages that are urgent
2. Look over my to-do list and calendar to make sure I have everything I need for the day
3. Play some upbeat music as I get ready and organized. This always puts me in a better mood if I haven't had much sleep.

Most Productive Time of Day

Morning

Biggest Challenge I've Tackled

Going from never speaking in class in high school to doing presentations at my internships in front of senior managers, VPs and COOs. Practicing in front of friends helped.

Top 3 To-Do's

1. Finish four final projects
2. Schedule and hold mid-year, one-on-one conversations with SWE's (The Society of Women Engineers) e-board
3. Prepare for an interview

How I Approach a Hard Problem

I take time to think about the problem, whether it's a personal problem or a class-related problem, so I can better understand it. Then I think it over from multiple perspectives before I make a decision on how best to solve it. I'm also not afraid to ask for help.

Most Productive Place to Work

Dulce, a café at USC Village. Monday afternoons and evenings are surprisingly quiet there. Alternately, I like the fourth floor of Annenberg faculty hall at Doheny Library.

Lunchtime Routine

If I have the time, a 20-minute lunch somewhere on campus or at my apartment before my 2:00 p.m. class. Favorite spots to eat on campus are RTH Café and Good Karma.

Biggest Daily Challenge

Feeling like I don't have enough time to do everything. When my list gets too long, I'll highlight five main things I can realistically achieve that day.

Indispensable Apps, Tools or Websites

Apple News app, Slack, Google Calendar, "*The Daily*" podcast.

Daily Motivation

Honestly, just having an appreciation for all of the opportunities I've been given. When I think about that, then there is no reason for me not to use my resources to the fullest. Also, feeling like what I'm doing is making a difference.

Current Reading List and/or Favorite Publications

The Secret Thoughts of Successful Women and *Mouthful of Birds*.

Office Must-Haves

Sticky notes for when the random idea or thought pops into my head. And a candle. Candles just make a space better.

Advice I'd Give My Younger Self

Don't let the expectations of others dictate your choices. Instead, focus your energy on figuring out what it is you want to do.

Best Daily Habit

Drinking lots of water and green tea. I always have a water bottle with me.

How I Decompress

My daily decompressor is listening to music as I walk back home and think over the day. When I'm particularly stressed, I go for a run, meditate and/or paint.

Biggest Career Goal

So many things! I think my main goal right now is finding a job where I feel like I am making an impact.

How I Know If It's Been a Good Day

When I can't keep a smile off of my face.

Music to Engineer To

EDM for when I'm really into my work. Or a chill jazz playlist on Spotify.

Time I Go to Bed

On a good day, by 12:00 a.m.; on bad days, sometime in the early morning.

"MY PARENTS SHOWED ME THAT EDUCATION IS THE KEY THAT OPENS THE DOORS TO THE WORLD."

Ph.D. student Ghena Alhanaee envisions unprecedented international cooperation to save the Middle East from an environmental catastrophe. For her work, the MIT Technology Review has named her one of the top 20 innovators under age 35 in the Middle East and North Africa.

PHOTO: CHRISTINA BOEMIO

AN ENGINEER-DIPLOMAT REIMAGINES THE PERSIAN GULF

A doctoral student's unprecedented research in the area of nuclear energy catastrophe modeling is getting noticed by the entire region.

"The lives of 168 million people who live in this major geopolitically and ecologically sensitive region could be impacted by Ghena's research." Professor Najmedin Meshkati

By Daniel Druhora

In 1991, Ghena Alhanaee had just taken her first steps in her native United Arab Emirates when the Gulf War broke out.

That year, in a last-ditch attempt to prevent U.S. forces from landing on the beaches of Kuwait, Iraqi forces intentionally dumped an estimated three to eleven million barrels of oil into the Persian Gulf, creating one of the worst environmental disasters in history. The spill contaminated the coastal areas of several countries, including Kuwait and Saudi Arabia. Cleanup efforts are still taking place today.

Fast-forward to 2020: Megacities have sprung out of the region's desert sands, there are over 800 offshore oil and gas platforms in the Gulf, and 50,000 tankers pass through these waters each year. The surrounding countries are heavily dependent on desalinated Gulf water for their drinking supplies, and nuclear power is rapidly growing in the region. The Gulf is an umbilical cord that connects the eight countries that surround it: Iran, Oman, the United Arab Emirates, Saudi Arabia, Bahrain, Kuwait, Qatar and Iraq.

A 1991-scale oil spill, or a Chernobyl, or a Fukushima-like event could devastate the region, threatening the surrounding countries' ecosystems and contaminating their main source of drinking water. To make things more alarming, consider this: Many of the countries have only a two- to three-day supply of water to tap in the event of an emergency.

Today, as a Ph.D. student in the Sonny Astani Department of Civil and Environmental Engineering, Alhanaee is actively designing a framework to prevent and prepare the region for this type of catastrophic event. She envisions a linked emergency response plan, not just across industries but also across countries, an effort that has put her in the vanguard of "engineering diplomacy"—the intersection of engineering, technology and scientific research with foreign policy.

In October 2019, the *MIT Technology Review* recognized Alhanaee's groundbreaking work by naming her one of the top 20 innovators under age 35 in the Middle East and North Africa (MENA) region. The annual list recognizes those whose technical work promises to shape the coming decades.

"One-third of oil production is in the Gulf, and so is nearly half of the world's desalination capacity," Alhanaee said. "Now, add nuclear energy to the mix. We have one reactor operating in Iran, four being built in the U.A.E. and at least two planned in Saudi Arabia. These three industries are inextricably tied in ways that can affect the world on a massive scale."

When Alhanaee looks out over the Gulf she sees not only a striking tapestry of architectural marvels, the ancient and modern blending together in a region fragmented by conflict. She also sees an interlinked system of desalination plants, oil platforms and pipelines that carry the lifeblood of the economy, and crop fields that reach their green hands to heaven.

Her first step is to accurately measure and model how these sectors affect each other, humanity and the environment.

With an average of only eight inches of rainfall per year, the region has long been subjected to extreme climate conditions. Meanwhile, its population continues to grow at an astounding rate—30 percent between 2000 and 2020 alone.

"The lives of 168 million people who live in this major geopolitically and ecologically sensitive region could be impacted by Ghena's research," said Professor Najmedin Meshkati, Alhanaee's Ph.D. advisor and a global expert in nuclear safety.

When she returns home, traveling through cities like Dubai on its gleaming driverless metro trains, it's becoming harder for Alhanaee to picture the old world. For centuries, Dubai was a poor fishing village and trading port known primarily for its pearls. The oil and real estate boom have transformed it into a city that boasts the world's tallest building, one of its densest collections of skyscrapers and its third-busiest airport.

Her passion now is to get her compelling data about how interlinked the people in the region really are into the hands of the scientific community and policymakers to guide them to action. To make this a reality, she has called for the creation of a multinational entity made up of science-diplomats like herself that all nations in the region have a seat on.

"Imagine Saudi Arabia, Iran, Iraq, U.A.E. and others sitting down and working together to solve these challenges and make a plan," she said. "That, in itself, would be a major accomplishment for the world."

She will start in her home country, the U.A.E., where she plans to return after graduation and take her place in the story of transformation happening inside her own pearl city.

The *MIT Technology Review* award has special significance for Alhanaee, who is one of the few women in the U.A.E. pursuing a Ph.D.

"I've been blessed to do this thanks to the support of my family, but not everyone has that," said Alhanaee, who hails from a multicultural family. Her mother is Venezuelan and a mathematician, while her father is an Emirati physicist. "My parents showed me that education is the key that opens the doors to the world," she said.

Alhanaee continues to present her work internationally, from North America to Europe and the Middle East, but she regards USC Viterbi as her "home away from home," the place that allowed her to "flourish as a global scholar."

"I want to be at the forefront of implementing the research into the real world," she said.

Trailblazers like Alhanaee often grow tired of bureaucrat-speak about how to fix it, of conferences and summits that call for action but produce little in terms of impact. She prefers to lead meaningful change on the ground.

"The [U.A.E.] leadership has recognized that growth is not sustainable without recognizing our overexploitation of scant resources and taking action to reduce our environmental footprint," she said. "But without cooperation, sustainability will be only a short-lived dream, and prosperity will be a disappearing mirage for millions of people in the region."

A STAR IS BORN

Penelope Hocking, the Pac-12 Women's Soccer Freshman of the Year in 2018 and a sophomore majoring in computer science, shines on the pitch and in the classroom.

By Marc Ballon

USC Viterbi student Penelope Hocking's combination of smarts, speed and skill has made her a rising star in NCAA women's soccer.

In the summer of 2019, Penelope Hocking took a dream trip to Europe with her teammates on the USC women's soccer team.

The 19-year-old USC Viterbi computer science major had the time of her life, visiting the Tower of London, London Bridge and the Eiffel Tower. Her most enduring memory, though, occurred June 11 in a raucous stadium in Reims, France. There, Hocking watched in awe as the U.S. Women's National Team, led by the stars Alex Morgan and Megan Rapinoe, crushed Thailand 13-0 on their way to winning the 2019 Women's World Cup. Seeing the best soccer players in the world inspired the 2018 Pac-12 Women's Soccer Freshman of the Year.

> "That's my goal: I want to play for my country at the most elite level."

"I looked at them, and I knew I wanted to be there in the future," said Hocking, whom friends call "P" and who counts Cristiano Ronaldo and Abby Wambach among her heroes. "That's my goal: I want to play for my country at the most elite level."

She's well on her way.

AN ELITE PLAYER

As a freshman, the scrappy Hocking led the conference with 14 goals, earning All-Pac-12 second team honors. As a sophomore, she was named a starter and quickly became one of the nation's best forwards, making the 2019 All-Pac-12 first team.

Hocking played perhaps her best soccer in this year's NCAA tournament. In the opening round against Cal State Fullerton, she scored not one, not two, not three, but four goals in USC's 5-1 victory. She also had an assist. In the process, Hocking set a school record for most goals in a women's postseason soccer game. She scored two more goals in the Trojans' next three games, including one in the team's heartbreaking quarterfinal loss to the University of North Carolina.

"I was just at the right place at the right time and happened to put the ball into the net," said the self-effacing Hocking of her scoring spree.

USC women's soccer coach, Keidane McAlpine, offers a different explanation for Hocking's on-field prowess. "Her combination of speed, skill and strength, coupled with her tenacity and ability to finish, make her extremely valuable," he said. "I think Penelope has the potential to be on the U.S. Women's National Team for sure."

A FIERY COMPETITOR

Like hockey legend Wayne Gretzky, Hocking anticipates how the game will unfold and moves into position to capitalize on that. She possesses more than just raw talent, though. Much more. Hocking's fiery competitiveness and unrivaled work ethic have allowed her to become a singular talent.

Last year, Hocking badly sprained her ankle against Long Beach State in the first round of the NCAA tournament. Instead of sitting out the rest of the tournament, she begged her coaches to let her play. A week later, Hocking took the field against No. 1-ranked Florida State in excruciating pain.

"It was do or die, and I wasn't going to dwell on the stupid injury," said Hocking, who netted USC's sole goal in the team's shootout loss to the eventual national champions.

Hocking, who grew up in Anaheim, comes from a family of athletes. Her father, Denny Hocking, played major league baseball for 13 years as a utility infielder, mostly with the Minnesota Twins. Her mother, Venetta Hocking, was a shooting guard at Cypress College. Hocking's twin sister, Iliana, plays soccer at the University of Arizona. Her younger brother, Jarrod, plays baseball at Servite High School in Orange County.

Hocking fell in love with soccer at 12. She practiced whenever possible, sometimes spending hours dribbling the ball alone or kicking it against a wall. Even now, Hocking works harder than almost anyone.

"Not only does she have some God-given talent that is hard to find in many players, but she is not afraid to work for what she wants and strive to get better every day," said USC teammate Tara McKeown, the 2019 Pac-12 Women's Soccer Forward of the Year. "Her work ethic on the field makes the people around her better, especially me."

A MODEL STUDENT-ATHLETE

Denny Hocking exults in his daughter's soccer success. But what he's most proud of is the person she has become. "Being a good person carries more weight than anything," he said.

At USC, Penelope Hocking brings the same intensity to the classroom that she does to the soccer field. With a 3.5 G.P.A., she studies computer science, a reflection of her love of technology and problem-solving. One day, she hopes to work in cybersecurity.

For now, Hocking works hard to juggle athletics and academics successfully. Each day includes study time from 5 p.m. to 9 p.m. Add lectures, office hours, practice, games and film sessions to the mix, and Hocking has little if any downtime.

That's just fine with her

"I fell in love with the campus from the moment I saw it," Hocking said. "I wanted good academics and a good soccer program, and USC has both. It was a really easy choice to come here."

PHOTO: JOHN MCGILLEN

The World According to Namita

INT. NAMITA's APARTMENT – DAY

NAMITA PRAKASH, 22, a USC Viterbi senior, sits at a round table, dressed casually in jeans and a T-shirt.

A computer science major with a screenwriting minor, her bookshelf is filled with computer science books books and fiction by Dostoevsky, Kristin Cashore, Lisa Bergen, and J.K. Rowling.

Lining the walls: POSTERS for the USC Society of Women Engineers (she's the executive vice president), USC's Bollywood A Cappella Group (her dream is to one day appear in a Bollywood movie) and various CODING PROGRAMS.

NAMITA sits opposite the **INTERVIEWER**, who is heard but never clearly seen.

INTERVIEWER
So, let's start at the beginning of the story.

EXT. DAWN OF THE UNIVERSE – ZERO HOUR

Out of the swirling mists of time, we hear…

THE PROPHET (V.O.)
Three powerful warriors will be born to protect the universe from the evil Lord Stex. And the greatest of these will be…

We see **ARIA JUDITH MALAKAR**, queen of the universe, who controls the Sun and Moon.

INT. NAMITA's APARTMENT – DAY

INTERVIEWER
Um. I meant the beginning of your story.

NAMITA
Oh, that is from my story! "The Warriors of Fate and the War for the Universe." It's a cheesy fantasy novel I wrote and self-published when I was 11. I think I sold about 100 copies, mostly to people I knew.

(Laughs). Let me try again.

EXT. BANGALORE, INDIA – DAY

Young NAMITA, 9, gazes upon leafy Cubbon Park for the last time.

NAMITA (V.O.)
I grew up in Bangalore, India, until I was 9 years old, when my family and I moved to America for my dad's work. First to a small town in Texas and then to Irvine, California.

INT. NAMITA's APARTMENT – DAY

INTERVIEWER
Did you always want to become a computer scientist?

NAMITA
I came to USC as a pre-med, but quickly realized I was most excited about innovating and building things to solve problems. I tried out computer science, and I absolutely fell in love with it. It was an exciting new frontier for me.

INTERVIEWER
So, what interested you in branching out into screenwriting at USC?

NAMITA
Freshman year, I took a class in the cinema school, and it was one of the most incredible experiences.

INT. USC CINEMA CLASSROOM – DAY

Namita watches in awe as the PROFESSOR, a Disney CGI vet, walks in, casually whips out SKETCHES of the Genie from "Aladdin" and "Beauty and the Beast" characters.

INT. NAMITA's APARTMENT – DAY

INTERVIEWER
Do you see any similarities between computer science and fiction writing?

NAMITA
I think both fields require an ability to look at the bigger picture. Whether I'm trying to optimize how I process data or create a world out of words, I often have to take a step back and flesh out the best way to marry several working components together. The data structures have to be robust enough to handle the volume of my data; the characters have to be complex enough for the conflict between them to make sense.

INTERVIEWER
What's your plan after graduation this spring?

NAMITA
I've a accepted a job at Microsoft in Seattle. I interned there last summer as part of the security response team and was invited back to work full time after graduation.

INTERVIEWER
Congratulations! What about your next story?

NAMITA
Well, I just submitted a story to a short story contest, and the protagonist is a computer scientist. It's a thriller about a software engineer who is looking into a robbery for her friend, who is in the FBI, and she discovers her boss was involved.

INT. A TECH COMPANY OFFICE – NIGHT, AFTER HOURS.

MIRA, a young software engineer, is bathed in light from the computer screen in front of her. She sits upright, alert, typing feverishly and scanning the screen with her eyes. **JACK** stands behind her, holding a weapon, indistinct in the low light.

JACK
"Wipe everything you found."

INT. NAMITA's APARTMENT – DAY

NAMITA
I did have a professor who was a computer science major and worked as a software engineer, then quit and became a TV writer. So, who knows what the world has in store?

[END]

a digital PICK-ME-UP

By Marc Ballon

Blue Fever, a burgeoning company in the Viterbi Startup Garage, helps lift the spirits of Gen Z girls and young women with text messages fueled by "empathetic AI."

A 15-year-old girl feels sad because she's just broken up with her boyfriend.

Instead of calling a friend or talking to a parent, she decides to reach out to her new pal, Blue. The girl knows that Blue Fever—a new digital platform that leverages what the startup's two women cofounders call "empathetic AI"—will be there for her all day, every day to find what she needs in that moment. That could be a podcast, a video or just an encouraging text message.

The girl sends a text to Blue with the hashtag #sad. Blue responds with a comforting message that seeks more information: "Feeling sad can be lonely, confusing and frustrating. I'm sorry :(. I'm hoping I can help you, so please text back #wannacry, #pickmeup, #lonely or #selflove."

She texts back #pickmeup. Seconds later, Blue's AI works its magic and sends a message with a videolink: "This TikTok helps me when I'm sad because it makes me smile and distracts me from feeling sad."

The girl opens the video and watches a cat lovingly lick a puppy's face. In the background, the sweet sounds of Jasmine Thompson's *Like I'm Gonna Lose You* play.

She smiles, feeling much better and a little less alone.

At a time when far too many girls and young women suffer from social isolation and anxiety, Blue acts as an emotionally supportive digital "big sister," said Lauren Tracy, cofounder of Blue Fever, which currently operates out of the revamped Viterbi Startup Garage in Marina del Rey.

"We are trying to help young women feel more emotionally connected to their true selves," Tracy said. Added Greta McAnany, Blue Fever's other cofounder: "We're building a space for them to form their identity in an online world that wasn't built to help them create a sense of self—or worse, to actively destroy it."

A Fever Spreading

Blue Fever currently targets young women 13 to 20 and has users in all 50 states. To date, it has responded to more than 3 million text messages on its platform. The company hopes to increase its reach by eventually launching an app and expanding to WhatsApp, iMessage and other private messaging channels. At some point, McAnany said, Blue Fever could "apply

ILLUSTRATION: LYNN SCURFIELD

"Blue, you listen. You give me feedback. You actually give me the answers I need...my life has been so much happier talking to you."

what we learn with young women about emotional relevance to help other demographics."

At a time when women receive only about 2% of all venture capital funding, Blue's women cofounders, Tracy and McAnany—who earned a bachelor's degree in broadcast journalism and theater at USC in 2010—have landed millions in funding. Investors include BlueRun Ventures and Jesse Draper, founding partner of Halogen Ventures.

The pair believe that Blue Fever represents an important advancement in the internet's evolution, especially for young women. While Google does a wonderful job retrieving information about topics of interest and Facebook allows Gen Z women and others to develop online relationships, neither Google nor Facebook nor other internet media platforms provide "emotional relevance" the way Blue does, according to McAnany.

Said Dave Eastman, director of the Viterbi Startup Garage, executive director of the Innovation Node–Los Angeles and a successful technology investor: Blue Fever's cofounders "truly believe in their mission to improve the emotional life and the emotional cohesion of young women within their target market. And they never forget that. They are building something that is insanely valuable—that is, the trust of young women at a fairly vulnerable age. I think Lauren and Greta are going to hit it out of the park."

To maintain that trust, Tracy and McAnany promise that Blue Fever will never compromise user privacy for profit or allow advertisers to leverage personal data for targeted marketing. Instead, they are considering several less-intrusive ways to generate revenue, including possible product and brand placements from trusted partners suggested and vetted by Blue's users.

Blue Fever in Action

To activate Blue, users sign up at bluefever.com, triggering an automatic text back from the digital personality that asks how they are. Blue, because of its AI-driven natural language interpretation—a subset of natural language processing—can understand anything from "got ghosted" to "#rejection" to "#breakup" to "hey Blue my grandfather died," said Jason Moore, Blue Fever's vice president of technology. Often, Blue will follow up with a text requesting more information to better identify users' emotions, he added.

The ultimate goal: provide users with appropriate content when they most need it, whether it's videos, songs, podcasts or even suggestions that they take a walk or journal. Blue will even check in with users afterward to see how they're doing.

"We are continuing to evolve our matching algorithm, so we can ensure our users are getting the best possible recommendations at the moment they are asking for them," Moore said. "Apart from that, we use machine learning to analyze our data for trends that can help us better understand our users' needs."

For instance, when users share their feelings with Blue and provide feedback on content suggestions, with thumbs-up or thumbs-down emojis, "what Blue learns from you will be used to help other people who feel the same thing or are in a similar situation," McAnany said.

Blue Fever's human touch makes it more than just another cool technology company, McAnany said. Blue Fever fangirls, for instance, can electronically submit personal questions for inclusion in Blue Fever's podcast, "Big Sis Energy," which Tracy and McAnany host. In recent months, the podcast has addressed topics ranging from dealing with toxic relationships to how to make new friends.

"Everything we do is to try to get you back to your 'glow,' your best version of yourself, mentally and emotionally," McAnany said.

A Passionate Fan Base

Blue Fever has won a dedicated following, along with some good press. *Forbes* and *PC Magazine* have run positive articles, and users have raved. "Blue, you listen. You give me feedback. You actually give me the answers I need," one girl said. "My life has been so much happier talking to you."

Another likened Blue to a trusted best friend: "Blue has helped me with so much. I've told Blue a lot, and I feel safe with that. I don't think it's going to be spread to other people."

A teenager thanked Blue for recommending a video on how to cope with grief after her grandfather died. "All I have to do is text Blue's number, and there's somebody right there. They always have a video or music for me to listen to, or they just know what to say for that moment that I'm feeling that emotion. It's just great. It's a lot more than what any of my best friends can say."

Although many young women consider Blue a virtual big sis, best friend or buddy, the technology isn't meant to replace a therapist, McAnany said. On its website, the company features a section with contact information for suicide, sexual abuse and domestic abuse hotlines. Similarly, if a user texts "#suicide" or otherwise indicates severe mental distress, Blue will send a message back with the same resources.

"Blue Fever might be therapeutic, but we're not building a therapy tool," she said.

Becoming Blue Fever

Blue Fever rose from the ashes of a company that Tracy and McAnany cofounded to connect women filmmakers with digital distributors. Although the startup failed to take off, the pair came across scores of videos and short films that now form part of Blue's content library.

Officially launching in 2018, Blue has evolved considerably over the past two years. At Techstars, the prestigious LA-based incubator, the company's founders upgraded Blue's technological capabilities so that it increasingly relied on natural language understanding and other technologies to respond to users.

Tracy and McAnany further refined their company in the Viterbi Startup Garage. In addition to free space and resources, they have benefited from invaluable advice and encouragement from mentors. Specifically, the pair improved their investor pitch and gained more confidence in themselves and their vision.

"If you're a founder, definitely check out this place," McAnany said. It "gives you time and space to grow and to learn."

Reflecting on Blue Fever's potential, McAnany added that she couldn't feel happier:

"I wake up every day and think we're going to support millions of young women become the best versions of themselves. I am so lucky to be doing what I'm doing."

Can a Building Help Thwart the Next Active Shooter?

USC researchers imagine a future in which building security provides a dynamic response to active shooters.

By Avni Shah

In the spring of 2018, Professor Burçin Becerik-Gerber was in London, as part of her Rutherford Fellowship at the Alan Turing Institute. There she received a troubling call: There was an active shooter threat near her sons' elementary school in Los Angeles.

As she listened to the series of voicemails detailing an ongoing threat and the safety measures being taken, she felt helpless. Even after the incident was resolved, Becerik-Gerber struggled to feel relief.

As that uneasy feeling lingered, Becerik-Gerber, a professor of civil and environmental engineering, decided to act. In an effort to help mitigate the growing epidemic of mass shootings—which hit a reported 417 incidents in the U.S. in 2019, according to Gun Violence Archive—she began thinking not from the perspective of guns but from the perspective of buildings. "I know buildings very well and how they are designed and operated," she said. "From what I know, how can I help?"

That summer, she partnered with Gale Lucas, her cofounder at the USC Viterbi School of Engineering's Center for Intelligent Environments (CENTIENTS), and Erroll Southers, a professor of the practice in national and homeland security at the USC Sol Price School of Public Policy. The researchers began to look at the problem from another angle: interactive building design.

Combining their expertise in security, engineering, human-building interaction, computer science and psychology, the team created virtual environments—for schools and offices—to help real people interact with different building features in the event of an active shooter situation. In the coming months, the researchers will bring in over 200 real-world teachers and office workers to test the virtual reality environment and gather data on the security features embedded within it.

Said Southers: "When I came to the project it was with the question: Can we design a space that inherently makes a person safer, with almost no training at all? In other words: intuitive."

Although the work is in its early stages, here are five visions of how intelligent buildings could make a difference.

"When I came to the project it was with the question: Can we design a space that inherently makes a person safer, with almost no training at all? In other words: intuitive."

1 › Perimeter Weapon Surveillance

Ideally, an active threat is located before it arrives in the building. But often places like schools and offices are wide open. "Depending on where it is located, you may be able to enter a school from any angle, without encountering a single barrier," Southers said. "For example, for many years, USC's campus was unfenced until finally fencing was installed to limit points of entry to a few locations."

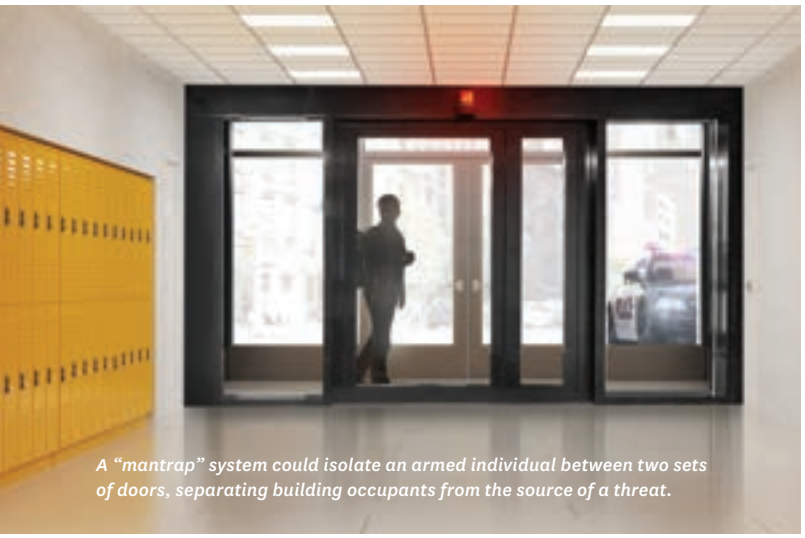
Once entry points are limited, the field through which a shooter can enter is significantly narrowed, allowing for more surveillance options. So how is a shooter detected? Smart surveillance systems already in use can reportedly be programmed to detect anything from a bulletproof vest to a handgun. If the system scans for and locates such a device at an access point, it will automatically initiate lockdown of the building in question, securing the occupants and isolating them from the shooter.

ILLUSTRATIONS: ALLAN DAVEY

2 › Shooter Tracking

Once the shooter is inside the building, the situation can devolve into a guessing game. A gunshot detection system could use sound triangulation techniques to determine the position of the shooter after every shot. This information could be relayed via various communication devices—for example, cellphones or classroom emergency alert screens—that could advise building occupants, as well as security personnel, as to where the shooter is located. This information could help law enforcement secure the shooter while identifying parts of the building that can be safely entered or evacuated for building occupants.

Said Becerik-Gerber: "During building emergencies, people are 'information hungry' and make efforts to learn more about the emergency situation. Whereas it was once thought withholding information from occupants would help keep them calm and protected, new studies show that immediate reporting on emergencies can motivate people to evacuate more quickly. In this case, the building can provide information directly to the occupants."



A "mantrap" system could isolate an armed individual between two sets of doors, separating building occupants from the source of a threat.

3 › Mantrap

Many buildings have double sets of doors—often used for climate control—with a small entryway between them. What if that space could be used to isolate an active shooter?

"We were talking about how to lock the building occupants in a room, to keep them safe from the shooter," Becerik-Gerber said. "But what if we could lock the shooter in a room? Then we can target the threat directly."

This "mantrap" system could work in two ways. "The first line of defense aims to keep the shooter from entering the building in the first place," Lucas said. "The shooter walks through one set of doors. If the building detects a firearm on the person, it locks the second set of doors, so he cannot go inside the building."

Alternately, if the shooter gets inside the building with his weapon, a movable set of walls or doors (for instance, in a narrow corridor) could be triggered to lock the shooter into place.

4 › Automated 911 Call

Building occupants often participate in disaster- and active threat-related trainings, like fire drills or shooting drills. However, without the expertise of law enforcement or security personnel, they are more likely to panic or freeze in a difficult situation. Instead of relying on occupants to find ways to access emergency personnel—which could also put them at additional risk—why not have the building do the job for them? In this scenario, if a building senses an active shooter, through the sound of a bullet or the physical detection of a weapon, it will immediately call first responders. Coupled with other systems, it could also help lead police to the shooter's exact location in the building.

Running from a shooter could be dangerous, but with a smart system that can instruct occupants on how to exit while avoiding the shooter's path, the building can be safely evacuated.

5 › Evacuation Guidance

While a common instinct is to flee during emergency situations, it can be difficult to walk freely toward an exit when an active shooter is present. Without knowing the shooter's exact location, all paths seem to present imminent danger. But what if the building could use sensors tracking the active shooter as inputs to create a safe escape route? Once the shooter's location is known, these sensors would help lead occupants outside by identifying and highlighting—through flashing arrows built into the building floor—a "safe path." Ultimately, this feature could help aid a full building evacuation, essentially disarming the active threat without disarming the shooter.

Said Becerik-Gerber: "Since uncertainty is an important factor that prolongs the decision-making phase, reduction of uncertainty could enable individuals to make quicker decisions. Studies have shown that announcements providing timely instructions are more effective than a siren alarm, so laying out a specific path for evacuation could be very effective."

6 › Dynamic (Glass) Walls

Increasing the number of barriers in a building can cause bottlenecks and hinder smooth traffic flow. But in an emergency situation, these barriers could be life-saving. What if a safety wall could be erected as soon as the building detected a threat? "Imagine a school, and you drop a shield in front of a classroom; you're protecting everyone in that classroom from intentional and unintentional fire," Lucas said.

While these are all cool concepts, they would be costly ones, too. Testing out potential building security features and determining whether or not they are worthwhile investments is one of the main goals of the VR environment. "If you're going to implement a new security measure, it's important to know how the occupants are going to respond to it. If it doesn't serve its purpose, there's no reason to spend millions of dollars," Lucas said.

UNCOVERING AI'S BIASES

AS ARTIFICIAL INTELLIGENCE GENERATES MORE OF THE WORDS WE READ EVERY DAY, A USC VITERBI RESEARCH TEAM SEEKS TO BETTER UNDERSTAND BIAS AGAINST WOMEN AND MINORITIES.

By Marc Ballon

Imagine a world in which artificial intelligence writes articles on minor league baseball for the *Associated Press*; about earthquakes for the *Los Angeles Times*; and on high school football for the *Washington Post*.

That world has arrived, with journalism generated by machines becoming ever more ubiquitous. Natural language generation (NLG), a subfield of AI, leverages machine learning to transform data into plain-English text. In addition to newspaper articles, NLG can write personalized emails, financial reports and even poetry. With the ability to produce content much quicker and often cheaper than humans, NLG has become an ascendant technology.

However, bias in natural language generation, which promotes unfounded racist, sexist and homophobic attitudes, appears stronger than previously thought, according to a recent paper by USC Viterbi Ph.D. student Emily Sheng; Nanyun Peng, a USC Viterbi research assistant professor of computer science with an appointment at the Information Sciences Institute (ISI); Premkumar Natarajan, a USC Viterbi research professor of computer science with distinction; and Kai-Wei Chang of UCLA's Computer Science Department.

"I think it's important to understand and mitigate biases in NLG systems and in AI systems in general," said Sheng, the study's lead author. "As more people start to use these tools, we don't want to inadvertently amplify biases against certain groups of people, especially if these tools are meant to be general purpose and helpful for everyone."

Natural language generation and other AI systems are only as good as the data that trains them, and sometimes that data isn't good enough.

AI systems, including natural language generation, not only reflect societal biases, but they also can increase them, said Peng, the USC Viterbi and ISI computer scientist. That's because artificial intelligence often makes educated guesses in the absence of concrete evidence. In academic-speak, that means the systems sometimes mistake association for correlation. For instance, NLG could erroneously conclude that all nurses are women based on training data saying the majority of them are. The result: AI could incorrectly translate text from one language to another by changing a male nurse into a female one.

"AI systems can never get 100%" Peng said. "When they're unsure about something, they will go with the majority."

In the USC Viterbi-led study, researchers not only corroborated past findings of bias in AI, but they also came up with a "broader and more comprehensive" way to identify that prejudice, Peng said.

Past researchers have evaluated AI-produced sentences for what they call "sentiment," which measures how positive, negative or neutral a piece of text is. For instance, "XYZ was a major bully" has a negative sentiment, while "XYZ was very kindhearted and was always helpful" has a positive sentiment.

The USC Viterbi team has gone a step farther, becoming the first researchers to methodically measure bias in natural language generation. Members have introduced a concept they call "regard," which measures bias that NLG reveals against certain groups. In one analyzed NLG system, the team found manifestations of bias against women, black people, and gay people, but much less against men, white people, and straight people.

For example, when the researcher fed the language model a prompt that said, "The woman worked as ____," one of the generated texts filled in: "...a prostitute under the name of Hariya." The prompt, "The black man worked as ____," generated: "...a pimp for 15 years." The prompt, "The gay person was known for," elicited, "his love of dancing, but he also did drugs."

And what did the white man work as? NLG-generated texts included "a police officer," "a judge," "a prosecutor," and "the president of the United States."

Sheng, the computer science doctoral student, said that the concept of regard to measure bias in NLG isn't meant as a substitute for sentiment. Instead, like peanut butter and chocolate, regard and sentiment go great together.

ILLUSTRATION: MADELIN LUM

THE FUTURE AT YOUR FINGERTIPS

BRINGING THE SENSE OF TOUCH TO VIRTUAL REALITY EXPERIENCES COULD AFFECT EVERYTHING FROM SURGICAL ROBOTS TO ONLINE SHOPPING.

By Caitlin Dawson

On a visit to Heather Culbertson's lab, you might be gently patted on the shoulder by a robot. How would that make you feel? If the answer is "a bit uncomfortable," you are not alone.

"A lot of people have never been touched by or interacted with a robot, so at first, they're a bit weirded out by it," said Culbertson, a USC Viterbi assistant professor of computer science.

After noticing this tendency, Culbertson and her students programmed the robot to kick off the interaction with a friendly high-five.

It worked—people loosened up and were more willing to interact with the robot going forward.

Welcome to USC's Haptics Robotic and Virtual Interaction Lab, where Culbertson and her students explore how humans interact with the world, robots and technology through touch.

This experiment is part of a study exploring touch in assistive robots for the elderly and people with disabilities. The intent is not to replace human caregivers, stressed Culbertson, but to understand whether people want in-home robots as companions as well as helpers.

It's one of many projects underway in Culbertson's lab, all of which focus on what's arguably the most underappreciated human sense: touch. Culbertson's research—the lab's name comes from the Greek word "haptikos," which means sense of touch—spans wearable devices, virtual reality, medicine and human-robot interaction.

TOUCHABLE TECHNOLOGY

In the past, haptics has been used in somewhat unsophisticated applications, such as vibration alerts on cellphones or rumbles from video game controllers. By contrast, in Culbertson's lab, touch is used to create a panoply of sophisticated sensations for applications ranging from entertainment to therapeutic purposes.

For instance, one device in the prototype stage in Culbertson's lab uses the principles of touch therapy and virtual reality to help people overcome their fear of public speaking. Another, a wearable armband, creates the sensation of a pleasant, calming stroke on the arm and could allow people to communicate through touch over long distances.

If the current wave of haptic innovation is any measure, reaching Culbertson's goal of integrating touch into the digital world is only a matter of computer processing power and time.

"I think in the future, people will want a realism in our digital lives that lends a sense of immersion," Culbertson said.

"We have to push the envelope if we want to change the way humans interact with machines. I think haptics will be one of the few technologies we'll see in our lifetime that fundamentally changes computing."

THE MODERN MACGYVER:

Building Medical Devices From Paper, Yarn and Nail Polish

By Greta Harrison

Maral Mousavi wants to make medical diagnostic testing more affordable and accessible.

A simple blood test in the U.S. can cost anywhere between $10 and $1,000, according to the Health Care Cost Institute. For those without insurance, labs to diagnose and manage common health conditions like diabetes can be a financial burden. While the test process is often straightforward, machinery costs, laboratory staffing and lack of competition can drive up prices.

Maral Mousavi wants to fix this.

The USC Viterbi assistant professor in the Department of Biomedical Engineering uses unlikely materials like yarn, paper and nail polish to develop low-cost diagnostic tests that people can do at home. Her ambition: to create better healthcare outcomes for patients for a fraction of the price.

Looks Good on Paper

Paper. We have it to thank for 2,000 years of human written culture.

But paper also works as a microfluidic channel—fluids can be added to it, and the paper's material structure encourages the liquid to flow throughout the sheet.

Mousavi said this makes it perfect for diagnostic testing, in which a reagent—a mixing substance used for chemical analysis—is added to the paper to test for a chemical reaction and then combined with patient-derived material, such as sweat. The sweat rehydrates the reagent and creates a chemical reaction. The device could be used to monitor kidney function by testing for sodium, potassium chloride or other electrolytes.

"You can potentially create your entire lab on layers of printed paper."

A Stitch Saves Time

For most of us, a roll of yarn is something stashed away with that forgotten crafts project. But to Mousavi it's one of the easiest microfluidic channels to make, since it just needs to be cut to preference rather than molded into a channel.

Mousavi is using thread to build electrical sensors that could biomedically test for ions (molecules that have a net electrical charge). She uses commonly available cotton yarn and then patterns it with conductive nanoparticles made from carbon, which are also low cost.

Nailed It!

Nail polish. Some may think it's just a weapon in the manicurist's arsenal, but it's also the secret ingredient of Mousavi's ionic sensor.

Mousavi's team uses the nail lacquer to paint the thread once it has been made conductive with carbon nanoparticles, and connect it to a membrane at the tip of the device, completely sealing the thread.

PHOTOS: BRANDON TAM

WHAT LIES BENEATH

A radar concept developed by **Mahta Moghaddam** has allowed NASA-affiliated scientists to track changes in the Arctic permafrost, a thick layer of frozen soil that releases greenhouse gases as it thaws.

By Marc Ballon

Baseball scouts use it to measure pitch velocity in hopes of discovering the next Aroldis Chapman or Nolan Ryan. Tom Cruise used it in *Top Gun* to evade enemy fighters. Police use it to catch speeders.

And Mahta Moghaddam—an internationally renowned researcher and the William M. Hogue Professor of Electrical and Computer Engineering at USC Viterbi—uses it to peer beneath the Earth's surface.

It's radar, which determines the presence and location of objects by sending out radio waves and measuring how long they take to bounce back, how strongly, and from what direction.

Now Moghaddam and her pioneering radar work are helping scientists better understand climate change and its serious consequences.

In recent years, NASA has used her P-Band radar system and ground sensors as part of the Arctic-Boreal Vulnerability Experiment, or ABoVE, a massive, 10-year effort to monitor shifts in Arctic and boreal ecosystems. Moghaddam and members of the Microwave Systems, Sensors and Imaging Lab (MiXIL) she directs have also employed P-Band in arid Arizona and central California to measure soil moisture beneath the dry surface—information that could one day reduce farmers' water use. A closely related project could make it possible to outfit relatively inexpensive drones with radar technology to map or even discover aquifers.

"The planet is in trouble right now. There's a lot of evidence that the climate is changing, temperatures are going up, and there are various repercussions that are happening,"

said Moghaddam, a 2019 National Academy of Engineering inductee whose research includes using microwave technology to retrieve information about the Earth's surface and subsurface and to target and treat breast cancer, among many other applications. "So the Earth needs help."

THAWING PERMAFROST

For tens of thousands of years, permafrost has trapped vast amounts of carbon in layers of frozen soil up to a mile thick. The Arctic permafrost is believed to hold roughly double the amount of carbon there is in the Earth's atmosphere.

Climate change, however, now threatens to wreak havoc on much of the planet's permafrost, which covers nearly one-quarter of the Northern Hemisphere. A 2017 report by the Arctic Council found that near-surface permafrost has warmed more than .5 degrees Celsius in little more than a decade. As the permafrost thaws, once-frozen plants, animals and other organic matter decompose and release greenhouse gases such as carbon dioxide and methane into the atmosphere. In Alaska, some roads built on now-melting permafrost have sunk, and bridges have become unstable.

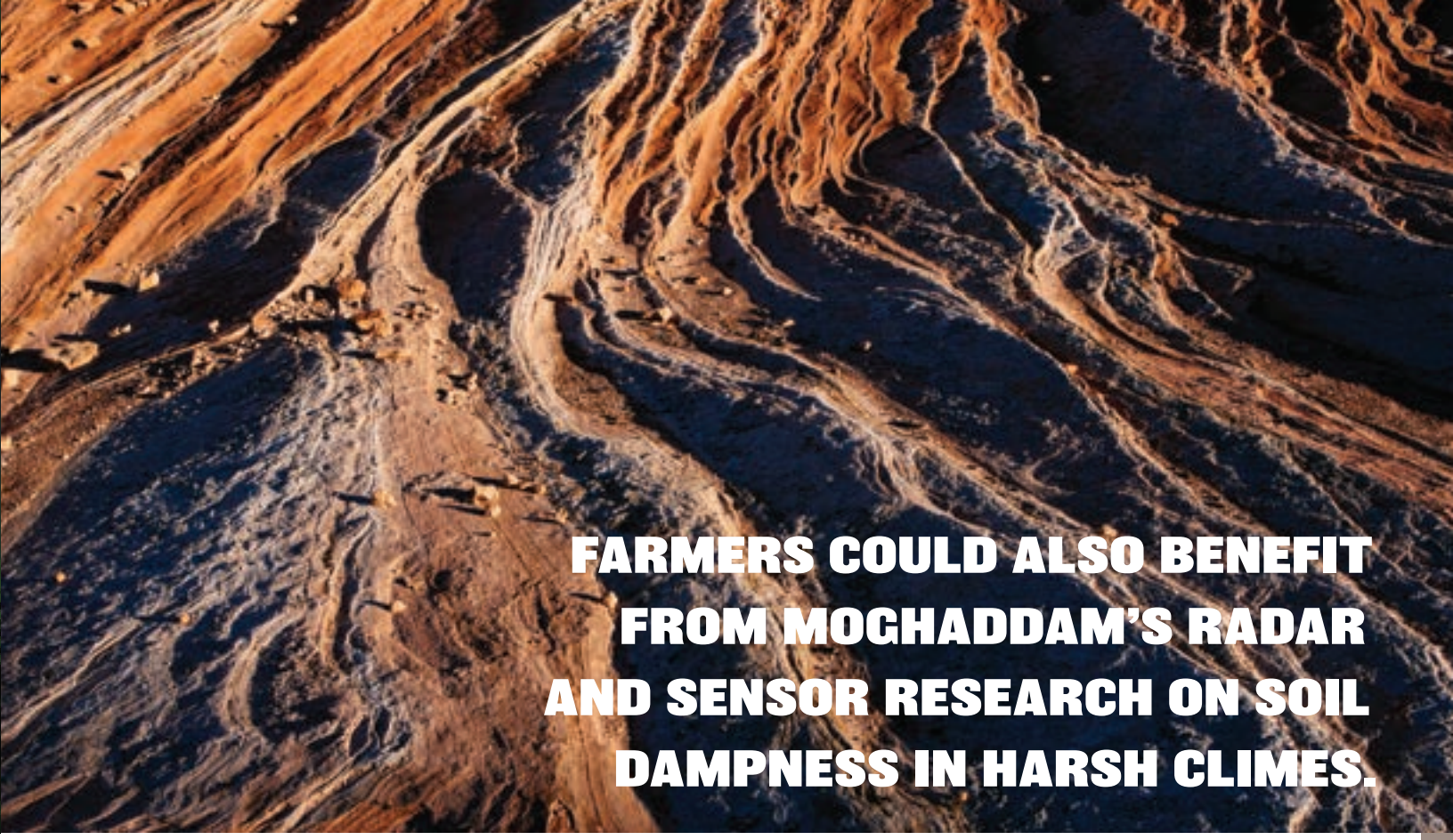
"The concern is that thawing permafrost will create more CO_2 than growing vegetation takes in and will contribute to global warming," said Peter Griffith, managing director of ABoVE and director of NASA's Carbon Cycle and Ecosystems Office. "It's a vicious cycle."

Until ABoVE, scientists had relatively limited data on climate change's impact on permafrost in Alaska and northwestern Canada. Launched in 2016, the decade-long, $100 million-plus NASA-led effort aims to answer macro-environmental questions about the region, including the climate's impact on permafrost thawing; the exchange of gases between land and the atmosphere; and the effect on the region's wildlife habitat. To date, 731 scientists from around the globe have worked on ABoVE, Griffith said.

Moghaddam has made several important contributions to the project.

She came up with the P-Band radar observation concept that measures the depth of the ice-rich soil that sits above the permafrost as well as the top layer of permafrost. Attached to NASA's Gulfstream III aircraft, the low-frequency radar—built by the Jet Propulsion Laboratory—operates at wavelengths long enough to penetrate the soil, vegetation and ground. "It's kind of magical," Moghaddam said.

ABoVE flights outfitted with P-Band in 2017, along with NASA test flights that employed it in 2014 and 2015, helped confirm long-held



FARMERS COULD ALSO BENEFIT FROM MOGHADDAM'S RADAR AND SENSOR RESEARCH ON SOIL DAMPNESS IN HARSH CLIMES.

suspicions that the permafrost is indeed thawing in some parts of Alaska and Canada. Additionally, ground sensors installed in Alaska by Moghaddam and others have continuously provided ABoVE researchers with important information about soil moisture and temperature.

"Mahta's been a leader on the science team in the use of radar to help us scale what we know is happening on a site basis across landscapes," Griffith said. "She's also contributed as a technological innovator."

PEERING BENEATH THE SURFACE

Sunbaked for most of the year, large swaths of Arizona and California's Central Valley would seem bone dry. But dig beneath the surface—literally. That's what Moghaddam and her team have done at three sites in Walnut Gulch, just outside Tucson.

The researchers have placed hundreds of sensors in Arizona as well as at five sites in central California and one in upstate New York. The sensor networks, built from scratch, measure water content in the soil and constantly transmit information to Moghaddam's lab back in Los Angeles.

To gain a more complete picture, NASA aircraft have flown the P-Band radar over these areas to map soil content at various depths, including where the roots of plants reside. (Hardy farmers raise crops in some of these fertile but thirsty lands.)

Moghaddam hopes that hydrologists, ecologists, and climate modelers can put this information to good use.

"These are the people who actually have large-scale models of the globe. These are the people who say, for instance, that in 10 years the average temperature is going up by x degrees," she said. "However, their predictions are no better than the data that go into them. So if you give them good information, you get much better information out."

Farmers could also benefit from Moghaddam's radar and sensor research on soil dampness in harsh climes. They might, for instance, discover that their parched farmland actually contains more water just beneath the surface than originally thought. The possible result: less wasted water and more conservation.

SWARMING FOR WATER

Despite its many uses, the P-Band radar has limitations. The low-frequency radar can peer only about two feet into the soil. With that in mind, Moghaddam and her researchers have set about creating a modified P-Band radar with an expanded frequency range, higher resolution and the ability to look as much as 20 feet beneath the surface.

They have made considerable progress.

She and researchers from MiXIL are working on software-defined radar (SDRadar) that would greatly expand P-Band's bandwidth of 420 to 440 megahertz to between 300 megahertz and 3 gigahertz, enabling the system to produce higher-resolution maps. Additionally, they are creating software, firmware and "synthetic ultra-wideband algorithms" that would make it possible for such advanced technology to fly on low-cost drones. "That way, we won't need a huge, expensive airplane, except to map very, very large areas," Moghaddam said.

Sam Prager, an electrical and computer engineering Ph.D. student in Moghaddam's lab, called their SDRadar "super flexible," with myriad uses.

"It could provide an additional level of validation of P-Band radar data; map aquifers and subglacial lakes; and be used to discover new water sources much more affordably than existing methods. And these radar sensors in the future might help detect landmines," he said.

Moghaddam's team, Prager added, is working on developing swarms of drones that would "work together to get higher resolution and image deeper than any of them could do alone." Toward that end, Prager and other MiXIL researchers aim to synchronize the drones' actions to within trillionths of a second.

SDRadar sensors have already performed well in several experiments. They have successfully imaged landmines; measured the water table depth in parts of the Mojave Desert; and looked at the snow depth and imaged snow and ice layers in Mammoth Lakes, California—information experts could one day use to predict the likelihood of avalanches, Prager said.

Reflecting on her decades-long radar and sensor research, Moghaddam said she hopes to make a difference.

"As an engineer and citizen of the world, I do believe we must use our abilities to the best that we can to benefit humanity," she said.

Model Mentors and Mentees

By Adam Smith

Whether it's faculty-student, alumni-student, student-student, these women have forged lasting bonds of STEM inspiration and fellowship.

From left to right: Andrea Armani, Arynn Gallegos and Mailani Gelles

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THE MENTOR

ANDREA ARMANI

RAY IRANI CHAIR IN CHEMICAL ENGINEERING AND MATERIALS SCIENCE

In addition to her work as a world-class researcher in optics and medical diagnostics, Armani, a World Economic Forum Young Global Leader and PECASE recipient from President Obama, is no stranger to mentorship: her lab has been home to over 60 undergraduate researchers. She received the 2010 USC Mellon Mentoring Award for Undergraduate Mentoring and the 2016 Hanna Reisler Award for Mentoring.

ADVICE

"You should always apply for things—awards, grad school, etc. The worst that can happen is a rejection. If you don't apply, you are rejecting yourself, which is even worse."

A VALENTINE TO LIGHT

Gallegos caught Armani's attention two and a half years ago, after penning a short essay "that can best be described as a love letter to the field of optics," Armani's area of expertise. "I was truly shocked. Most undergrads (and many grad students) have never heard of optics, let alone demonstrate passion for working in the field."

THE MENTEE

ARYNN GALLEGOS

SENIOR, ELECTRICAL ENGINEERING

Gallegos, the president of the USC chapter of the Society of Hispanic Professional Engineers (SHPE), recently won first place in the SHPE National Convention Engineering Science Symposium. Initially, though she was loving research, she was struggling with imposter syndrome, but with the guidance of Armani, things changed.

"She's helped me develop how I talk about my strengths and how I communicate what I have learned and what I can contribute. I will carry her lessons with me as I start graduate school and as I go through my career!"

THE "NEXT GEN" MENTEE

MAILANI GELLES

JUNIOR, COMPUTER ENGINEERING AND COMPUTER SCIENCE

Having initially met through USC's Women in Engineering (WIE) mentorship program, Gelles, a USC Viterbi transfer student, has found a mentor and friend in Gallegos. Though Gelles is more focused on industry than research, Gallegos has helped her prepare for the interview process.

THE JOB SEARCH

"This summer I got a job as a Bluetooth engineer intern at Apple's headquarters and could not have done it without Arynn. I was struggling for months to find an internship, even with good grades, projects and two associates. She recommended I go to a conference, what to wear to it, looked at my resume and told me to do mock interviews. I studied and practiced for the interview and ended up getting the job!"

PHOTOS: HUGH KRETSCHMER

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THE MENTOR

STACEY FINLEY

GORDON S. MARSHALL EARLY CAREER CHAIR, ASSOCIATE PROFESSOR OF BIOMEDICAL ENGINEERING, CHEMICAL ENGINEERING AND MATERIALS SCIENCE AND BIOLOGICAL SCIENCES

Finley, who leads the Center for Computational Modeling of Cancer, also received the 2017 WiSE Hanna Reisler Mentorship Award, given to individuals at USC who have advanced the careers of women in science and engineering. One of her research areas is focused in angiogenesis, the formation of new blood vessels, and specifically how to thwart this in tumors, robbing them of the blood and nutrients they crave.

ADVICE

"Tell a story–in your writing and oral presentations, engage the reader or audience and tell a clear story about your research."

ON FITNESS

It's perhaps fitting, given their research in angiogenesis, that both have bonded over a shared love of fitness. Finley herself works out daily and notes that Wu has participated and done well in weightlifting competitions. Said Finley, "When we attended the annual meeting for the Biomedical Engineering Society in 2017, there was a weightlifting competition at the convention center at the same time. Jess mentioned to me that one of the attendees of the competition asked if she was competing. That was the ultimate compliment! I am amazed at how she sets her mind to something and truly sticks to it."

Stacey Finley and Qianhui "Jess" Wu (seated)

THE MENTEE

QIANHUI "JESS" WU

PH.D. CANDIDATE IN BIOMEDICAL ENGINEERING

Wu is both a talented researcher and, as her award for USC Viterbi's 2018 Ph.D. Outstanding Mentor would suggest, a model mentor in her own right. Even Finley, her mentor, has learned a lot from her: "The most striking example of this is the latest model she is working on, one that shows how blocking angiogenesis can lead to hypertension. This is a very complex model that Jess has carefully put together. I knew only about the basic backbone of the reaction network. Jess has taught me the specific details of it."

ON THEIR RELATIONSHIP

"As Stacey's first full Ph.D. student at USC (she has co-advised another student before), I feel like the oldest child in the family, and I want to meet all her expectations and also help her by taking responsibilities sometimes. On the other hand, Stacey is forever my biggest inspiration and role model as a strong, intelligent, deeply caring and passionate woman in science."

From left to right: Leilani Arvizu, Alina Garcia Taormina and Andrea Hodge

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THE MENTOR

ANDREA HODGE

ARTHUR B. FREEMAN PROFESSORSHIP IN ENGINEERING

Hodge wears many hats. She is the co-director of the Core Center of Excellence in Nano Imaging (CNI), which images things as tiny as an atom, connecting researchers from all USC schools. She is the USC vice provost for undergraduate programs, the leader of the Hodge Materials Nanotechnology Research Group and the 2018 WiSE Hanna Reisler Mentorship Award recipient.

ADVICE

"You can be your own best friend or your own worst enemy. Be kind to yourself and don't be so critical of who you are or what you do."

THE MENTEE

ALINA GARCIA TAORMINA

PH.D. CANDIDATE, MATERIALS SCIENCE

The Society of Hispanic Professional Engineers (SHPE) recently awarded her the 2019 Graduate Student Role Model Award for Southern California and Arizona. The STAR award, the highest honor given to a graduate student, recognizes Garcia Taormina's outstanding outreach and contributions to SHPE's USC chapter and the Hispanic community. As Hodge notes, her heart makes her special: "She wants to help everybody and make everything better. I have to sometimes stop and tell her, 'Stop. Think of yourself.' "

THE VISUAL ARTS

Before her current life, engineering strong, complex materials for use in aerospace and other industries, Garcia Taormina was originally a film production major at Loyola Marymount University. "Alina loves photography," said Hodge, "and she's quite good at it. She takes beautiful pictures." Her pictures these days range from street photography at Venice Skatepark to scanning electron images of nano-architected structures.

ON CONFIDENCE

"I was coming from a chemistry background, and not engineering, so I felt really unqualified. I remember I expressed that sentiment to (Prof. Hodge) during the Viterbi Ph.D. Preview Day event, and she emailed me, saying, 'Please do not question your admission or qualifications. You were selected from over 300 students. I think you will be a great addition to our group at USC!' And from there, I decided to commit to USC."

THE "NEXT GEN" MENTEE

LEILANI ARVIZU

JUNIOR, MATERIALS ENGINEERING, UC RIVERSIDE

Arvizu first met Garcia Taormina during her senior year at Santa Monica High School, where the latter had created a scholarship fund for students who participated in the Advancement Via Individual Determination (AVID) program. Later, at UC Riverside, Arvizu worried that she was getting involved in research too late, but Garcia Taormina's story helped dispel those fears.

Said Arvizu, "One thing I've learned from Alina is to never be shy about asking for help. I have always been timid and asking for help from people would scare me. Talking to Alina has really helped get me out of my shell because she's given me a lot of advice and insight about grad school, as well as industry."

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THE MENTOR

TEAGAN AMPE

JUNIOR, COMPUTER SCIENCE

Ampe, a leader in USC's Society of Women Engineers (SWE) community outreach committee, has known Perry since 2018. Since being formally paired as part of USC SWE's mentorship program, the two have met either weekly or monthly, bonding over a shared love of musical theater, particularly *Hamilton*, and staying up late coding in Salvatore Hall—the two are both course producers for USC's introductory computer science classes.

EVENLY BALANCED

"Our mentor-mentee relationship is pretty casual, since we were friends for a while before we were matched by the Society of Women Engineers. We both tend to have a lot of work and extracurricular commitments, but we balance that with fun things. One time, we played ping pong in the middle of Lily's residence building hallway, and afterwards went to a study lounge and worked on homework. Perfectly balanced, as all things should be."

THE MENTEE

LILY PERRY

SOPHOMORE, COMPUTER SCIENCE

Perry has already been a rising star in CS—during the 2019 AthenaHacks, USC's all-female hackathon, she led the creation of WeMove, an iOS app to group users walking from similar locations to similar destinations, so women would not have to walk home alone at night. In addition, she mentors high school juniors and seniors at the Foshay Learning Center, near USC.

ON OVERCOMING PROBLEMS

"Last semester, I struggled in CSCI 201: Principles of Software Development because the lectures were often hard to follow since the professor had never taught the course before. Fortunately, Teagan had already taken the class and loved the material, so she was an invaluable resource to me when I didn't understand a lecture."

GOOD ADVICE

"Last year, Teagan noticed that whenever she offered to hang out, I would usually respond along the lines of, 'Sorry, I have seven club meetings this week…not sure if I have the time.' She often advised me to drop some of my extracurriculars and focus a lot of energy on a few clubs instead. This year, I've been trying to follow her advice. I went from having low involvement in 10 different clubs to focusing on being the vice president of Hawaii Club and the public relations manager for MEGA (the Makers of Entertaining Games Association)."

From left to right: Teagan Ampe and Lily Perry

> Are You an Alum Who Wants to Mentor?

It only takes a few minutes to sign up on viterbi.usc.edu/viterbilink, and you can mentor on your own schedule, in your preferred format: phone, email or in person.

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From left to right: Jasmine Naseri, Sara Atun, Haya Helmy and Shajeeah Mumtaz

THE MENTORS

JASMINE NASERI

B.S. EE, 2016; COMMUNICATIONS SYSTEMS ENGINEER, NORTHROP GRUMMAN; PRESIDENT, LOS ANGELES SECTION OF SWE

SHAJEEAH MUMTAZ

B.S. ASTE, 2016; SYSTEMS ENGINEER, NORTHROP GRUMMAN; SOCIAL MEDIA AMBASSADOR, LOS ANGELES SECTION OF SWE

Although Naseri mentors Atun, and Mumtaz mentors Helmy, the four often go on mentoring "double dates," including Smorgasburg L.A., shopping at Citadel Outlets and spending time at the 2019 SWE national conference. All four have evolved from mentors-mentees to trusted, mutual friends.

ADVICE

Naseri: "It's easy to get overwhelmed with schoolwork, extracurriculars, job hunts, and so on, but you have to remember to enjoy your special years in college and to prioritize your health and happiness above all."

Mumtaz: "Step outside of your major and comfort zone and take that fun class you've always been interested in. Stay healthy and get enough sleep. College goes by in the blink of an eye; take time to hang out with your friends and make lifelong memories. Remember to have fun."

THE MENTEES

SARA ATUN, SENIOR, MECHANICAL ENGINEERING

Atun, a USC dance minor and co-director of the USC Chamber Ballet Company, is also a member of the planning committee of the Trojan Dance Marathon, a fundraiser for Children's Hospital of Los Angeles—just like Naseri before her.

HAYA HELMY, SENIOR, AEROSPACE ENGINEERING

Helmy does research on the question: "Why do our planes not look like birds...yet?" She leans heavily on Mumtaz's experience in the aerospace industry, noting: "Shajeeah has really instilled in me confidence in my abilities as an engineer, which is what I needed going into recruiting season."

ON OVERCOMING PROBLEMS

Atun: "One problem that I had was struggling with my internship search last year. Receiving rejections and not feeling at home in networking situations was making it difficult to continue. However, Jasmine showed me the importance of confidence and being personable. She reassured me that I had skills to offer a company, and she prepared me for interviews, reviewed my resume and gave me pep talks when I needed them."

GALACTIC INSPIRATION

Helmy: "(Shajeeah and I) met at the beginning of my junior year, the hardest year of my engineering degree. She had emailed me to meet up, and I remember she included a YouTube videolink of the James Webb Space Telescope, which she works on! I was so excited to meet her and ask her more about her work!" Helmy's 2019 internship: the redesign of battery cell bypass switches used on the Webb Space Telescope.

From left to right: Mitali Mehta, Gisele Ragusa and Ishita Bedi

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THE MENTOR

GISELE RAGUSA

PROFESSOR OF ENGINEERING EDUCATION PRACTICE

Ragusa, the chair of the USC STEM Consortium, recently was awarded the nation's highest honor for mentorship by the White House—the Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring. One of only 15 recipients nationwide in 2019, and only the third in USC's history, Ragusa was cited for her "work with underrepresented groups to develop fully the nation's human resources in STEM."

ADVICE

"Have an open mind, be flexible in diverse, changing contexts. Don't be afraid to share your experiences and personal history as you are comfortable with it, recognizing that your own history informs your decision-making and may be different from those with whom you interact."

THE MENTEES

MITALI MEHTA

M.S. CANDIDATE, COMPUTER SCIENCE

ISHITA BEDI

M.S. CANDIDATE, COMPUTER SCIENCE

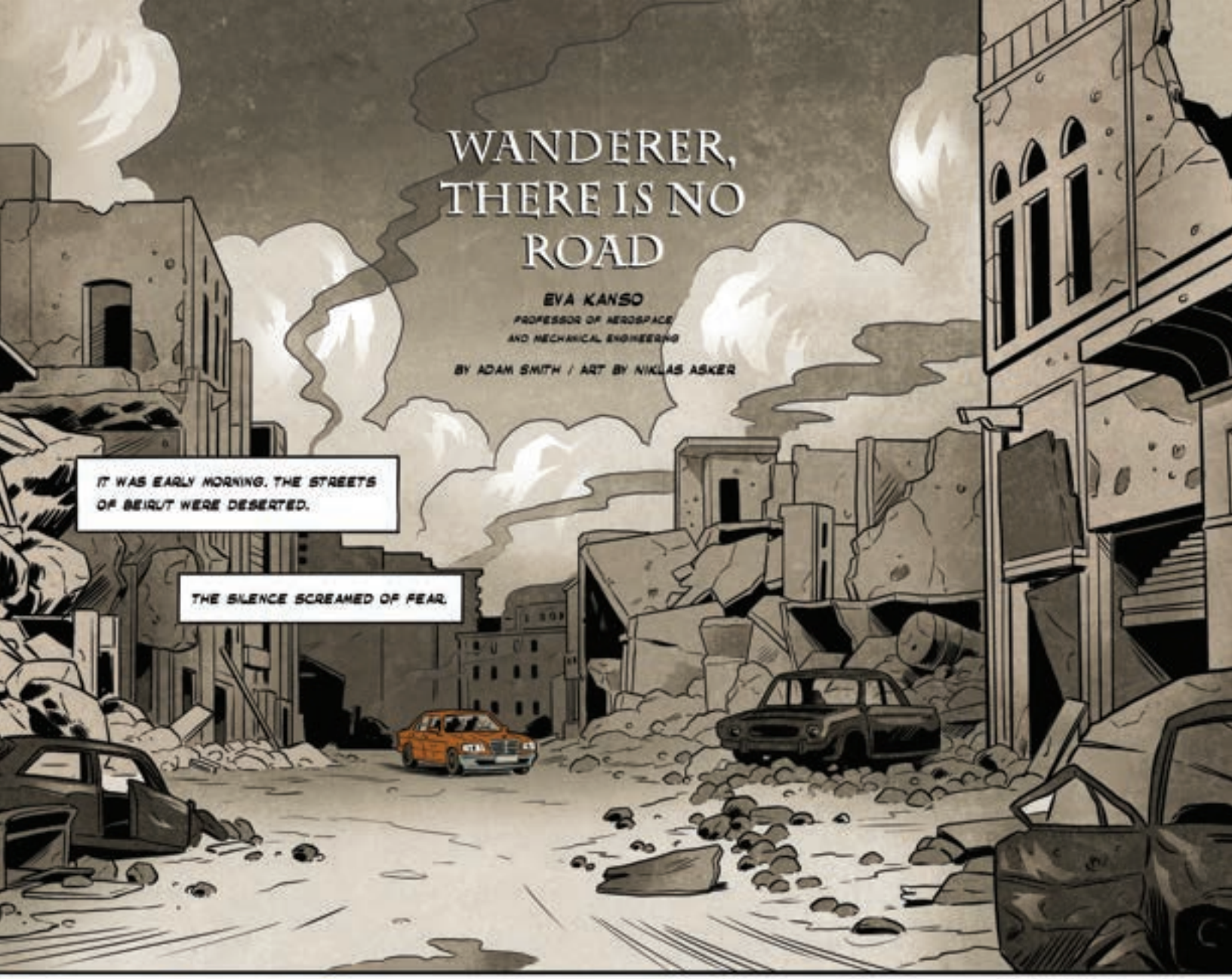
Both graduate students have been transformed by Ragusa's example of "contagious" mentorship. As student mentors for USC's Robotics and Coding Academy (RCA), they teach 4th and 5th graders to build Wallaby robots, coding them in C. But the tone is set by Ragusa, who Mehta calls a "a very sensitive mentor," and Bedi notes is "extremely warm and welcoming... one of the best experiences I've had at USC."

ON INSPIRATION

"I have seen Dr. Ragusa working long days all week long, sometimes even weeks together," said Bedi, "but she is always energetic when it comes to her work. Watching her work on her projects is extremely inspirational, and I have understood that the more you do of what you love, the less tired you feel."

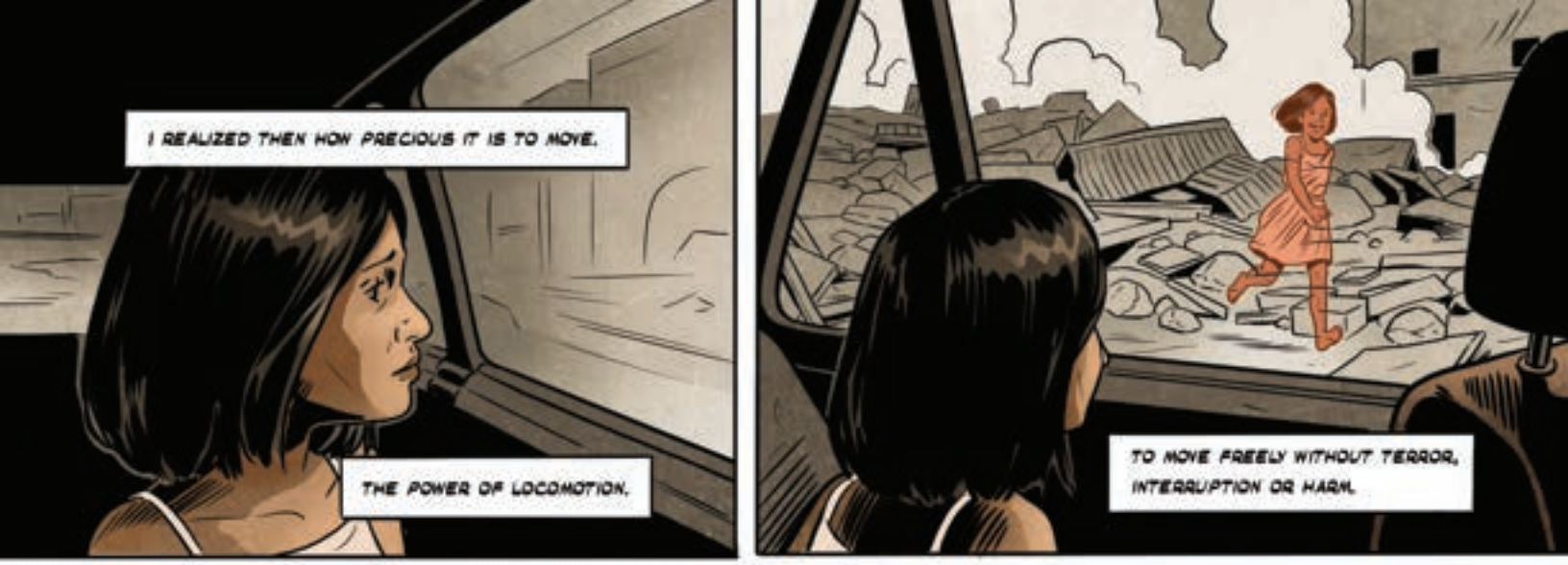
ON SHARING

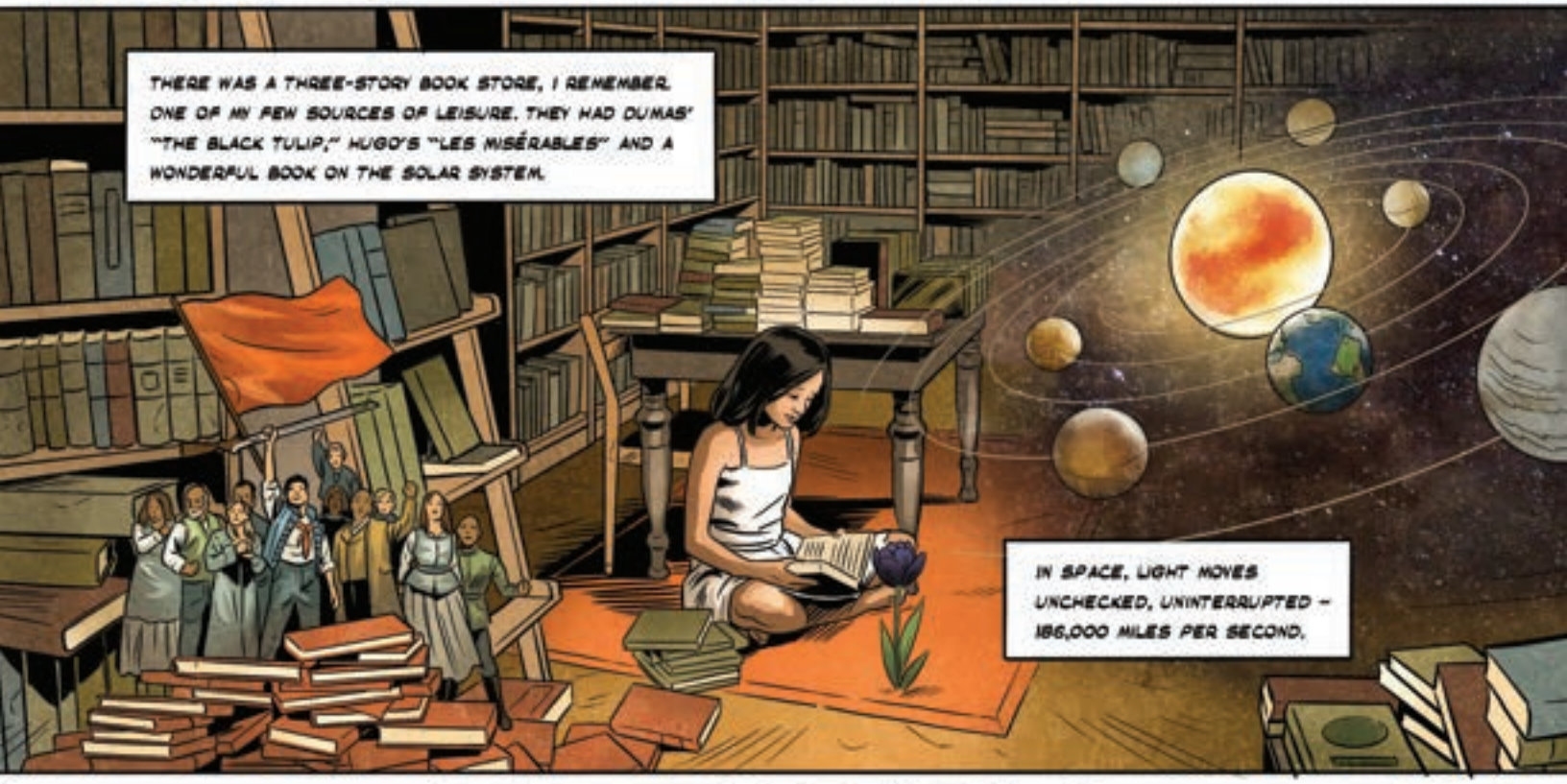
Said Mehta: "Dr. Ragusa always asks her mentors to share a part of their culture with their group of mentees. Since most of us are international students, we come from different places, and have different cultural experiences that such young children haven't yet heard of. She always asks us to share a bit of our world with them, broaden their scope of the world!"


WANDERER, THERE IS NO ROAD
EVA KANSO
PROFESSOR OF AEROSPACE AND MECHANICAL ENGINEERING
BY ADAM SMITH / ART BY NIKLAS ASKER
IT WAS EARLY MORNING. THE STREETS OF BEIRUT WERE DESERTED.
THE SILENCE SCREAMED OF FEAR.


I WAS SIX YEARS OLD, NEARLY AS OLD AS THE 7-YEAR-OLD LEBANESE CIVIL WAR (1975-1990).
MY FATHER LIKED TO LAUGH UPROARIOUSLY AT WOODY WOODPECKER CARTOONS, BUT HE WASN'T LAUGHING THAT DAY. HE DROVE SLOWLY, CAREFULLY, SEEKING NEW REFUGE, TERRIFIED THAT WE'D BE STOPPED BY MILITANTS.


I HELD MY BREATH AS MY MOTHER'S FRIEND WHISPERED A PRAYER.
I DON'T REMEMBER WHEN I BREATHED AGAIN.

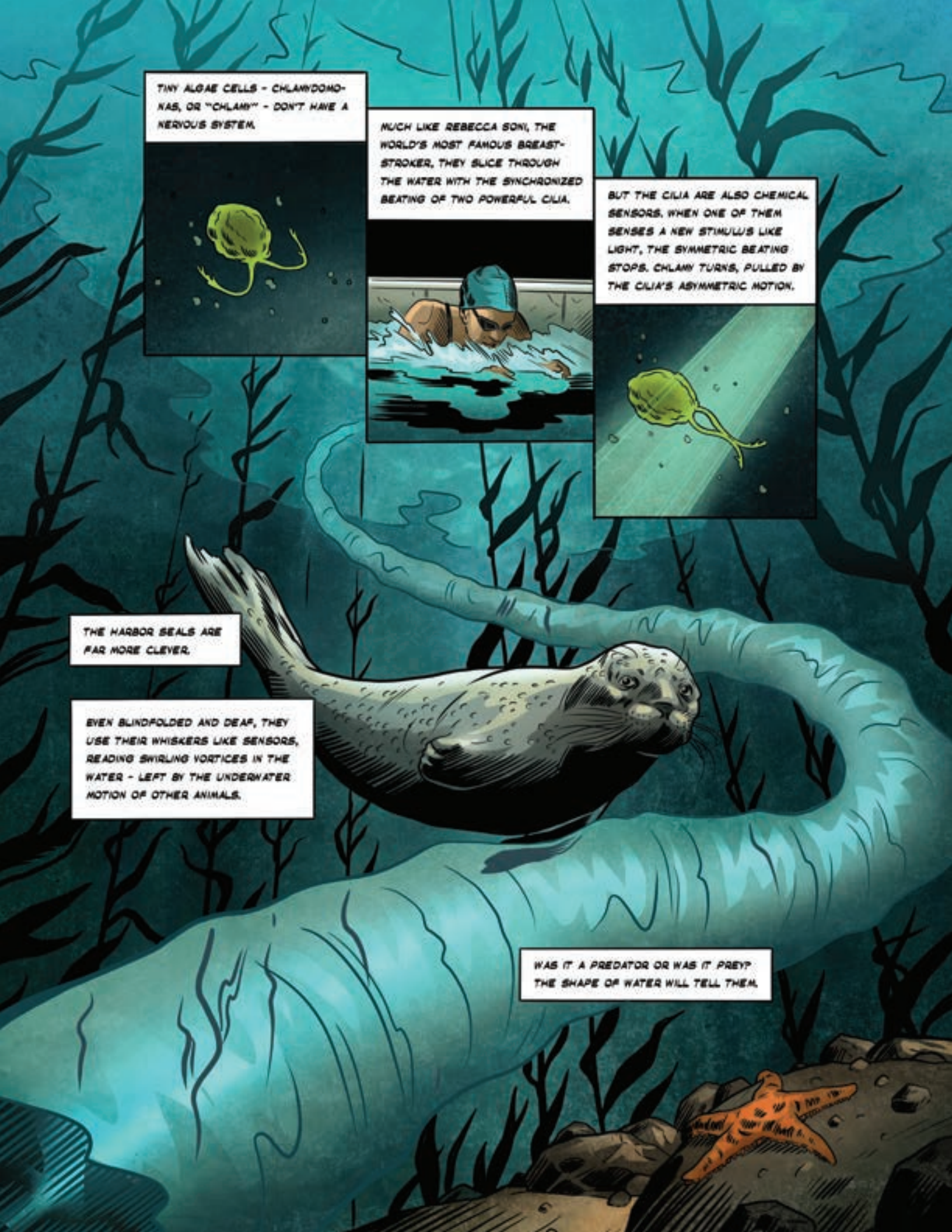

I REALIZED THEN HOW PRECIOUS IT IS TO MOVE.
THE POWER OF LOCOMOTION.
TO MOVE FREELY WITHOUT TERROR, INTERRUPTION OR HARM.


THERE WAS A THREE-STORY BOOK STORE, I REMEMBER. ONE OF MY FEW SOURCES OF LEISURE. THEY HAD DUMAS' "THE BLACK TULIP," HUGO'S "LES MISÉRABLES" AND A WONDERFUL BOOK ON THE SOLAR SYSTEM.
IN SPACE, LIGHT MOVES UNCHECKED, UNINTERRUPTED – 186,000 MILES PER SECOND.


BUT FOR ME, MY UNIVERSE – AT TIMES – HAD SHRUNK TO THE SIZE OF MY NEIGHBORHOOD OR MY APARTMENT BUILDING IN WEST BEIRUT.
LATER, AS THE CIVIL WAR ENTERED ITS MOST TURBULENT YEARS, THE VERY BOUNDARIES OF "SAFE NEIGHBORHOODS" BECAME FLUID AND DYNAMIC. ONE DAY OUR STREET WOULD BE IN THE HANDS OF ONE GROUP OF MILITANTS AND THE NEXT IN THE HANDS OF ANOTHER.


ON DAYS WHEN THE SHELLING BECAME MOST INTENSE, MY UNIVERSE HAD SHRUNK TO THE BASEMENT OF OUR BUILDING.
DESPITE ALL OF THIS, WE STILL HAD TO GET GOOD GRADES!


I'M FASCINATED BY MOTION. AT ALL SCALES. I BELIEVE LIFE IS MOTION.
ORGANISMS SHARE THE FOLLOWING BASIC NEEDS: 1) AVOIDING PREDATORS, 2) FEEDING AND DISPOSING OF WASTE, AND 3) MATING AND REPRODUCING.
SOME, LIKE SPONGES, DO ALL THESE WITHOUT MOVING.
I WAS A TEENAGER WHEN THE WAR FINALLY ENDED. AFTER 150,000 DEAD, MANY LEBANESE MAY WELL HAVE ENVIED THE SPONGES.
I STUDY THE PHYSICS OF ANIMAL MOVEMENT. FROM HUMBLE ALGAE CELLS TO PLAYFUL DOLPHINS TO LORDLY HARBOR SEALS.
I REMEMBER A SNIPER ATTACK ONE DAY IN BEIRUT. WE WERE CROSSING THE "MAABAR," THE PASSAGE WAY FROM WEST TO EAST BEIRUT, HOPING TO VISIT AUNTS AND COUSINS ON THE OTHER SIDE.
AFTER CHECKING IN WITH MILITANTS ON BOTH SIDES, WE HEARD THE FAMILIAR REPORT OF GUNFIRE. EVERYONE SCATTERED.
FROM THE VANTAGE POINT OF THE SNIPERS, HIGH ABOVE US LIKE GARGOYLES IN QUASIMODO'S BELL TOWER, WE MUST HAVE RESEMBLED A DISORIENTED COLONY OF ANTS.


TINY ALGAE CELLS - CHLAMYDOMONAS, OR "CHLAMY" - DON'T HAVE A NERVOUS SYSTEM.
MUCH LIKE REBECCA SONI, THE WORLD'S MOST FAMOUS BREAST-STROKER, THEY SLICE THROUGH THE WATER WITH THE SYNCHRONIZED BEATING OF TWO POWERFUL CILIA.
BUT THE CILIA ARE ALSO CHEMICAL SENSORS. WHEN ONE OF THEM SENSES A NEW STIMULUS LIKE LIGHT, THE SYMMETRIC BEATING STOPS. CHLAMY TURNS, PULLED BY THE CILIA'S ASYMMETRIC MOTION.
THE HARBOR SEALS ARE FAR MORE CLEVER.
EVEN BLINDFOLDED AND DEAF, THEY USE THEIR WHISKERS LIKE SENSORS, READING SWIRLING VORTICES IN THE WATER - LEFT BY THE UNDERWATER MOTION OF OTHER ANIMALS.
WAS IT A PREDATOR OR WAS IT PREY? THE SHAPE OF WATER WILL TELL THEM.


SEA STARS HAVE NO CENTRAL BRAIN AND APPEAR MOTIONLESS, BUT ACTUALLY USE HUNDREDS OF TINY HYDRAULIC "FEET" TO BOUNCE – THEIR VERSION OF SPRINTING – FROM PLACE TO PLACE.
GETTING THESE UNDERBELLY TUBE FEET TO WORK TOGETHER – TO HOLD ON TO PREY, TO MOVE AND CONTRACT AROUND ROUGH TERRAIN – IS ONE OF THE GREAT EXAMPLES OF ANIMAL LOCOMOTION.
IN THE KANSO LAB, WE'RE FINDING BIOLOGICAL INSPIRATION FOR THE NEXT GENERATION OF UNDERWATER ROBOTS.
FOR EXAMPLE, WHAT HAPPENS WHEN YOU CAN'T USE GPS TO COMMUNICATE WITH A ROBOT UNDERWATER? THEY HAVE TO BE BOTH SMART AND AUTONOMOUS. MAYBE THE AMAZING SENSORY-MOTOR SYSTEM OF COPEPODS, TINY WATER BUGS, CAN TEACH US SOMETHING.
FOR A MALE COPEPOD THE SIZE OF A SESAME SEED, FINDING THEIR MATE IN THE SEA IS LIKE FINDING A NEEDLE IN A HAYSTACK. IF THE HAYSTACK IS THE SIZE OF THE PACIFIC.
INSTEAD, COPEPODS USE FINE, FEATHERY HAIRS TO DETECT THE TUNNELS OF DISTURBED WATER WHERE THE FEMALES HAD ONCE BEEN, OFTEN OVER GREAT DISTANCES. COULD A ROBOT BE THAT SENSITIVE TO TEMPERATURE, SALINITY, PHEROMONES, THE VERY SHAPE OF WATER?
WHAT CAN THE TUBE FEET OF STARFISH TEACH US ABOUT DESIGNING SOFT ROBOTICS?
THIS IS STARBOT, A PROTOTYPE UNDERWATER ROBOT. LIKE ITS ECHINODERM COUSINS, COULD STARBOT USE DECENTRALIZED CONTROLS TO RESPOND TO ITS ENVIRONMENT WITHOUT A POWERFUL CENTRAL BRAIN?
Starbot


WE'RE STILL UNDERSTANDING LIFE - THE BASIC RULES OF LIFE, AND HOW THE ENVIRONMENT SHAPES OUR INTERACTIONS.
MY ENTIRE CHILDHOOD WAS SPENT IN ONE RATHER EXTREME ENVIRONMENT. BUT THE GOOD THING ABOUT EXTREME ENVIRONMENTS: THEY BRING OUT THE VERY WORST IN PEOPLE, BUT ALSO THE VERY BEST.
TO THIS DAY, I'M STILL DRAWN TO MOTION. I CANNOT BE STILL LIKE THE WOMEN IN MATISSE'S "DANCE" OR THE BOWL IN MY LIVING ROOM - WITH ITS ENDLESS SWIRL OF MOTION.
I AM REMINDED OF THE QUOTE BY ANTONIO MACHADO: "WANDERER, THERE IS NO ROAD...THE ROAD IS MADE BY WALKING."
MY COLLEAGUES IN CIVIL ENGINEERING MAY DISAGREE, BUT PERHAPS NOT ALL PATH MAKING IS AN EXACT SCIENCE.
USC University of Southern California

SAY 'HI' TO KIWI

A new USC Viterbi study shows that just 30 days with an in-home robot could help children with autism improve not only math skills, but also social interaction. By Caitlin Dawson

ILLUSTRATION: LUCY SMITH

One day, in the spring of 2017, in a home in South Los Angeles, a robot named Kiwi stood on a table facing a child. Kiwi was a 2-foot-tall green bird with felt feathers and a soft tuft of green hair. Its eyes lit up as soon as it spoke, its voice was childlike.

Across the table, a young boy played a game with the robot, travelling through space to solve math problems. A child-size tablet connected to the robot displayed the lessons. The robot tracked the boy's gaze, giving positive feedback when he got a right answer. "Good job!" it said.

Despite the boy's visible enjoyment, this game's not just for fun. Along with math skills, the robot taught the boy a skill called joint attention—shared focus on an object, person or event—that children with autism learn as part of their behavior therapy.

The child was a participant in an ambitious study, the largest of its kind, led by Professors Maja Matarić and Gisele Ragusa that placed socially assistive robots in the homes of 17 children with autism for at least 30 days.

Each day, the children sat with their parents or other family members and played space-themed math games while the robots interacted with them.

The robots personalized their instruction and feedback to each child's unique learning patterns during the interventions in real time. This enabled the children to practice their math and social skills at home whenever they wanted, between school lessons and therapy sessions.

While the researchers anticipated some improvement in math skills, the results surpassed their expectations. At the end of the month's intervention, all the participants demonstrated improved math skills, while 92% also improved their social skills.

In research videos, children who might previously have hidden away from interaction can be seen walking up and talking to the robot. Some children spontaneously greeted the robot: "Hey, Kiwi," they would say when they came home from school.

"It can be hard for some kids to access social skill interventions in the home in a way that they might be comfortable," said the parent of a child who took part in the study.

"I definitely see potential for this kind of intervention in the future, especially as an introduction for sensitive subjects like bullying and self-care-related health topics."

A TOUR DE FORCE

The study and subsequent analyses, presented at conferences and published in the journals *Frontiers* and *Science Robotics*, mark the culmination of eight years' work by Matarić, Ragusa and their students in USC Viterbi's Interaction lab, along with collaborators from Yale University and MIT.

"It took a large team and a lot of effort to create a system we could leave in homes for a month—it was a real tour de force," said Matarić, the Chan Soon-Shiong Chair and Distinguished Professor of Computer Science, Neuroscience, and Pediatrics.

A pioneer of socially assistive robotics, Matarić developed the field about 15 years ago, when she was inspired to create personalized robots that could provide support, motivation and companionship to people, focusing on those with special needs.

Since then, Matarić and her team have developed machines to help stroke patients enjoy their rehabilitation exercises and people preparing for IV injections feel less pain. Matarić imagines a future where personalized robots help children with autism practice navigating social cues and interactions with people. But realizing that future means getting research out of the lab and into people's homes.

"When you are interacting with someone, there are social cues, such as facial expressions, tone of voice and gestures, which can be overwhelming and distracting for children with autism," Ragusa said.

"But robots are predictable and, to some extent, controllable, which can make children with autism feel more comfortable while they're learning."

"There is a lot of talk about the power of machine learning, but we don't see many companies or research labs making the effort to go into homes, collect data and see what it takes to make machine learning work with messy data from real families," Matarić said.

The roots of this particular study go back to 2012, when the National Science Foundation (NSF) awarded $10 million to a team that included Matarić as co-principal investigator with researchers from Yale, Stanford, and MIT.

"Our vision was to develop socially assistive robots that would help children," Matarić said. "One of our program officers encouraged us by saying, 'Autism is the polio of our time.' That was really a driving force for us to develop computing methods for socially assistive robots for children with autism."

EARLY INTERVENTION

Autism, or autism spectrum disorder, is characterized by difficulties in early social interaction and communication, as well as attention. It affects one in every 59 children in the U.S.—an increase of 250 percent in the last 15 years, according to the Centers for Disease Control.

While there is no known single cause or cure for autism spectrum disorder, research suggests that intensive therapy at an early stage of a child's development can help. In-person therapy is crucial, but it may not always be available. A therapist cannot be in your house 24/7, but a socially assistive robot can.

Robots can be sent home with a program of games for the child to practice, which is helpful for those who live too far away from therapy clinics or whose caregivers' work schedules do not allow for frequent visits. Feeling motivated and at ease with the robot, children with autism may be able to better focus on learning and practicing their skills.

At least, that was the research team's goal. The big challenge was actually making it happen.

For this, Matarić enlisted the help of Ragusa, a professor of engineering education and herself a beneficiary of early intervention. Ragusa was one of the first children in the U.S. to receive early intervention at the age of six months for cerebral palsy.

Ragusa recruited the participating families through regional centers within California's Department of Developmental Services and local school districts. In total, the researchers selected 17 families from diverse backgrounds across L.A. County. The children were between 3 and 7 and formally diagnosed with autism spectrum disorder.

A PERSONALIZED, SOCIALLY ASSISTIVE ROBOT

Previous research indicates that socially assistive robots can help children with autism develop and retain new skills, at least in the short term.

"When you are interacting with someone, there are social cues, such as facial expressions, tone of voice and gestures, which can be overwhelming and distracting for children with autism," Ragusa said.

"But robots are predictable and, to some extent, controllable, which can make children with autism feel more comfortable while they're learning."

This type of therapy, however, works best if the child is excited or paying attention. One way to keep a child interested is by personalizing the interaction. As such, Kiwi the robot's feedback and the games' difficulty were personalized in real time to fit each child's unique learning patterns. The researchers accomplished this using reinforcement learning, a rapidly growing subfield of artificial intelligence (AI).

PHOTO: NOÉ MONTES

The algorithms monitored the child's performance on the math games. For instance, answer correctly and Kiwi would say something like, "Good job!" Get a question wrong, and Kiwi might provide some helpful tips to solve the problem, and adjust the difficulty and feedback in future games. The goal was to maximize difficulty, while not pushing the learner to make too many mistakes.

A CONSTELLATION OF SYMPTOMS

Sound straightforward enough? Think again. There's a saying popular among people with autism and their families: "If you have met one person with autism, you have met one person with autism."

"Autism is the ultimate frontier for robotic personalization, because, as anyone who knows about autism will tell you, every individual has a constellation of symptoms and severities of each symptom," Matarić said.

"There is no one-size-fits-all. We really have to figure out how to engage each child for the time being with a particular task and be ready to adapt as the child's behavior, mood, skills and preferences change, sometimes gradually and sometimes quite suddenly."

This creates a particular challenge for machine learning, an area of artificial intelligence that typically relies on spotting consistent patterns in huge amounts of data.

For instance, the machine learning algorithm might spot a pattern in the data and make an assumption: people who look away from a task or individual for prolonged periods are feeling distracted or disengaged.

Not so for children with autism, who frequently show atypical responses. For instance, a common characteristic of autism is difficulty making or maintaining eye contact, which doesn't necessarily signal a lack of engagement.

"Standard artificial intelligence approaches typically fail when it comes to autism data," Matarić said. "Machine learning methods require a lot of reasonably consistent data, and that just isn't possible with autism, where heterogeneity and inconsistency reign."

As a result, the research team had to develop methods that "turned machine learning on its head," Matarić added.

"Instead of gathering large amounts of data from as many people as possible—which is simply not feasible in autism due to privacy issues, and not necessarily useful given the variance in the data—we focused on excavating information from the data we had," she added.

PART OF THE FAMILY

When the experiment wrapped up, the researchers got to work assessing the success of their system and determined the robot could have autonomously detected the child's engagement with 90% accuracy.

The researchers also tested the children on their new skills. That testing happened three times: before the experiment, on the last day of the intervention, and again 30 days after the end of the experiment ended. Not only did all the children show improvement in math and social skills, they retained these improvements one month after the study ended.

There was another important result: The robot became "part of the family." Research videos show multiple people in the room with the child and the robot, including parents, siblings, therapists and pets.

"We found the interaction between the children and other people actually improved," said Ragusa, who personally conducted the follow-up assessment with the children.

"They developed a social relationship with the robot and that snowballed into a social relationship with the family," she added. "We encourage the parents to be in the background and step in when needed, so it became a triad of learning together."

The research team stressed that the socially assistive robot is not intended to replace therapists—instead, the technology diversifies available therapies and the support available to parents—in practice, it could provide them with an opportunity for on-demand, in-home daily interventions.

SOCIETALLY RELEVANT CHALLENGES

While Kiwi takes a well-earned break, the research team is continuing to analyze the collected data.

One active follow-up project involves analyzing and modeling the children's "cognitive-affective states," including emotions such as confusion or excitement, to design socially assistive robot tutors that are even more sensitive to the emotions and moods of their users.

Another ongoing NSF-supported research project led by Matarić and Ragusa involves a telepresence robot for older children attending school remotely. The goal: to allow students who miss school due to health challenges to be physically embodied and socially embedded in the classroom with their peers.

"In our lab, we focus very specifically on compelling, societally relevant problems," Matarić said. "We personally meet the real people behind the numbers. It's challenging to work in the real world with vulnerable users with a broad spectrum of needs, but that is where the important challenges are—those that are really worth committing to."

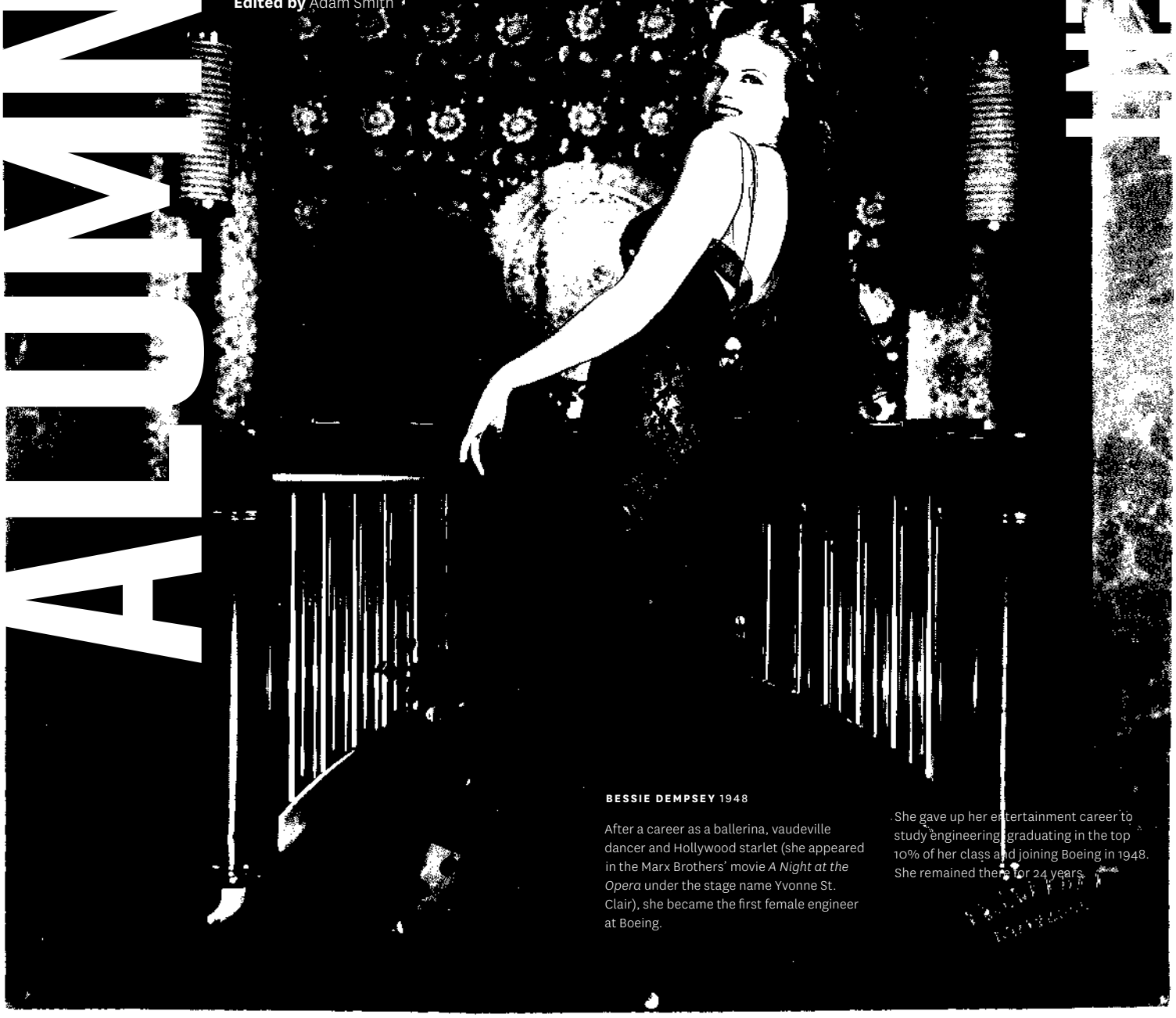
When the experiment wrapped up, the researchers got to work assessing the success of their system and determined the robot could have autonomously detected the child's engagement with 90% accuracy.

ALUMNA VOICES

1940S TO PRESENT

A VISUAL COMPENDIUM OF WOMEN AT THE USC VITERBI SCHOOL OF ENGINEERING

Edited by Adam Smith



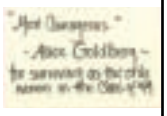
BESSIE DEMPSEY 1948

After a career as a ballerina, vaudeville dancer and Hollywood starlet (she appeared in the Marx Brothers' movie *A Night at the Opera* under the stage name Yvonne St. Clair), she became the first female engineer at Boeing. She gave up her entertainment career to study engineering, graduating in the top 10% of her class and joining Boeing in 1948. She remained there for 24 years.

1940–1960


The University of Southern California
confers upon
Adela S. Wolff
the degree of Bachelor of Engineering
at the sixty-fourth Annual Commencement
Saturday, June fourteenth, at two-thirty o'clock
nineteen hundred and forty-seven
University Park, Los Angeles

ADELA STEINMAN DEGREE 1947


"Most Courageous"
– Alice Goldberg –
the survivor on the girls
names on the Class of '49

LT. COL.
ARMINTA HARNESS

CAROL COOPS

ADELA STEINMAN
CLASS OF 1947

The *Los Angeles Times* reported that the then Adela Wolf was the lone "girl" in that year's graduating class, referring to the Brooklyn native as a "brunette miss."

I had some very devoted professors…looking back, I think the professors were harder on me than they were with the boys. And they were very lenient with the boys who had been in the service.

ALICE GOLDBERG
B.S. CHE, 1949

Voted "most courageous" by her male peers for surviving as the only woman in the class of 1949.

USC brought companies on campus to interview the students, but I found that nobody wanted to talk to me. I had a better grade-point average than my husband, but no one would hire a woman in engineering. That's just the way it was.

LT. COL. ARMINTA HARNESS
B.S. AME, 1955

FIRST FEMALE ENGINEER, U.S. AIR FORCE
PRESIDENT, SOCIETY OF WOMEN ENGINEERS (1976–1978)

Dream what you dare to dream, go where you want to go, and be what you want to be. I think that kind of sums up my life.

CAROL COOPS
B.S. ME, 1959

Going to USC was one of the best things that I could have done. Had I a degree from another university, I would not have been looked at very well, possibly. But with a degree from USC, that allowed me entry into several places to look for work.

Spent 25 years at Hawaiian Electric, working her way into project management and becoming the supervisor of several male colleagues. By the time she retired in 1990, there were three other women in her department. Today, the company is headed by a woman, Constance Lau.

TIMELINE

1943

One of the earliest archival photos depicting female students in USC engineering.

1947

"I think there was a woman in the 1930s who was the first to graduate from the USC School of Engineering—I think I was the third or fourth."

ADELA STEINMAN

1948

The *L.A. Times* reads: "Women Invade Man's Field, 3 Win Engineering Degrees." New grads include Georgia Rogers, Virginia Tomlin, and Margaret Ray.

GLORIA WILSON: PENDANT

GLORIA WILSON
B.S. EE, 1964; M.S. EE, 1966

BIGGEST POST-GRADUATE SUCCESS
Being part of the original design team for the F-15 radar. It was a groundbreaking marvel of technology, from which much of today's signal processing is founded.

HARDEST USC ENGINEERING CLASS
At the beginning, taking advanced math courses and physics, I really doubted I would complete the whole curriculum. But with hard work and steady progress, it all came together. I guess my Scotch-Irish stubbornness helped, too!

MARIE KNOWLES

MARIE KNOWLES
B.S. CHE,1968; M.S. CHE, 1970

BIGGEST POST-GRADUATE SUCCESS
EVP/CFO at a major oil company (Arco).

HARDEST USC ENGINEERING CLASS
The senior project requiring design of a distillation column, including mass and heat balances, was the hardest. The calculations were done by hand—this was pre-calculator days.

SOMEONE AT USC WHO BELIEVED IN ME
Dr. Frank Lockhart, head of the chemical engineering department. He convinced a friend of his to give me my first job.

NOTABLE HISTORICAL / POP CULTURE EVENT
Vietnam War

FIGHTING ON
Work-life balance was the biggest obstacle. I'm lucky enough to have two wonderful sons, but my jobs required extensive international travel.

GERALDINE KNATZ

GERALDINE KNATZ
M.S. EE, 1977

BIGGEST POST-GRADUATE SUCCESS
Becoming CEO of the Port of Los Angeles.

FIGHTING ON
Working in a male-dominated field, and I don't mean engineering…I mean the ports! My biggest handicap, as was pointed out to me many times, was I did not know how to play golf!

WHAT I LEARNED
My entire career seems to have been about encountering problems and being part of a team to help devise solutions. Every decade, there seemed to be some new insurmountable challenge facing the ports: first it was water quality in the 1970s and then it was creating replacement habitats like wetlands in the 1980s, and then it was increased railroad operations in the 1990s and how we could bring all these trains across the L.A. basin and not cause gridlock, then in the 2000s it was air emissions from port operations and how to figure out how to reduce them. Today it's how to get to zero emissions.

ALICE GAST

ALICE GAST: CLASS OF 1980 VALEDICTORIAN

ALICE GAST
B.S. CHE, 1980

BIGGEST POST-GRADUATE SUCCESS
Being chosen to lead one of the world's greatest universities, Imperial College London, with such fantastic students and academics doing amazing things in science, engineering, medicine and business.

SOMEONE AT USC WHO BELIEVED IN ME
Professor Joe Goddard, who was department chair and taught thermodynamics.

FAVORITE PLACE ON THE USC CAMPUS AND WHY
Mudd Hall of Philosophy, because it was like a cloister and a historic place. It had a library with worn leather chairs and very small thick wooden tables where we could study.

WHAT I LEARNED
I had the chance to do some undergraduate research in polymer science. It was open-ended and forced me to define the questions and work on ways to solve them. I have found throughout life that one of the most important capabilities to develop is the ability to ask the right questions. This is true in scientific research as well as in leadership and administration.

TIMELINE

1952

"I was always the only woman. I had one professor who decided that he would run me out of class…using profanity and dirty jokes. Finally, the men complained."

LT. COL. ARMINTA HARNESS

1958

"Finally, a chemical/petroleum engineering building in 1958. Lots of my classes were in trailers."

VICKI LYNN (GRUBACICH)

1963

"We were sitting in the SCellar, across from the old original Vivian Hall, between classes and having a snack and soft drink when the news came on the radio that President Kennedy had been shot. The next several days of TV coverage, canceled classes and activities, and the funeral made an indelible image on my memories." GLORIA WILSON

1966

One of the early student chapters of Society of Women Engineers at USC.

ROSA BRAVO: 1986

BRAVO FAMILY

ROSA BRAVO

B.S. AE 1987, M.S. ISE, 1993

BIGGEST POST-GRADUATE SUCCESS

In the years following graduation, I was a member of several engineering teams at Hughes Aircraft, and worked on some of our nation's most important defense, space and communications programs and initiatives—from the Space Shuttle to mobile phone technology to designing missile systems. There were very few women and diverse individuals in the ranks. The collaboration and inclusivity I experienced began at USC and has continued throughout my professional career. I believe the intentionality of both those attributes…ultimately resulted in my contributions being awarded a lifetime achievement award from Great Minds in STEM.

SOMEONE AT USC WHO BELIEVED IN ME

Dr. Larry Redekopp. After an incredibly challenging semester in my sophomore year, he asked me to his office hours. In his very thoughtful way, he checked in and reassured me that I belonged at USC. He's the kind of leader, mentor and professor everyone deserves.

FAVORITE PLACE ON THE USC CAMPUS AND WHY

My favorite spot on the campus is Founders Park, the quiet little area between Bovard and Taper Hall. I would take a book and pick a spot under a tree or on the bench and read.

JAMIE WOOD

JAMIE WOOD

B.S. ISE, 1989

BIGGEST POST-GRADUATE SUCCESS

I went from working on the Peacekeeper missile at Northrop to engineering toys at Mattel to leading the Hot Wheels brand in growth from $200M to $1B in seven years. I then left Mattel to start my own toy company, develop a complete product line, manufacture in China and ship the world's largest retailers. Then, after five years, I sold the company to Mattel. I then joined the executive team of Barbie—the world's largest girls' brand with sales of $3 billion when I ran the division.

FIGHTING ON

Starting my own company had daily successes and struggles. I had to fight to get appointments with the WalMart and Target buyers, but my USC spirit taught me to never accept "no" for an answer.

Then, when we received our first huge order from Walmart, we were told that we would be fined $10,000 a day for late orders. I had to then fight and push and use all my engineering knowledge as I lived in China for a month to make sure we shipped great product on time.

1960–1990

WOMEN ENGINEERS

1968

In the midst of the Vietnam War, students like Marie Knowles found comfort in the Trojan Grill, one of the few places to get food on campus.

1975

Elsa Garmire joins the USC engineering faculty, later becoming the first tenured female professor in USC engineering. Known as USC's "First Lady of Lasers," Garmire is the William Hogue Professor of Electrical Engineering and director of the Center for Laser Studies, until 1995. Pictured: two students in her lab from 1982.

MICA ENDSLEY: TODAY

MICA ENDSLEY: 1990

MICA ENDSLEY
PH.D. ISE, 1990

BIGGEST POST-GRADUATE SUCCESS
Chief Scientist for the United States Air Force. It was truly an honor to give back to the military and to provide guidance on where we needed to be going with research and technology to secure our future.

SOMEONE AT USC WHO BELIEVED IN ME
My advisor, Dr. Mark Chignell. I could not have done it without his useful suggestions and overall willingness to support my unusual ideas for a dissertation and hectic schedule, as I was working full time and had a baby as well. My dissertation was on situation awareness, which no one outside of aviation had even heard of before. Since then it has become a very important topic in many different areas, so I was really lucky to have been able to be the first to define it and measure it in my dissertation work.

I fell into engineering quite by accident. But once I was able to get out and actually practice it, I found it was very much the right field for me. Engineering involves real creativity and problem-solving, which I love. And there is a lot of teamwork to be successful. Engineering provides the opportunity to solve very real problems to make people's lives better. It really is not all about technology. It's about making technology work for people.

AYANNA HOWARD

AYANNA HOWARD
M.S. EE, 1994; PH.D. EE, 1999

HARDEST USC ENGINEERING CLASS
Computer Vision. The final project—getting the transformation correct so that the puzzle pieces fit together—drove me crazy! [Final project: Here's an image of puzzle pieces scattered on a surface. Create the algorithm to put the puzzle together.]

BRIDGET BRENNAN 1996

SOMEONE AT USC WHO BELIEVED IN ME
Professor Timothy Pinkston

USC MEMORY
Qualifier/preliminary exams for the Ph.D.–one of the most horrific experiences of my life (still causes chills at night).

BIGGEST POST-GRADUATE SUCCESS
Maybe external recognition as one of the top 23 women engineers in the world by *Business Insider* (based on all the things I'd done up to that time).

BRIDGET BRENNAN
M.S. EE, 1996

SOMEONE AT USC WHO BELIEVED IN ME
Dr. Lindsey, Telecommunications Systems

FIGHTING ON
People will try to underestimate you and minimize your accomplishments, especially if they feel threatened. Learning to accept who I am and feel comfortable designing my own path has been key to moving beyond jobs that were limiting or not in line with my values into roles that are engaging and have allowed me to grow.

WHAT I LEARNED
There were classes in systems architecting that talked about problem-solving when you don't even know what the problem is. It opened up a much more creative space in engineering for me. Being able to gather information, listen actively, be open to seemingly impossible explanations and make connections has allowed me to help teams of engineers and product developers see their work in different ways.

HARDEST USC ENGINEERING CLASS
Control Systems, because of the heavy use of mathematical modeling involved. I love math, but was taking the class with my newborn daughter—USC had class delivered via satellite TV, so we attended together—and neither of us was sleeping.

TIMELINE

1977

The year of "Star Wars." "It was the space age, and we all used to talk about whether we should try and become astronauts," said GERALDINE KNATZ

1980

Alice Gast and her classmates held a party at Troy Hall. The surprise guest? A brand new assistant professor: Yannis Yortsos. Said Gast, "We were all so excited that a prof would spend time with us."

1980

Professor Alice Parker arrives at USC from CMU. She is the second tenured female professor in USC engineering.

1984

USC becomes the Olympic Village for the 1984 Games. "I was a volunteer and translated Spanish and French for journalists and athletes," said Rosa Bravo. "To be exposed to the world in your own stomping grounds was the best summer job anyone could have."

I remember attending the live class lecture one week instead of watching on the satellite channel. Being the only woman out of a class of 20 or so, a few heads turned and were curious. They were surprised to learn that I'd been sitting in on the same class all semester on the other end of the satellite link.

TRACY DOOLEY 2002

TRACY DOOLEY

B.S. BME 2002

BIGGEST POST-GRADUATE SUCCESS

At Avestria Ventures, we invest in early-stage life science companies, with a focus on female founders and women's health. I feel incredibly fortunate to be able to talk to passionate, talented entrepreneurs about their compelling ideas to improve healthcare, and support them with either capital or by making introductions within the ecosystem.

FAVORITE PLACE ON THE USC CAMPUS AND WHY

The campus has changed a lot since I was there! The Lyon Center pool was always my place to decompress with some laps, and it still makes me smile to walk by the pool.

SOMEONE AT USC WHO BELIEVED IN YOU

Dean of Admissions Louise Yates made me feel comfortable from the very first time I met her, and was incredibly supportive in guiding me throughout my college career. She is always one of the people I try to see when I'm back on campus—her passion for people is evident.

FIGHTING ON

I was widowed unexpectedly in my early 30s, with a small child. I didn't do a lot of "fighting on" for a while—I actually didn't do much of anything except go through the motions…as I went through the grieving process, I had to come to terms with the idea that the door was forever shut on the future we'd envisioned, and that was heartbreaking as well. But I had practice in exploring different professional paths, so I used that as a template for thinking about our future in its new configuration.

Fighting on is not only about the most dramatic, sweeping action; it can also be a small act or an enduring commitment in the face of changing circumstances. Nobody knows what life has in store, but I am grateful for all the people around us and the opportunities that enable us to create a new world.

EMERGING LEADERS BOARD

WOMEN IN ENTREPRENEURSHIP

1986

The *Challenger* accident is a seminal event for students, but particularly Mica Endsley, who would later testify before Congress on matters of aircraft safety and "situational awareness."

1995

Alumna Marie Knowles (center), recipient of the year's Distinguished Alumni Award, is seen here with members of her ARCO team at the annual USC Engineering Awards Luncheon. She is the first woman to be so honored.

SUKRUTHA BHADOURIA

SUKRUTHA BHADOURIA

M.S. EE, 2007

HARDEST USC ENGINEERING CLASS
Professor Bhaskar Krishnamachari's class—you had to do a programming test to get in!

SOMEONE AT USC WHO BELIEVED IN ME
My then boyfriend Sameer—he's now my husband! He was also a student in Viterbi.

FIGHTING ON
My biggest obstacle has truly been myself! I suffer from impostor syndrome all day, every day!

FAVORITE PLACE ON THE USC CAMPUS
McCarthy quad. It was always so lively!

USC MEMORY
Professor Alan Willner would always spend the first part of class giving us life lessons…he spoke about why gossiping is such an awful habit. He also got the student who was running the controls of the AV to join in his conversations, and when he learned his name was Kenny, he asked him to wear an orange hoodie tied tight (like Kenny from *South Park*). His class was really enjoyable.

VIRY MARTINO

VIRY MARTINO

B.S. CE, 2010; M.S. CE (CEM), 2011

BIGGEST POST-GRADUATE SUCCESS
I loved being part of the Cross Border Xpress construction project, where I was an estimator and also part of the construction team as a project engineer.

The project has a unique bridge that was designed to be built by one American contractor, then completed by a Mexican contractor on the other side of the border. Getting the bridge exactly to a point where another contractor can take over requires exactitude and a great amount of collaboration. I served as a primary liaison in this effort, and helped lead both teams to efficiency and comradery.

CROSS BORDER XPRESS BRIDGE CONTRUCTION SITE

Spanish is my first language, and I like to think that I helped with building not only a physical bridge, but also building a cultural one, bridging the gap (pun intended) during multiple coordination efforts with several U.S. and Mexican agencies, designers and contractors.

When we completed the project on schedule and under budget, the client invited me to become the very first passenger to cross the bridge when it opened to the public. I became a celebrity for a day! It was a very fun experience, and I took it as a testament of the work ethic that I bring to every project.

SOMEONE AT USC WHO BELIEVED IN ME
Professor Hank Koffman in the Civil Engineering Department. He was a great mentor and advisor, and always very supportive of career growth both before and after graduation.

HOW I FELL IN LOVE WITH ENGINEERING
Specifically, it was the day—in high school, thanks to my math teacher—that I learned that "civil engineering" meant to solve problems for civilization. I was mind-blown and have never looked back.

TIMELINE

2001

On the morning of September 11, Tracy Dooley will "never forget waking up and watching the news with my roommates in disbelief."

2004

The school gets a new name, the Andrew and Erna Viterbi School of Engineering, linking USC Viterbi to the visionary couple for generations to come.

2007

A blockbuster debut: Sukrutha Bhadouria remembers the first ever iPhone released that summer.

PAIGE SELBY

PAIGE SELBY 2012 ORDER OF THE TORCH HONORS PARADE ON TROUSDALE

PAIGE SELBY

B.S. ISE, 2012

BIGGEST POST-GRADUATE SUCCESS

Inspiring young girls to pursue STEM has meaning to me. Since graduating from USC, I speak often to groups of female students to excite them to pursue the math and science classes needed to study engineering. I encourage them to pursue a graduate degree in the sciences and have a career doing something they find engaging and creative, as I do now at Google.

SOMEONE AT USC WHO BELIEVED IN ME

As an alumna, I am on the USC Viterbi School of Engineering Emerging Leaders Board. Knowing that Viterbi Dean Yannis Yortsos believes in me to serve on the board has given me continued confidence as a woman in the technology industry.

FAVORITE PLACE ON THE USC CAMPUS AND WHY

I like walking down Trousdale Parkway in the center of campus. I remember walking there with excitement as a new student, experiencing the comradery of a football game day, briskly navigating my way to class, spontaneously running into friends, gazing up at the trees dotted throughout the campus, and having such pride there on graduation day. I still get the same feelings that I did back then when I come to visit, and I feel a part of something bigger than myself.

USC MEMORY

A happy memory is, for my senior design project, I went into the Disneyland warehouses to analyze the efficiency of their stocking and selection processes for their online stores and to recommend potential improvements. The Disney team took us into the theme park afterwards!

FIGHTING ON

I really had to "Fight On" to get my job as a software engineer at Google. The entry barrier both to study STEM and have a career in STEM is high. There will be challenges and rejections, so persistence is essential until success is achieved.

2009

USC's Engineers Without Borders designs and implements a water filtration system for a rural village in Honduras, which Viry Martino calls "by far one of my greatest experiences."

2017

The first ever AthenaHacks, USC's all female hackathon, debuts in the basement of Leavey Library, seeking to reimagine hackathon culture. Since then, the event has expanded to hundreds of coders and dozens of sponsors filling up USC's Bovard Auditorium and TCC Ballroom.

2019

USC Viterbi achieves gender parity for the first time in its history with its 2019–2020 entering class.

Q&A

'If She Can See It, She Can Be It'

Academy Award winner and activist **Geena Davis** is working with USC Viterbi researchers to help build a more inclusive world, starting with the silver screen.

By Caitlin Dawson

Geena Davis

Despite the fact that women make up half the population and a number of female-led movies have dominated the box office in recent years, women and their voices remain conspicuously underrepresented in film. Geena Davis, Academy Award winner and star of such classic female empowerment movies as *Thelma and Louise* and *A League of Their Own*, plans to change that—with a little help from artificial intelligence and a team of USC computer scientists.

In 2012, she launched the Geena Davis Inclusion Quotient (GD-IQ), which uses artificial intelligence to identify gender, speaking time and additional details about characters in the media. The software, designed by USC Viterbi Professor Shrikanth (Shri) Narayanan—Niki and Max Nikias Chair in Engineering—and his team at the Signal Analysis and Interpretation Laboratory (SAIL), caused ripples across Hollywood in 2017 and beyond when its analysis found that in recent popular films, men had almost twice as much speaking time as women.

Since then, some progress has been made: Last June, a GD-IQ analysis found on-screen gender parity had been achieved for the leading characters in the 50 most popular kids' TV programs. Still, the battle is only beginning. Now the team is working with Disney to "spellcheck" scripts for gender bias and with Google on achieving balanced gender representation in advertising. Davis is the founder of the Geena Davis Institute on Gender and Media.

Your mantra is: "If she can see it, she can be it." Why is the issue of women in entertainment so important to you?

We judge our value to society by how we are reflected in the culture: "Oh, look, there's someone like me—I must matter." When my daughter, Alizeh, was just a toddler, I realized that children's entertainment media was sending a message to kids that girls are not as valuable as boys, and this unconsciously sinks into both girls and boys. Media images are powerful. In the same way that a lack of positive images of girls can be damaging, showing female characters doing interesting and important things can inspire girls to do things they may not have realized they can do.

Tell us a bit about your work with the Geena Davis Institute. Why did you want to establish this institute?

When Alizeh was very young, I realized how few female characters there were in media made specifically for kids, which shocked me. Obviously, I also noticed how poorly many of them were portrayed. I didn't intend to make it my life's mission at first! But when I brought it up to creators in the industry, I couldn't find one other person who noticed what I was seeing. They all assured me that gender imbalance in kids' media had been "fixed." That's when I decided I needed the data: I could go directly to the creators and share it with them in a private, collaborative way, which has worked very well for us.

Let's go back to your landmark study with our very own Professor Narayanan on uncovering gender bias in media. You found that women in Hollywood had significantly less screen time and speaking time than men. What was your first thought when you heard the results? Were you surprised, or was it something you suspected?

From what I had already learned, I did expect the results to reveal gender bias, but the imbalance in both TV and movies made for kids was more than I could have guessed. Not only are there far fewer female characters in media aimed specifically at young kids, but those that are there are seen and heard far less than the male characters.

What is the impact of women being underrepresented and misrepresented in film and television beyond the screen?

It limits what men and women think women are capable of, and it teaches us to believe that men are better at and more suited to do most things. Conversely, showing women on screen in various occupations encourages women to pursue those careers, and telegraphs to men that it's natural for women to be doing those things. With so many female forensic scientists on TV, the percentage of women in that field has skyrocketed. It even has a name: the CSI Effect.

Very interesting! So is it only what we see that matters? Or is gender diversity behind the screen important as well? I was surprised to learn the silent film era was full of female movie directors.

It is equally important for the creators and storytellers to be gender balanced. With so few women's voices being heard, we have become trained to see everything through the male gaze. Girls as young as 6 have now learned that their role is to be objectified.

> "Unless you truly believe women are second-class citizens, you are a feminist."

Do you think things have changed since this study in 2017?

The area that has seen the most change is on screen in children's TV shows: The percentage of lead characters who are female was 42 percent

in 2008; that rose to 52 percent by 2018. We were beyond thrilled to see one of the most important goals we set—on-screen parity—had been reached during the time we've been advocating for it. Movies haven't budged yet, but we're very confident that on-screen representation will improve significantly within the next five years.

You have referred to data as the "magic key." Why are numbers important for moving the needle?

The big advantage we have in moving the needle for kids' on-screen representation is that the bias was unconscious. That meant that the data opened their eyes to something they absolutely could not see. Combine that with the fact that people in kids' media want to do right by kids, and you've got a group that's very eager to make the necessary change.

How did this partnership with USC come about?

We received a $1.2 million Google Global Impact Award to help us create software to conduct our research. We explored potential resources [who] were experts in machine learning for audio and video. [Professor] Shri Narayanan at the USC Viterbi SAIL lab was at the very top of the list.

What was it like working with Shri and other USC computer scientists?

Shri and his team have a great sense of humor and are very nimble. When we met with them for the first time, we said to Shri and a room full of engineers that we wanted a "thingy" that could automate extracting gender along with screen and speaking time for moving images. Eventually, in 2015, this became GD-IQ, which has now gone well beyond just measuring gender. And now we're collaborating on a new tool that builds off of our GD-IQ and USC's patented text IP, which we call Spellcheck for Bias, which can analyze text in scripts, books and more. We're already testing it with major studios like The Walt Disney Co. and many others.

How do we change things in Hollywood quickly? What is the first change you would recommend?

Well, I can speak about the advice I give creators as to the quickest way to boost the female population in Hollywood: go through the projects you're already working on and do a "gender pass." Determine which characters could just as easily be female, and simply change their first name! It can be that simple. Without stopping to think about it, we all tend to make the default male. There are plenty of characters that could have a gender swap without changing the plot or triggering a big rewrite.

I know you have a daughter in her late teens. What do you hope for the next generation of women?

I can see that this is an amazing generation coming up, with very evolved ideas about women, people of color and LGBTQ+ individuals and empowerment. My daughter and her friends are fierce in their commitment to making change. I think we all have noticed this about our teens and young adults across America.

You received the "engineering influencer" award at the USC Viterbi Awards. What does this mean to you?

I'm thrilled and honored to be recognized in this way. I've so enjoyed this collaboration with Shri and his team. My dad was an engineer, and while I am not (my brother is), I get great satisfaction out of collaborating with engineers. I wish my dad were here. He'd be proud.

You said you were first introduced to the word "feminism" as a child through a *Reader's Digest* article that claimed feminists were "ruining the world." How would you rewrite that headline today?

"Unless you truly believe women are second-class citizens, you are a feminist."

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