Welcome to Impact: Research at Brown, Brown’s first magazine devoted to the University’s research.

In these pages you’ll learn about our academically rigorous and intellectually entrepreneurial approach to research. Our leadership in exploration, discovery, and innovation, together with our desire to work as a community for the greater good, makes Brown a truly distinctive institution.

At Brown, impact is about deploying knowledge to address critical and complex problems. Our faculty, students, and postdoctoral researchers work on the urgent problems of society, in computing, engineering, international relations, medicine, and much more. Equally important to the future of society is the work of Brown faculty and students in basic research, advancing frontiers of knowledge in areas such as creative arts, history, mathematics, and theoretical physics.

Collaboration is a vibrant force powering our innovation at Brown; it is part of our DNA. Our research often crosses traditional department and disciplinary lines so effectively and imaginatively that those boundaries seem not to exist. Research at Brown; it is part of our DNA. Our research often crosses traditional department and disciplinary lines so effectively and imaginatively that those boundaries seem not to exist. Research at Brown.

We hope this magazine, which we plan to publish annually, gives you a fuller understanding and appreciation of how Brown is working to facilitate the evolution of discoveries and inventions to benefit humanity. It is also our hope that these stories inspire a greater public appreciation of the remarkable government-university and foundation-university research partnerships that have changed our lives and our world for the better, as well as the potential for the future.

ON THE COVER: As part of its research studying mechanisms of motor neuron wiring, the lab of neuroscience professor Alexander Jaworski, affiliated with the Brown Institute for Brain Science, captured this image showing part of an embryonic mouse spinal cord. In this microscope image, fluorescent probes highlight different structures—blue shows cell nuclei, green shows motor neurons, and red shows part of nerve fibers.

RIGHT: An adult mouse cerebellum is shown in another image from the Jaworski lab. The probes show Purkinje neurons in red, axons in green, and nuclei in blue.
Sohini Ramachandran is working at Brown on issues in population genetics and evolutionary theory, with grant funding from the National Institutes of Health and the National Science Foundation.

Data Detectives
New computational biology center uses analysis and advanced genomics to look for ways to fight diseases.

Sohini Ramachandran, an associate professor of ecology, evolutionary biology, and computer science at Brown, is a scientist on a mission: to identify risk genes for leukemia that differ in incidence across ethnic groups and genders.

Ramachandran, the new director of Brown’s Center for Computational Molecular Biology, is developing advanced computational and analytical methods that take into account multi-ethnic samples. “My hope is that my research group and collaborators at Brown can ensure that those most in need will not be the last to benefit from genomic research,” she said.

Ramachandran’s research is part of an ambitious new effort at Brown as it launches a Center of Biomedical Research Excellence (COBRE) for Computational Biology of Human Disease. Its goal is to expand research, using sophisticated computational and bioinformatics analyses, to understand and fight human diseases. Powered by a five-year, $11.5 million grant from the National Institutes of Health, work is intensifying in advanced genomics, tackling diseases such as cancer, pre-eclampsia, and severe kink infections.

“It’s data, and then there’s information,” said David Rand, director of COBRE and chair of the Department of Ecology and Evolutionary Biology. “Tying data into information you can use for something is what computational biology is all about.” —Phoebe Hall

Prevent, Treat, Recover
School of Public Health faculty take the lead on the opioid crisis in Rhode Island and nationally.

With the toll of opioid drug dependence and deaths soaring to crisis levels in Rhode Island and across the United States, Brown University School of Public Health researchers have taken a leading role in searching for causes and devising solutions.

Three experts from the school have been key to mobilizing efforts in Rhode Island. Professors Jody Rich, Traci Green, and Brandon Marshall were coauthors of “Rhode Island’s Strategic Plan on Addiction and Overdose,” completed in 2016 for Gov. Gina Raimondo. Their research led to a statewide plan for treatment, rescue, prevention, and recovery, with government agencies and the medical community widely adopting their recommendations.

Marshall, an associate professor of epidemiology, also developed the “Prevent Overdose R.I.” web dashboard. The site is updated regularly so people can have timely data to track the latest information on addiction and overdoses in Rhode Island as well as the state’s progress toward reaching prevention and treatment goals.

And, in a study published in the American Journal of Public Health, Marshall investigated the national efforts of painkiller manufacturers to promote prescribing medicines by paying doctors through meals, honoraria, and other marketing and education programs. He found that drug manufacturers paid more than $46 million to more than 68,000 doctors in a 29-month period.

“The opioid epidemic is a national tragedy that we must work at every level to combat.” —Brandon Marshall

In 2009, in a significant surprise to scientists and others around the world, a Brown planetary science team discovered that water exists on the surface of the Moon, a place thought to be completely dry. Professor Carle Pieters was the lead scientist for the Moon Mineralogy Mapper that went to the Moon on India’s Chandrayayaan-1 satellite, and she was at the center of the effort that sparked reconsideration of the Moon’s geology.

“Prevent, Treat, Recover is a national tragedy that we must work at every level to combat.” —Brandon Marshall

“Soohi Ramachandran is working at Brown on issues in population genetics and evolutionary theory, with grant funding from the National Institutes of Health and the National Science Foundation.”

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“RESEARCH HISTORY FACT: In 2009, in a significant surprise to scientists and others around the world, a Brown planetary science team discovered that water exists on the surface of the Moon, a place thought to be completely dry.”

“RESEARCH BRIEFS - A COMPENDIUM OF RECENT HIGHLIGHTS OF BROWN RESEARCH”
RESEARCH BRIEFS

Destination Mars
Brown planetary scientists are major forces in planning NASA’s 2020 trip to the Red Planet.

Building on a long record of planetary research, and expanding upon strong ties to NASA, Brown scientists are playing a major role in the search for the best landing site for the next unmanned rover to explore Mars.

Two of the three landing site finalists are ones championed by Brown professors and graduate students. Jezero Crater, an ancient lake with a dazzling river delta, and Northeast Syrtis Major, a swath of mineral-rich terrain once home to hydrothermal activity, have both been subjects of intense study by Brown researchers. Final landing site selection is likely in 2018. Brown scientists also are working with NASA on other responsibilities for the Mars mission, including mapping and developing scientific objectives.

The Mars 2020 mission is far from the first time Brown has put a strong stamp on the Red Planet’s exploration. In the 1970s, the late Brown professor Tim Mutch helped select the landing site for Viking and was principal investigator for that spacecraft’s camera system. “Since that time, dozens of Brown planetary scientists have contributed to the site-selection process and to the missions once they have successfully landed,” said Professor James Head ’69 PhD of Brown’s Department of Earth, Environmental, and Planetary Sciences. —Kevin Stacey

Brown scientists say the complex geology of the Northeast Syrtis Major region on Mars (in a color-shifted image) is a prime reason for NASA to land an unmanned rover there. Top, a rendering of a Mars rover. Above, Michael Bramble and colleagues at Brown developed the most detailed map ever produced of the Northeast Syrtis Major region on Mars.

Top, a rendering of a Mars rover. Above, Michael Bramble and colleagues at Brown developed the most detailed map ever produced of the Northeast Syrtis Major region on Mars.
RESEARCH BRIEFS

Under the Radar
Brazil has made progress in stopping deforestation, but Brown research found some destruction undetected.

Over the past 15 years, the Brazilian government has drawn worldwide praise for its efforts to curb deforestation in its Amazon region—but a study from the Institute at Brown for Environment and Society (IBES) discovered that gaps in Brazil’s forest monitoring system allow extensive destruction to fall through the cracks.

The study, published in the journal Conservation Letters, compared data from Brazil’s official monitoring by satellite, known as PRODES, with two independent satellite measures of forest cover. The IBES study found that, from 2008 to 2012, about 9,000 square kilometers of forestland were cleared—an area roughly the size of Puerto Rico—without being caught by PRODES monitoring.

“PRODES has been an incredible monitoring tool and has facilitated the successful enforcement of policies,” said Leah VanWey, coauthor of the research and a professor of environment and society and sociology. “But we show evidence that landowners are working around it in ways that are destroying important forests.”

The problem, researchers say, is that PRODES monitors only primary Amazon rainforest. It excludes dry forests, another critical type, as well as secondary forests. Undetected deforestation has ramifications beyond the loss of critical forests. Brazil uses PRODES to calculate how much greenhouse gas the country emits through burning forest biomass. The study suggests that Brazil’s deforestation-related greenhouse gas emissions are nearly twice as high as PRODES estimates. “By missing so much deforestation in PRODES measurements, Brazil is overestimating their emissions reductions,” VanWey said. —Kevin Stacey

A Brown study found home-delivered meals provide more health benefits to seniors.

Aging Better
Researchers work to slow down the process of getting old and to improve quality of life.

“There is a lot of new research that very clearly says that aging is actually something we can do something about,” says Brown Professor of Biology and Medical Science John Sedivy. The Biology of Aging initiative, which he’s leading, is looking for breakthrough solutions.

As people live longer and spend more time in old age, they suffer more from diseases associated with aging, such as arthritis and dementia. Brown researchers, led by those from the Division of Biology and Medicine and School of Public Health, are interpreting mechanisms controlling how people age, with the goal of increasing time spent without age-related problems or reducing symptoms.

The Biology of Aging initiative brings together nearly two dozen faculty members from across Brown and its affiliated hospitals. Researchers have identified processes that regulate aging and are exploring fixes through diet, genetic engineering, and drugs. For example, Assistant Professor of Molecular Biology, Cell Biology, and Biochemistry Ashley Webb has identified genes common to worms, flies, mice, and humans, all affected by the same family of longevity proteins.

In 2016, the National Institutes of Health accelerated the initiative, naming Brown to lead a five-year, $9.67 million program grant along with New York University and the University of Rochester. Multiple lines of research are being pursued by Brown faculty, including biology professor Stephen Helfand, who has found evidence that health becomes endangered when aging cells lose control of rogue elements of DNA.

The School of Public Health has an ambitious agenda of research on aging and gerontology, focusing on improving quality of life for those with age-related problems. The Center for Long-Term Care Quality & Innovation, directed by Professor of Health Services, Policy, and Practice Vincent Mor, received a grant from the U.S. Centers for Disease Control and Prevention in 2016 to fight health care-related infections in nursing homes. In another project, assistant professor Eric Jutkowitz did a simulation estimating the economic impact dementia has on households and public insurance, providing a tool for projecting the impact of different interventions.

“New research... clearly says that aging is actually something we can do something about.”
—John Sedivy
Science and Art
Ambitious academic initiatives launched in Data Science and Brown Arts.

"We needed an organizing principle" and entity to launch the Data Science Initiative in 2017, said Jeffrey Brock, its director and professor of mathematics. "We realized that computation, mathematics and statistics needed to be woven together to address the fundamental challenges of data collection and curation, causal inference, and pattern recognition."

The initiative also includes a dozen other affiliated areas around Brown, such as the Institute for Computational and Experimental Research in Mathematics, the Center for the Study of Race and Ethnicity in America, and the Brown Center for Biomedical Informatics.

"This is about advancing knowledge at an entirely new level," Brown President Chris Paxson said. "It expands the capacity of Brown scholarship to have impact."

In its first year, the initiative received a $1.5M grant from the National Science Foundation and a master's in data science degree program, and started a series of lectures and colloquia.

THE BROWN ARTS INITIATIVE
The Brown Arts Initiative (BAI), another program rooted in long-term academic strengths at Brown, also launched in 2017. Spanning teaching, performance, and research, it is built on a philosophy that integrates the latest arts practices and research that reacts to and engages with the environment. The two-day gathering attracted over 350 people, including students and faculty from Brown and Rhode Island School of Design, as well as participants who came from as far away as California.

"The BAI's inaugural program season this academic year includes leading performing, literary, and visual artists in a variety of performances, workshops, master classes, lectures, symposia, exhibitions, and films."

The BAI emphasizes approaches that break traditional boundaries between academic disciplines and advance cultural, scholarly, and scientific discourse. "We are working to serve the entire University, establish ties to the broader arts world, spur research, and discover new forms and means of production and performance," said Butch Rovan, professor of music and faculty director of the initiative.

—Noel Rubinton

Where Research Funds Come From
FY 2017 Brown grant expenditures, by source.

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<th>Source</th>
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<tr>
<td>Corporate and Industry</td>
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<td>TOTAL $168.0 MILLION</td>
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Source: Brown University Research Administration Information Systems & Reporting

A two-day symposium in March 2017 on natural and constructed environments formally launched the BAI and unveiled its three-year theme of "Arts & Environment." The re|ACT: Arts & Environment Symposium brought together 22 international artists, curators, designers, architects, writers, activists, and scholars to showcase the latest arts practices and research that reacts to and engages with the environment. The two-day gathering attracted over 350 people, including students and faculty from Brown and Rhode Island School of Design, as well as participants who came from as far away as California.

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Jeffrey Brock says a key Data Science Initiative goal is to “extract meaning from data.”
RESEARCH BRIEFS

‘A Vital Part of Education at Brown’
Brown President Christina Paxson talks about the University’s research growth and what’s ahead.

Q: In what ways is Brown distinctive in how it integrates its research and teaching mission in service to society?

A: Brown has always been dedicated to its educational mission, and over the years, we have expanded our capacity to produce groundbreaking research across fields. Our approach is distinctive in two ways. First, Brown faculty routinely use their classrooms as places to test and hone new research insights. And second, Brown students are frequently involved in faculty research, learning by doing.

One of my favorite events of the year is the Summer Research Symposium, where students present original research they engaged in over the summer, collaborating with faculty. This event clearly demonstrates that research is a vital part of education at Brown.

Q: Is there significant national discussion about the roles of universities as economic engines? What impact is Brown research having on economic development in Rhode Island?

A: In recent years, we have worked closely with our city and state governments to align Brown’s research and education planning with economic development priorities. This began when Brown made initial investments in Providence’s Jewelry District, including the Warren Alpert Medical School and the Laboratories for Molecular Medicine. We have since complemented these investments with research in South Street Landing, where we have relocated 11 administrative units, and the Innovation Center, which will be the new home for our School of Professional Studies. Our total investment now exceeds $220 million.

The state government has succeeded in courting companies to Rhode Island, many of which want to partner with universities they see as incubators in a knowledge economy. These companies are active, for example, in data science, cybersecurity, biomedical, and engineering, areas where Brown research and discovery are particularly robust.

Q: How have your own research experiences as an economist informed your views about the possibilities and power of university-based research?

A: My research in economic development, public health, and economic demography underscored how valuable it is to collaborate with people in other disciplines. Working with psychologists, sociologists, and political scientists always made my research stronger.

“Brown must be strategic in exploring funding from multiple sources.”—Christina Paxson

I learned that research is uncertain—a great deal of time is spent doing things that may not turn out the way you envision. But I also learned the value of perseverance. If researchers make enough attempts, some insight, discovery, or outcome will eventually turn out to be consequential or to advance knowledge in some way.

I am gratified that some of my research influenced policy on health disparities, health care in Africa, and the treatment of orphans in developing countries, and I draw a lot of satisfaction from this. Now I am in a position where I can support Brown faculty seeking to make an impact through their research.

Q: Given the current political climate, how will Brown navigate the federal research funding environment, going forward?

A: While Brown has increased its market share of research funding in recent years, there is uncertainty about the overall funding environment. As a case in point, federal funding for the National Institutes of Health has long enjoyed bipartisan support, but the initial White House budget included cuts to the agency. Irrespective of the outcome of the budget process, Brown must be strategic in exploring funding from multiple sources. That is partly why we established a new office of Industry Engagement and Commercial Venturing and will continue to develop partnerships with industry with a view toward diversifying support for Brown research. Supporting research is especially challenging in the humanities and social sciences. Because the federal government has not been a major source of humanities funding for some time, Brown has looked to foundations. And federal funding for social sciences is at some risk because research in these fields can unfortunately become politicized.

The most important thing we can do is to keep applying for grants and submitting strong applications, regardless of the funding environment. We can’t get funded if we don’t apply. One way we have been supportive of our faculty is to help groups of researchers who want to submit large multi-investigator proposals. These proposals are time-consuming to write and often require specific expertise. The University has achieved great results with this approach, such as the Institutional Development Award from the National Institute of General Medical Sciences, which funds Advance Clinical and Translational Research at Brown.

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A Nobel for Brown
Physicist J. Michael Kosterlitz wins prize for key theoretical work in the hunt for matter.

On Oct. 4, 2016, Brown University Professor of Physics J. Michael Kosterlitz awoke to some unexpected, life-changing news—the Royal Swedish Academy of Sciences had award ed him the Nobel Prize in Physics. Drawing on a branch of mathematics known as topology, Kosterlitz’s theoretical work on phase transitions in two-dimensional materials has been instrumental in basic research and a bedrock for investigations into ultra-thin materials and exotic phases of matter.


“This year’s Laureates opened the door on an unknown world where matter can assume strange states,” the Royal Swedish Academy of Sciences said. “Thanks to their pioneering work, the hunt is now on for new and exotic phases of matter. Many people are hopeful of future applications in both materials science and electronics.”—Kevin Stacey
Getting Max from Mini
Adding blood vessels to brain models could be a major research boost.

Mini-brains—3-D cultures of neural cells that model basic properties of living brains—could help transform the study and ultimately treatment of diseases and injury. Now a new finding at Brown could add to their usefulness in another way: mini-brains could grow blood vessels, too.

Networks of capillaries within the mini-brains’ small balls of nervous system cells could enable large-scale lab investigations into conditions such as concussion or stroke, where interaction between the brain and its circulatory system is paramount, said Diane Hoffman-Kim ‘93 PhD, an associate professor of medical science and engineering at Brown. Her study was published in the Journal of Neuroscience Methods.

Adding vasculature makes mini-brains more realistic models of natural brains and hence more valuable. “For our neurons to do their thing, they have to be close to some blood vessels,” said Hoffman-Kim.

Hoffman-Kim’s lab first described its mini-brain method in 2015. The mini-brains were relatively easy and inexpensive to make and scientists can make them by the hundreds, with mini-brains holding promise for advancing medical and scientific research with less need for animal models. The 3-D petri dished used were created by Professor of Medical Science and Engineering Jeffrey Morgan, who started a production company through Brown’s technology venture operation.

There is no blood in a tiny mini-brain, Hoffman-Kim said. They exist in an agarose well plate, not a living animal. She’s working with a Brown colleague to design a way to connect mini-brains with an apparatus that could produce an external source of circulation.

Vasculature is important because it delivers oxygen, glucose, and medicine to brain cells, and also because research shows that in strokes, Alzheimer’s disease and brain injury, the brain sometimes attempts to redesign its vasculature to compensate for what’s happening. Mini-brains could allow researchers to observe such responses amid different lab-created conditions and treatments, Hoffman-Kim said.

Under the microscope, lab staining highlights networks of neurons and support cells that make up a mini-brain.

Crossing Borders
A major foundation grant enables the Cogut Institute to increase humanities collaboration across disciplines.

Brown is taking the lead in developing collaborative research in an area where it was long thought that work was best done alone: the humanities.

In recent years, Brown’s Cogut Institute for the Humanities has developed collaborative practices as a way to add meaning and get better results in its scholarship and other work. An inflection point came in 2016 when Cogut launched a graduate certificate in Collaborative Humanities.

Now there’s more. The Andrew W. Mellon Foundation awarded a $1.3 million grant to Brown in the spring of 2017. It is enabling Cogut to start a three-year program to further advance and promote collaborative research and scholarship, stimulating thinking across academic disciplines.

“We are thrilled by the opportunity this grant will provide to galvanize collaborative work across the humanities at Brown through dynamic research and teaching models,” said Amanda Anderson, director of Cogut and professor of humanities and English. “Collaboration is an especially sought-after skill that serves students well in academia and beyond.”

New graduate Cogut research seminars—such as on “Politics and Literature” and “Trans/Passing, in Theory”—are being team-taught by two or more faculty, with students from different fields working together on research. The Mellon grant will also fund workshops and symposia, and provide international research and exchange opportunities.

—Amanda Anderson

—Noel Rubinton
Growing Grants
All grant awards to Brown, in millions of dollars

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Source: Brown University Research Administration Information Systems & Reporting

Homegrown Research Successes
Six professors receive new Brown recognition.

In recognition of exceptional scholarship and groundbreaking work across a wide range of academic disciplines, six Brown faculty members were honored in April 2017 with the University’s inaugural research achievement awards.

The awards were launched by the Office of the Vice President for Research with support from Brown President Christina Paxson and Provost Richard M. Locke, to celebrate the research contributions of faculty. Each winner received a citation and a $5,000 research stipend; OVPR plans to present the awards annually.

Maurice Herlihy, a professor of computer science, received the Research Innovation Award. Among other accomplishments, Herlihy helped develop transactional memory, a technique helping computers with multiple processors coordinate shared data revisions in real time.

Vincent Mor, a professor of health services, policy, and practice; and Constantine Dafniemos, a professor of applied mathematics, received the Distinguished Research Achievement Award, which honors faculty with outstanding records of research throughout their careers at Brown.

Susan Moffitt, an associate professor of political science and international and public affairs; Joseph Braun, an assistant professor of epidemiology; and Tim Kraska, an assistant professor of computer science, received Early Career Research Achievement Awards, which recognize faculty who have built extraordinary research portfolios in their first years at Brown.

“Here at Brown, we are committed to recruiting and rewarding exceptional scholars and providing them with the tools and the environment to engage in critical research across the disciplines,” Locke said. —Noel Rubinton

Computer scientist Maurice Herlihy, above, won Brown’s Research Innovation Award, and Susan Moffitt, right, a political scientist, received an Early Career Research Achievement Award.

RESEARCH BRIEFS

Around the time that Alexander Graham Bell was inventing the telephone, Brown professors and students were also working on a communication device. In 1877, the group, headed by professors Eli Whitney Blake (whose great-uncle was Eli Whitney, inventor of the cotton gin) and John Peirce, created a phone receiver ultimately adopted by Bell in his final design for the telephone.

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“We are committed to recruiting and rewarding exceptional scholars.”
—Provost Richard M. Locke

Engineering’s New Hub
Significant new avenues of research—from nanotechnology to bioengineering and more—will be enabled for Brown’s School of Engineering and other campus departments. A new three-story, 80,000-square-foot Engineering Research Center opened in October, complete with clean-room technology and other state-of-the-art facilities designed to heighten research and collaborative possibilities.
“If these obstacles persist, we will squander the potential of many of our citizens.”

—Janet Yellen ’67

Women and the Economy

As Federal Reserve Chair, Janet Yellen ’67 used oral histories from Brown alumnae to tell the story of U.S. women’s workforce participation.

When Janet Yellen ’67 came to Brown in her post as Federal Reserve Chair to give a keynote address in May 2017, her message was a research-intense one, blending troves of broad historical data with stories of other Brown alumnae to describe how generations of women have pushed past barriers.

“As we celebrate the 125th anniversary of women being admitted to Brown, it seems appropriate to reflect on the progress that women have achieved,” said Yellen, who earned her bachelor’s degree in economics summa cum laude, at the 125 Years of Women at Brown conference.

“Evidently, this remains a challenge to many of us,” Yellen added.

In the book, Sloman and Fernbach grapple with implications of the community of knowledge for societal issues such as education and politics. Sloman said teaching should embrace the community of knowledge rather than assuming each child should harbor all needed knowledge entirely. In politics, meanwhile, it’s probably unrealistic to expect voters to be comprehensively informed. But they depend on the community of knowledge to feel as if they understand issues, Sloman said, so it’s crucial they know which members of a community they should rely upon.

“You made it so.”

—Janet Yellen ’67

“Community of Knowledge

New analysis examines why we look to others in seeking to understand phenomena.

We can’t know everything as individuals, and our sense of what we do know about something is increased when we learn that others around us understand it.

That idea of a “community of knowledge,” where people blend the perceived expertise of others into the assessment of their own understanding, is central to new research from Steven Sloman, professor of cognitive, linguistic, and psychological sciences at Brown.

Research included web-based experiments in which Sloman presented several false but plausible scientific phenomena with cursory descriptions and no explanation. Volunteers proved more likely to give a higher rating of their understanding of how phenomena worked if they were told “scientists” understood it.

Research also found people can believe they understand something when they don’t. “We think we know a lot more than we actually do,” Sloman said. “It’s important to know what you don’t know.”

Sloman’s research, done with Nathaniel Rabb of Boston College, was published in the journal Psychological Science, and is among the ideas explored in his book The Knowledge Illusion: Why We Never Think Alone, coauthored with former Brown doctoral student Philip Fernbach ’10.

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RESEARCH BRIEFS

Andy Van Dam, a professor at Brown since 1965, is credited with being a leader in the field of computer science education. Many of his students went on to work at Pixar and created many popular films, such as Toy Story and Monsters, Inc. Steve Jobs invited Van Dam to the premiere of Toy Story and presented him with a production book that included the inscription, “You made it so.”

RESEARCH HISTORY FACT

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We can’t know everything as individuals, and our sense of what we do know about something is increased when we learn that others around us understand it.

That idea of a “community of knowledge,” where people blend the perceived expertise of others into the assessment of their own understanding, is central to new research from Steven Sloman, professor of cognitive, linguistic, and psychological sciences at Brown.

Research included web-based experiments in which Sloman presented several false but plausible scientific phenomena with cursory descriptions and no explanation. Volunteers proved more likely to give a higher rating of their understanding of how phenomena worked if they were told “scientists” understood it.

Research also found people can believe they understand something when they don’t. “We think we know a lot more than we actually do,” Sloman said. “It’s important to know what you don’t know.”

Sloman’s research, done with Nathaniel Rabb of Boston College, was published in the journal Psychological Science, and is among the ideas explored in his book The Knowledge Illusion: Why We Never Think Alone, coauthored with former Brown doctoral student Philip Fernbach ’10.

In the book, Sloman and Fernbach grapple with implications of the community of knowledge for societal issues such as education and politics. Sloman said teaching should embrace the community of knowledge rather than assuming each child should harbor all needed knowledge entirely. In politics, meanwhile, it’s probably unrealistic to expect voters to be comprehensively informed. But they depend on the community of knowledge to feel as if they understand issues, Sloman said, so it’s crucial they know which members of a community they should rely upon.
OPEN DOORS

Growing opportunities for research experience are transforming undergraduate education at Brown and advancing the University’s search for knowledge.

BY SARAH C. BALDWIN

WHEN DEVERICK ANDERSON, director of the Duke Infection Control Outreach Network, got an email from a Brown student asking for information on MRSA infection among college athletes, he knew just the paper he wanted her to read. Then he realized she was actually one of its coauthors.

“'I was amazed,' said Tori Kinamon '17, the student who wrote Anderson, 'that one of the leaders in the field had read my paper and called it 'great.'"

No less amazing is how Kinamon came to be a published author in the peer-reviewed journal Clinical Infectious Diseases while still an undergraduate. A gymnast since the age of 3, the Georgia native was recruited to Brown’s gymnastics team in 2013. In her first semester, a mysterious infection landed her in Rhode Island Hospital. An MRI revealed an abscess deep inside her left hamstring. Eight surgeries and many months later she returned to Brown, a sophomore on a quest: to find out what had happened to her and why, and how to prevent the same thing from happening to other college athletes.

Kinamon reached out to Eleftherios Mylonakis, chief of infectious diseases at Rhode Island Hospital and the Miriam Hospital and professor at the Warren Alpert Medical School. Moved as much by her personal story as by her smarts and determination, he agreed to take her on as an undergraduate researcher in his lab.

“You’re going to learn this thing called meta-analysis,” he recalled telling her, “which will help your evaluation of the literature for the rest of your career.” Paired with a postdoc, Kinamon spent months reviewing medical literature on methicillin-
resistant Staphylococcus aureus, the bacterium that left her with a two-foot scar. Her research revealed something “remarkable,” according to Mylonakis: the prevalence of MRSA among collegiate athletes is 13 percent—almost seven times greater than in the general population.

Kinamon went on to do clinical research in Mylonakis’s lab, repurposing drugs used to treat worm infections and looking at their potential to treat MRSA. She wrote and produced an educational video designed to raise MRSA awareness among athletes, thanks to a prestigious Royce Fellowship connected to Brown’s Swearer Center. She plans to go to medical school. “My experience with MRSA was extremely painful and stripped me of a lot of things,” Kinamon said—including her identity as a gymnast. “But Brown gave me the confidence to be not just a victim but a victor over it through research. I was able to tap into the ethos of this place, the spirit of charting your own course of study, knowing that, if you want to change something, you can.”

Kinamon is one of many examples of how research is transforming undergraduate education at Brown and, in turn, how undergraduates are raising the quality of research. As research at Brown has grown in many academic areas, so has the infrastructure for undergraduate involvement.

OPEN DOOR POLICY

While reaching out to a professor, as Kinamon did, is one path to collaborative research opportunities, Brown has also created a superhighway to such connections. The Karen T. Romer Undergraduate Teaching and Research Awards, or UTRAs, enable students to engage with faculty as partners in their scholarship.

Created in the 1980s, UTRAs started small, but now number around 270 during the summer and 40 during the academic year. Associate Dean of the College Oludurotimi Adetunji, who oversees programs to aid undergraduate research, said projects give students much more than research experience and professors much more than research assistance. “It’s not just about a project, it’s also about a relationship,” he said.

Adetunji, a physicist, estimated that more than 1,000 undergraduates are engaged in research during the academic year, and between 600 and 800 undergraduates every summer, whether through grants, fellowships, or independent study projects. Every summer his office hosts a research symposium where students share their work—in the humanities and the social, life, and physical sciences—through poster presentations.

As a student, said Adetunji, early exposure to lab research “changed everything” for him. Supporting these partnerships has “really changed” his role as a professor. For Dean of the College Maud Mandel, it’s a mission. “A university is about teaching and learning, and also about extending knowledge. The teaching becomes linked to knowledge creation when you include students in the research side.”

Mandel, an expert on French and modern Jewish history, stresses that undergraduates impact the research done university-wide. She has participated in many UTRAs, and “having a collaborator, even a young one, can be powerful. They’re looking at the same source material you are, but they bring fresh eyes to the project.”

‘JUST COME IN’

Robotist Chad Jenkins credits his UTRA partner, Nifemi Madarikan ’17, with such a contribution. “Nifemi was a first-year student when we began collaborating,” said Jenkins, “and he helped me work through some more experimental ideas for making robotics more accessible to broader populations. His contributions to my group helped lay the foundation for research that is now maturing into academic publications. And he helped improve my approach to teaching.”

Raised in Nigeria and educated in Italy, Madarikan had never done computer science before he met Jenkins. “Chad was committed to helping me figure out the things I didn’t know,” he said. The summer after Madarikan’s first year at Brown, Jenkins (now at the University of Michigan) invited him into his Brown lab. “He told me ‘Just come in and try to figure things out.’”

Madarikan said, “‘Tinker where you can, feel free to reach out to me and to people in the lab whenever you need.’ That fall, they formalized their collaboration through an UTRA that aimed to develop network protocols for synchronizing data uploads from multiple robots. Madarikan headed to a job at Microsoft after graduating last May, but only after leaving another legacy: the creation of Mosaic+, a student-led support network for students from historically underrepresented groups in computer science.

Like Madarikan with computer science, Xiao “Candy” Rui ’18, a double concentrator in public health and Egyptology, didn’t let a lack of experience—she had never done an excavation before—stop her when she asked archaeologist and Brown postdoc Brett Kaufman to let her work on his Yangguanzhai Archeological Project in a Neolithic village outside of Xian, China. Rui had been a regular at Brown’s Joulwsky Institute for Archeology and the Ancient World lectures and symposia, Kaufman explained, and “I could tell she had a curiosity that she had to satisfy through fieldwork.” Their UTRA enabled Rui to spend the summer learning in the trenches—literally. She and Kaufman excavated together, and he taught her “how to use a trowel, how not to break things.” By the end of five weeks, she

“IT HELPS ME TAKE WHAT I’VE LEARNED AND ACTUALLY USE IT.” —SHELBY HEITNER ’18

SHELBY HEITNER ’18 is analyzing state and federal environmental data in her work for the Rhode Island Innovative Policy Lab at Brown.
Johnson sees a newly pivoted Swearer as the perfect place for this fusion of research and action. While the center operated for years as a “high-quality volunteer placement organization,” now, Johnson says, “we have a clear educational philosophy and framework that provides students with pathways to integrate their more traditional academic learning with the engagement that they’re doing, so that each feeds the other.”

So what does this look like in practice?

One notable example is the Royce Fellowship (named in honor of benefactor Charles Royce ’61), which, since launching in 1996, has funded hundreds of student-designed research projects that have taken undergraduates around the world. The roster of 2017 Royce Fellows includes students investigating how diet affects the aging process, how pediatric cancer patients respond to music therapy, and how birds in Costa Rican forests are being affected by climate change, to name just a few.

A more recent addition to Swearer’s research portfolio is the Engaged Scholars Program, through which students enhance traditional coursework with hands-on, immersive experiences geared toward solving societal problems. The program started as a pilot project in 2015, and in the roster of graduating Engaged Scholars in 2017 there are projects in Swaziland, Peru, and San Francis- co, covering fields including anthropology, engineering, and urban studies.

For his capstone research project, Ben Miller-Gootnik ’17.5 traveled to Macedonia to investigate the protest movement that emerged in the wake of the country’s canceled elections. With help from interviewed activists, United Nations and European Union officials, and the U.S. ambassador to Macedonia.

LOCAL IMPACT

SWEARER’S RESEARCH opportunities also seek to have local impact in Providence and Rhode Island. Gabriel Zimmerman ’18 helped to survey Providence’s homeless population as part of his involvement in the Swearer-based organization Housing Opportunities for People Everywhere. Zimmerman and other students walked the streets of Providence and spoke with homeless residents about the issues affecting them. They collected data that was funneled into a 2016 Rhode Island Coalition for the Homeless survey, which in turn helped inform the priorities of homeless advocates—and legislators—at the Rhode Island State House.

Johnson says the common thread among the center’s various research ventures (which also include faculty research) is an emphasis on thinking and doing at the same time. If a previous opportunity at Swearer might have involved a student tutoring a child in Providence, now the center’s hope is that the student may start with tutoring and then conducting research, reimagining that activity “to mentoring other tutors, to running the tutoring program, to doing an assessment and evaluation of the tutoring program, to designing a new phase of the tutoring program, and maybe to publishing research about the tutoring program,” he said.

Allen Hanco, the center’s director of academic engagement, says Swearer is fully integrated with Brown’s core academic mission. “Our goal is to advance research in which students and faculty actively collaborate with community practitioners to create knowledge and bring about positive social change.”

had learned how to take elevations, make technical drawings, identify artifacts, do assemblage analysis, and write a full report.

“Candy knew what to expect in theory, but the UTRA grant let her get her hands dirty,” Kaufman said. Now an assistant professor at University of Science and Technology Beijing, Kaufman continued to mentor Rui through the writing of the report, which he has encouraged her to present at a future annual meeting of the American Anthropological Association.

A VIRTUOUS CIRCLE

As it does for Kinoman, an urge to apply research to real-world practice animates Shiloh Heitner ’18, one of more than 20 undergraduates at the Rhode Island Innovative Policy Lab (RIIPL). Founded in 2015 by Brown economist Justine Hastings, RIIPL is using data and science to improve policy, alleviate poverty, and increase economic opportunity in collaboration with government partners. Soon after transferring to Brown from Cornell, Heitner “cold called” Hastings, who took her on as a research analyst on the environmental team. Heitner has been analyzing data from the EPA and Rhode Island’s Department of Environmental Management on companies’ noncompliance with air, water, and hazardous waste regulations. “This will give insight into how Rhode Island can improve compliance to better promote environmentally friendly practices,” she explained.

For Heitner, a double concentrator in economics and public policy, the combination of RIIPL research and Brown coursework creates a virtuous circle. “When I take econometrics, I’m then expected to apply that to my work at RIIPL,” she said. “It’s like a constant examination. It helps me take what I’ve learned and actually use it. I have a better idea of what to expect in my economics and public policy classes because I’ve done all this data analysis.”

She appreciates that Hastings pushes her to make her grow. “I’m treated like a colleague and like a student at the same time,” she said.

For Hastings, this circularity is the point. “Brown students are smart and keen to improve the world,” she said. “High-impact research is even more rewarding when it also helps students develop and discover their talents and passions.”

The common thread among the center’s research ventures is an emphasis on ‘thinking and doing’ at the same time.

Xiao “Candy” Rui ’18 was a regular at archaeology events, but had no field experience before she went to a Brown postdoc’s site in China, below.

Mylonakis, the infectious diseases specialist, “always says yes” to undergraduates who want to work in his lab. Not only do students play a part in advancing his research, but collaborative student-faculty partnerships help to prepare the next generation of educator-scholars.

“When I was younger,” he explained, “I would go to my teachers and mentors, and I would ask them questions and stretch their patience. I thought there was no way to repay them. Then I said, ‘Hold on—when I’m in their position, I can help other people.’ I see it as something I owe and pay back through my students. What they learn here they’ll carry for the rest of their careers.”

2018 IMPACT 33
Brain researchers at Brown are racing ahead on a mission that was long thought impossible: helping those who have lost the ability to move and communicate regain those abilities. 

BY DAVID ORENSTEIN
LEIGH HOCHBERG ’90, a professor of engineering at Brown, is also a critical care neurologist at Massachusetts General Hospital. Too often he sees patients who have lost their ability to move or speak, frequently because a brainstem stroke or injury has severed communications between a still-healthy brain and the individual’s body.

“When I see somebody in the neuro-intensive care unit who has suddenly become ‘locked-in,’ I want to be able to say to them, ‘I’m sorry that this happened, but you’ll be able to communicate easily tomorrow,’” said Hochberg, who also directs the Center for Neurorehabilitation and Neurotechnology at the Providence Veterans Affairs Medical Center. “And hopefully, not too long after, I want to be able to say to that same person, ‘You’ll be able to move again tomorrow.’”

By “locked-in” Hochberg means a condition in which a patient is aware but cannot move or speak due to the paralysis of nearly all muscles in the body. Finding a way to systematically restore those abilities to a wide range of people who have lost them due to disease, stroke, injury, or other causes would be revolutionary.

Such extraordinary life changes could happen as the result of the accelerating advances of Hochberg and other Brown researchers at the Brown Institute for Brain Science. “Our hope through the BrainGate research is that we can develop the technologies and the underlying neuroscience that will allow those once far-off goals to become reality,” Hochberg said.

By BrainGate, Hochberg means a brain-computer interface (BCI) system, a device being used in a nationwide clinical trial that he directs (caution: investigational devices, limited by federal law to investigational use). Indeed, with three major research papers published and several large grants received in just the past year, BCI research is racing forward at Brown.

The BCI works by using a tiny implanted array of electrodes to rapidly sample the electrical activity of scores of neurons in the brain’s motor cortex. Algorithms interpret those patterns as signals to move the arm and hand, and then translate them into digital commands to control a computer cursor, a robotic arm, a wheelchair, or even, with implanted stimulators, a person’s own paralyzed arm and hand.

As BrainGate advances its clinical work, Brown engineering professors Arto Nurmikko and David Borton are working to vastly increase the scale of the field’s technological capabilities and the ways in which BCIs might help future patients and advance basic neuroscience. If they can develop the technologies the way they hope to—in an immense challenge, Nurmikko acknowledged—they could enable BCIs that even extend beyond physical movement to augment or restore hearing, speech, or vision and mitigate psychiatric conditions.

Much more work must follow before patients might be able to conveniently and reliably use BrainGate’s innovations. In 2002, neuroscience professor John Donoghue published a pioneering study showing that a BCI enabled monkeys to control a computer cursor just by thinking about moving. That research spawned the initial BrainGate clinical trial in 2004. Since then, the team has grown to include computer scientists, engineers, mathematicians, neuroscientists, neurologists, and neurosurgeons, and many others.

PROGRESS FOR PATIENTS

In 2006, that team demonstrated human intracortical control over a computer via the BCI, and in 2012 they showed how two participants could control robotic arms to reach out and grab targets in the space around them.

BrainGate has now also expanded into a national clinical trial that Brown researchers help to direct in partnership with colleagues at Stanford University, Case Western Reserve University, and the Providence VA. Each team led major advances during 2017.

In February, the BrainGate/Stanford team showed in the journal eLife that trial participants using BrainGate could point and click on a computer screen at speeds of up to 20 characters (about eight words) per minute. Enabling increasingly fluid communication is vital to helping to restore independence, said Hochberg, who coauthored the study.

In March, colleagues at Case Western published a paper in as the BrainGate team’s catchphrase says, increasingly “Turning Thought into Action.”

“The next generation of this technology will be challenging and will take a lot of effort and the best people across a wide spectrum of expertise, from microelectronics to communications to computational neuroscience to clinicians,” Nurmikko said. “Brown is a great place for this because of the ease of crossing academic disciplines.”

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Wireless brain implants are being tested.
The mission...is to design, develop, and deploy neurotechnology to better understand the nervous system and improve human life.” —David Borton
The case of the Grolier Codex has long had the markings of a world-class mystery. Believed by some to be one of rarest and oldest manuscripts in the world, dating back to the Maya civilization in the 13th century, the codex also had its share of skeptics. It was reportedly found by looters in a Mexican cave in the 1960s, and, after a brief showing at a private club in New York City in 1971, it ended up stored unceremoniously in the basement of the National Museum of Anthropology in Mexico City.

For years, many in academic circles and beyond thought the Grolier Codex was a forged document. Others were unsure. To try to finally end the debate, in stepped Brown anthropologist and archaeologist Stephen Houston and a team of leading researchers in anthropology and Maya archeology. Like investigators reexamining a long-stalemated legal

BY GILLIAN KILEY
case, Houston and his colleagues meticulously retraced the efforts of others to authenticate the manuscript. They also declassified tests of their own, such as exhaustive scanning of the way the paper was made and comparing known practices of Maya painters to what the codex showed.

Houston and his team came to a definitive conclusion: the Grolier Codex is genuine. And not only that. It’s likely the oldest of all surviving manuscripts from ancient America, making it a far more important subject for further study. “It’s a glimpse of a lost world,” said Houston. “There’s the undeniable sense of contact with people long dead.” Such discoveries “hit us out as human beings,” he said.

Houston, professor of social science, anthropology, and archeology, and codirector of the Program in Early Cultures at Brown, worked with Michael Coe, professor emeritus at Yale and leader of the research team, along with Mary Miller of Yale and Karl Taube of the University of California—Riverside. They reviewed “all known research on the manuscript,” analyzing it “without regard to the politics, academic and otherwise, that have enveloped the Grolier,” the team wrote in its study, “The Fourth Maya Codex.” The paper, published in Maya Archaeology, filled a special section of the publication and included an elaborate facsimile of the codex.

CONTROVERSIAL FROM OUTSET

For years, academics and specialists have argued about the legitimacy of the Grolier Codex, alleging Houston and his coauthors trace. Many asserted it must have been a forgery, speculating that modern forgers had enough knowledge of Maya writing and materials to create a fake codex at the time the Grolier came to light.

The codex was reportedly found in a cave with a cache of six other ancient items, including a small wooden mask and a sacrificial knife with a handle shaped like a clenched fist. Although all the objects found with the codex have been proven authentic, the fact that looters, rather than archeologists, discovered the artifacts made specialists reluctant to accept that the manuscript was genuine. Some ridiculed as fantastical the account of wealthy Mexican collector Josué Sáenz, who said he was contacted about the codex in the mid-1990s by two looters who took him to a remote airstrip near Tortuguero, Mexico, to show him their discovery.

And there were questions about Sáenz’s actions once he possessed the codex. Why did he ship it to the United States, where it was displayed in the spring of 1971 at New York City’s Grolier Club, the private club and society of bibliophiles that the manuscript itself. It differed from other authenticated codices in several marked ways, including its relative lack of hieroglyphic text and the prominence of its illustrations.

“It became a kind of dogma that this was a fake,” Houston said. “We decided to return and look at it very carefully, to check criticisms one at a time.”

DIGGING IN

In their research, Houston and coauthors methodically analyzed many aspects of the manuscript, including its origin, the nature of its style and iconography, the nature and meaning of its tables about the planet Venus, scientific data—including carbon dating—about it, and craftsmanship of the codex.

The authors took up questions and criticisms leveled by scholars and described how the Grolier Codex differed from the three other known ancient Maya manuscripts, ultimately determining it should join their ranks as a bona fide and important piece of Maya writing.

Those other codices, the Dresden, Madrid and Paris (all named for the cities in which they are now housed), were regarded from the start as genuine, the authors note.

Variations among the codices, as well as the assumption that, because manuscripts such as the Dresden were validated first, made them canonical and fed scholars’ doubts about the Grolier. The Grolier, however, was dated by radiocarbon and predates those codices, according to the authors. Houston said going from three to four authenticated codices is “momentous,” as it gives information and context about an advanced ancient culture that produced thousands of books that were lost.

The Grolier’s composition, from its 13th-century bark paper, to the thin red sketch lines underlaying the paintings and the Maya blue pigments used in them, are fully persuasive, the authors assert. Houston and his coauthors outline all the elements of what a 20th-century forger would have had to know or guess to create the Grolier. They say the list is prohibitive; he or she would have had to intuit the existence of and then render deities that had not been discovered in 1964, by which time any modern forgery would have to have been completed; correctly guess how to create Maya blue, which was not synthesized in a laboratory until Mexican conservation scientists did so in the 1960s; and have a wealth and range of resources that would, in some cases, require knowledge unavailable until recently.

CYCLES OF VENUS

The Grolier Codex consists of 10 painted pages decorated with ritual Maya iconography and a calendar charting the movement of the planet Venus. Mesoamerican peoples, Houston said, linked the perceived cycles of Venus to particular gods and believed that time was associated with deities.

The Venus calendars counted the number of days that elapsed between when Venus, the morning star, appeared in the sky before the sun rose. This was important, the authors note, because measuring the planet’s cycles could help Maya people create ritual cycles based on astronomical phenomena.

The gods depicted in the codex are described by Houston and his colleagues as “workaday gods, deities who must be invoked for the simplest of life’s needs: sun, death, K’awil—a lordly patron and personified lightning—even as they carry out the demands of the ‘star’ we call Venus.”

The Grolier Codex is also a “predetermined rather than observational” guide, meaning it declares what “should occur rather than what could be seen through the variable cloud cover of eastern Mesoamerica. With its span of 104 years, the Grolier would have been usable for at least three generations of calendal priest or day-keeper,” the authors wrote.

That makes the Grolier suitable for a particular kind of readership, one of moderately high literacy, it may also have served an ethnically and linguistically mixed group, in part Maya, in part linked to the Toltec civilization centered on the ancient city of Tula in Central Mexico.

Created around the time when both Chichén Itza in Yucatán and Tula fell into decline, the codex was created by a scribe working in “difficult times,” wrote Houston and his coauthors. Despite his circumstances, the scribe “expressed aspects of weaponry with roots in the pre-classic era, simplified and captured Toltec elements that would be deployed by later artists of Chichén and Central Mexico” and did so in such a manner that “not a single detail fails to ring true.”

“These are exhilarating voyages of discovery,” Houston said.

It’s a glimpse of a lost world. There’s the undeniable sense of contact with people long dead.” —Stephen Houston
Within it—things like electrons, photons, and gravitons. We began to see that within those equations was something that looks like error-correcting codes. That was stunning, because these are the codes that make things like communications networks and web browsers and ATM machines work. So we started to think about where else in the natural world we might see error-correcting codes. The answer is genetics—specifically, evolutionary genetics. So the question becomes: Did something like evolution create the mathematical laws that describe our universe? That’s the question I’m pursuing.

Q: What about Brown makes this university a good place to continue your work?
A: Last academic year, I was a visitor at Brown as part of the Provost’s Visiting Professors Program. That gave me a chance to make a judgment about whether this was the right environment for me. What I found was that there’s a real spirit of interdisciplinarity here that enabled my work. I’ve come to realize that if I’m to accomplish my research goals, I have to move away from just talking only to physicists. I’ll be having interactions with mathematicians, because a lot of my research now is really an exploration of mathematics. I recently completed a paper based on more than one billion calculations. You don’t do that without marshaling the tools of computer science. And, because my work is starting to look more and more like evolutionary genetics, I’ll want to talk to people in those fields as well.

All of these are areas in which Brown has strengths, and my work can be supported by a number of extraordinarily talented scholars at Brown.
Elizabeth Hoover is keenly aware of the problems Native Americans face, and her research is illuminating more of their issues and accomplishments.

BY NOEL RUBINTON

Like most scholars, Elizabeth Hoover ’03 AM ’10 PhD has plenty of books in her office. But she also has covered almost all her furniture with Native American designs, and the room is chock-full of Native American pottery, dreamcatchers, beans, corn kernels, and posters for the “Spring Thaw Pow Wow” events that she’s helped to organize at Brown.

And then there’s the food, including hundreds of seeds she’s gathered as part of her passions for gardening and cultural history, and food she keeps on hand in case a hungry student needs it. “I may have been a squirrel” in a past life, Hoover jokes about her collecting.

Light-heartedness is part of Hoover’s personality, but right behind it is energy and determination. As Manning Assistant Professor of American Studies, Hoover is on a path not too broad at Brown, with an ambitious research agenda that includes environmental health and justice in Native American communities, indigenous food movements, and community-engaged research.

With a book just published about a Native American community fighting back against the toxic contamination of its land, another book well underway about indigenous food sovereignty among Native American communities, and a number of other articles in scholarly publications, Hoover has become an in-demand speaker at academic conferences, Native American conferences, and other venues around the United States.

“There are lots of grim statistics out there on Native Americans,” says Hoover, herself part Mohawk and part Canaan. “Acutely aware of the health, economic, and other problems that have beset Native Americans, Hoover feels that a key goal of her research should be not to deny that reality, but rather to show another aspect of Native Americans. “We need to support the way people on the ground are working,” she said, “and see the way people are surviving and thriving.”

Hoover grew up in upstate New York and planned to be a farmer until a school guidance counselor convinced her to take advantage of her strength in social studies, apply to Williams College, and consider studying anthropology. After earning an undergraduate degree from Williams, she came to Brown for a master’s and PhD and joined the faculty in 2011.

Hoover’s first book is The River Is In Us, an outgrowth of her doctoral dissertation about Akwesasne, a Mohawk community in upstate New York, downwind and downstream of three Superfund sites. Hoover chronicled the community activism that sparked environmental health research, and how pollution changed tribal life and led to efforts to protect people’s health and preserve culture. Hoover describes how members of the Mohawk community, scientists, and others worked together in a way that benefited Native Americans and could be a model elsewhere. She is following up with articles, including a recent one in Environmental Sociology that she says “aims to expand the framework of environmental justice to more closely consider the impact of environmental contaminants on physical and cultural reproduction.”

“I imagine the story of Flint, Michigan, set on an Indian reservation,” said Brown’s American Studies department chair, Matthew Guterl. He calls Hoover’s book a “thoughtful scholarly analysis” that, while focusing on Native Americans in a specific locality, could have national impact on public policy and on how public-health research is conducted.

Another major thread in Hoover’s research is about indigenous food. To research her book-in-progress about food sovereignty—including how to address food insecurity, environmentally unsustainable production, economic inequality, and social justice—she drove 20,000 miles around the United States in a summer. With support from a Brown Institute of Innovation and Scholarship grant, she visited 41 different Native American farming and gardening projects to ask participants how they define food sovereignty in their own communities.

Hoover also focused on positive community organizing efforts, including about food, in her visits to the recent bitter Standing Rock pipeline protests. Among the places her research led was into the 13 impromptu kitchens created to feed the hundreds of Dakota Access Pipeline protesters, and that organizational effort is the subject of an upcoming book chapter. She is also writing about the idea of hypnagogics, the symbolic language and use of fire as part of the pipeline protests.

Hoover’s teaching, for which she’s won a Dean’s Award for Excellence at Brown, includes a strong emphasis on research so students can learn how to “produce data that is taken up and used.” She involves students in doing research with community organizations in Rhode Island, and significant time is spent learning research theory and techniques.

For Hoover, who started as the only person of Native American descent on the Brown faculty (she now has two colleagues), Adrienne Keene, also in American Studies, and Sarah d’Angelo in Theater Arts and Performance Studies), work is highly collaborative. Hoover serves on the steering committee of Native American and Indigenous Studies at Brown, an interdisciplinary institute of faculty and students. She is also one of the organizers of the Food Studies at Brown program, which spans American studies, anthropologies, biology, English, environmental studies, medicine, and public health. “There’s a lot of culture around food,” Hoover said, and the program is aiming to increase understanding.
Taking the Leap

Efforts are intensifying to turn science discoveries into treatments and train a new generation of physician-scientists along the way.

Jack A. Elias, Brown’s senior vice president for health affairs and dean of medicine and biological sciences, has made translational science a top priority at Brown. The goal is to ensure that breakthroughs in basic research are advanced to make a meaningful medical difference for patients, and that urgent scientific questions identified in clinics or among patient populations become research priorities in the lab.

But Elias is not just talking about translational science. He’s doing it.

A renowned researcher in the fields of pulmonology and immunobiology, Elias leads a lab that successfully identified a protein—chitinase 3-like 1 (CHI3L1)—with a malfunction that is implicated in a host of respiratory problems. He and colleagues at Yale share a $10 million grant from the National Institutes of Health that will enable them to develop a treatment for asthma that targets the protein.

“The dream would be that we end up with a drug that allows us to have a new kind of therapy for a very common disease,” Elias said. “We have successfully made the antibody, and it has succeeded in models of primary and metastatic lung cancer and asthma.”

To advance work on respiratory diseases, Elias founded a research team known as BRD6—the Brown Investigators of Respiratory Diseases—to encourage collaborations across university departments and affiliated hospitals, and it now includes about 45 people with a wide variety of expertise.

“We want to be a nationally and internationally recognized place where new concepts of disease pathogenesis are discovered and then turned into new therapies,” Elias said. “The beauty of it is that we now have impressive strengths in asthma, pulmonary hypertension, pulmonary fibrosis, COPD, lung cancer, lung development and pediatric lung diseases, and sleep apnea. It’s a really exciting time for all of us.”

**FOCUS**

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**BOOST FROM NIH GRANT**

Brown’s Division of Biology and Medicine, the Warren Alpert Medical School, and the School of Public Health are looking to replicate such efforts many times over. This plan got a large boost in 2016 when Brown received a $19.5 million Institutional Development Award from the National Institutes of Health. The award established Advance Clinical and Translational Research (Advance-CTR), a statewide partnership based at Brown that supports faculty through funding, other research services and support, and professional development opportunities.

“Our end goal is to create a research environment that will produce cutting-edge health discoveries for years to come,” said James Padbury, program director of Advance-CTR and a professor of pediatrics at Brown. “The synergies we facilitate among our state’s academic, hospital, and community partners will translate into increased collaborations between faculty of various disciplines and institutions.”

Advance-CTR brings together Brown, the University of Rhode Island, the Rhode Island Quality Institute, and hospitals run by Lifespan, Care New England, and the Providence V.A. Medical Center in a coordinated effort to support clinical and translational researchers, particularly new and junior faculty. It has already funded 10 pilot projects, which include research investigating human disease through microbiomes and repairing cartilage using human stem cells.

Elias says physician-scientists, particularly those with both M.D. and Ph.D. degrees, are best positioned to facilitate translational science. A $22 million grant from the Warren Alpert Foundation has established the endowed Warren Alpert Physician-Scientist MD/Ph.D. and Advanced Training Program, which will offer more students the opportunity to pursue the joint degree with tuition assistance and research stipends. Elias said the foundation’s support will advance the University’s vision to become a world-class center of innovation in biology and medicine.

“MD/Ph.D. physician researchers see patients in the clinic, understand the challenges of the diseases they study, and transfer those insights to work in the lab,” he said. “These scholars are integral in the research continuum and a critical ingredient for any school to truly excel in translational research.”

The foundation also pledged another $5 million to endow a professorship in the Brown Institute for Translational Science, which will help form integrated research teams comprising basic scientists, master clinicians, students, and policymakers to study specific diseases and other pressing medical challenges in society. The new professorship will enable the institute to recruit and support a faculty member with in-demand expertise integral in translating scientific discoveries into applicable solutions for health issues.

A **BALANCED PORTFOLIO**

Physician-scientist Jonathan “Jake” Kurtis ’89 Ph.D.’95, M.D./Ph.D. professor of pathology and laboratory medicine and chair of the department, leads the MD/Ph.D. program. A global health pioneer, Kurtis studies malaria and schistosomiasis. After years of testing the blood of West African children who had developed a natural antibody to malaria, Kurtis and his colleagues have created a vaccine that triggers the same type of response in people not born with it. They’re now poised to begin testing the vaccine in humans.

Such disease eradication efforts involve many different types of scientists. In developing potential vaccines, Kurtis works with epidemiologists, biostatisticians, cell biologists, molecular biologists, and immunologists. His vision for Brown’s Department of Pathology and Laboratory Medicine reflects that; he aims for a “balanced portfolio” of scientists. He hopes to add three more MD/Ph.D.s to his faculty.

“So much low-hanging fruit exists in basic science laboratories, but the results have not sufficiently translated to new therapies or diagnostics,” Kurtis said. “Pathology is the poster child for moving from the bench to the bedside.”

—Reporting by Phoebe Hall and Sarah C. Baldwin

**“Our end goal is to create a research environment that will produce cutting-edge health discoveries for years to come.”**

—James Padbury

**“We want to be a nationally and internationally recognized place where new concepts of disease pathogenesis are discovered and then turned into new therapies.”**

—Jack A. Elias, senior vice president for health affairs and dean of medicine and biological sciences, Brown University
Talking to Robots

Computer scientist Stefanie Tellex says we need help in how we communicate.

BY KEVIN STACEY

If someone asks you to hand them a wrench from a table full of different-sized wrenches, you’d probably pause and ask, “Which one?” Robotics researchers from Brown University have now developed an algorithm that lets robots do the same thing—ask for clarification when they’re not sure what a person wants.

By enabling them to ask a question when they’re confused, the algorithm helps robots get better at fetching objects, an important task for future robot assistants.

The research, including a paper presented in 2017 at the International Conference on Robotics and Automation in Singapore, comes from Brown’s Humans to Robots Lab led by Stefanie Tellex, an assistant professor of computer science. Her work focuses on human-robot collaboration—making robots that can be good helpers to people at home and in the workplace.

Tellex is part of Brown’s Humanity Centered Robotics Initiative, a multidisciplinary group dedicated to robotics as a technology that is innovative and beneficial to society. Directed by Michael Littman, a professor of computer science, and Bertam Maile, a professor in the cognitive, linguistic, and psychological sciences department, the initiative supports research to create and understand robots by being in situations where commands are ambiguous,” Tellex said. “So what we wanted to do here was come up with a way for the robot to ask a question when it’s not sure.”

Tellex—who’s work earned her a National Science Foundation CAREER Award and a Director’s Fellowship from the Defense Advanced Research Projects Agency in the last year alone—believes that in 20 years every home will have a personal robot to perform tasks such as clearing the dinner table, doing laundry, and preparing dinner. So it is crucial to generate methods for enabling people to effectively tell robots what to do.

Tellex’s lab had previously developed an algorithm that allows robots to receive simple speech commands as well as information from human gestures, a form of interaction that people use frequently. The system isn’t perfect; it runs into problems, especially when there are lots of similar objects in close proximity to each other. “What we want in those situations is for the robot to be able to signal that it’s confused and ask a question rather than just fetching the wrong object,” Tellex said. The new algorithm does that. It enables the robot to quantify how certain it is that it knows what a user wants. When its certainty is high, the robot will simply hand over the object as requested. When it’s not so certain, the robot makes its best guess about what the person wants, then asks for confirmation by hovering its gripper over the object and asking, “This one?”

And, even though the system asks only a simple question, “It’s able to make important inferences based on the answer,” said David Whitney, a graduate student who works in Tellex’s lab. For example, say a user asks for a wrench and there are two wrenches on a table. If the user tells the robot that its first guess was wrong, the algorithm deduces the other wrench must be the one that the user will want. Then the robot will hand over without asking another question.

To test their system, the researchers asked participants to interact with Baxter, a popular industrial and research robot. Participants asked Baxter for objects under different conditions set by the researchers. The participants who at different times programmed the robot to never ask questions, ask a question every time, or ask questions only when uncertain. The trials showed that asking questions intelligently was significantly better in terms of accuracy and speed.

In future work, Tellex and her team want to combine the algorithm with other speech recognition systems, which might further increase the system’s accuracy and speed.

“This work is a step toward the goal of enabling people to communicate with robots in much the same way that we communicate with each other,” Tellex said.

Where Access Equals Opportunity

Brown economist John Friedman is helping lead the big data project that’s shining light on universities and economic mobility.

BY GILLIAN KILEY

Two students attend the same college. One is from a low-income background, while the other’s family is in the top 20 percent of earners nationwide. When it comes to annual earnings in their mid-30s, which student is likely to earn more?

The two graduates earn about the same, suggesting that colleges help to level the economic playing field. That was the finding of John Friedman of Brown’s economics department, with colleagues at Stanford, Berkeley, and the U.S. Treasury, in their Equality of Opportunity Project study released in January 2017.

Complicating the picture, however, is getting onto the field in the first place. Once a student is at a particular school, those from wealthy families and those from poor families tend to have similar outcomes, Friedman said—yet, if schools aren’t admitting many low-income students, their impact on economic mobility is low.

The data in the study, titled “Mobility Report Cards: The Role of Colleges in Intergenerational Mobility,” show trends in access to colleges for low-income students and identify the schools that move the most low-income students into higher earnings brackets, as well as those that help low-income students reach the top 1 percent.

The findings, which drew wide media attention, challenge a number of popular notions about what colleges do and how they are perceived.

The data in the massive statistical study is comprehensive, covering college students from 1999 to 2013 for each college in America—more than 30 million students. The data identified includes family incomes in the five-year period when those students were between 15 and 19 vs. the earnings of those students who have reached their early 30s.

The researchers have made the data freely available on the web so that colleges, students, or anyone who is interested can make use of these statistics.

The study showed that, for low-income students, access to selective, private institutions is low, meaning that they are less effective engines of mobility than public universities and some high-performing community colleges.

It also showed that the increased number of students receiving Pell grants in recent years, which was understood as a proxy for access, was a misleading indicator due to two factors. Family incomes fell, making more families eligible for the grants; and between 2000 and 2011 more families with higher incomes became eligible for Pell grants when Congress raised the income-eligibility threshold. The increase in the share of students receiving Pell grants in recent years, which was understood as a proxy for access, was a misleading indicator due to two factors.

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The findings also failed to support the widely held “incomes hypothesis” that suggests low-income students will not thrive at highly ranked colleges; low-income students, once ad-

“I think this is the first time in many years that people have looked at the full impact of colleges on the college-level mobility of students,” Friedman said in January. “And it truly points to the value of attending college, not just attending any college, but attending a good college.”
BROWN UNIVERSITY

FOCUS

...Biologists at Brown have

...Moving Parts

Brown-grown XROMM, combining X-ray video

FOCUS

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BROWN RESEARCH INDEX

By the Book

In 2016, Brown professors published 93 books around the world on subjects spanning many disciplines.

American Studies

EVELYN HU-DEHART

■ Yaqi: The Struggle for Land and Autonomy, 1821–1910

SAMUEL ZIPP

■ Vital Little Plans: The Short Works of Jane Jacobs (Editor)

Anthropology

MATTHEW GUTMANN

■ Global Latin America: Into the Twenty-First Century (Editor)

■ Por mis pistolas: Sexualidad, anticoncepción, y vida en México (three foreign language editions)

DAVID KERTZER

■ The Pope and Mussolini: The Mystery of the Pius Xlll and Rome’s Social Order (Editor)

■ The Kidnapping of Edgardo Mortara (seven foreign language editions)

KATHERINE MASON

■ Infectious Change: Reinventing Chinese Public Health after an Epidemic

JOSEPH PUCCI

■ The Classics Renewed: Reception and Innovation in the Latin Poetry of Late Antiquity (Editor)

SAMPLER PERRY

■ Five Faces of Japanese Feminism: Crimson and Other Works (Translator)

LINGZHEN WANG

■ Chinese Sex/Gender: Historical Differences (Editor)

ECONOMICS

DAVID WEIL

■ African Successes: Volume I: Government and Institutions (Editor)

JACQUES KHALIP

■ Constellations of Contemporary Romanticism (Editor)

JAMES KUZNER

■ Shakespeare as a Way of Life: Skeptical Practice and the Politics of Weakness

EGYPTOLOGY AND ASSYRIOLOGY

JAMES ALLEN

■ Coping with Obscurity: The Brown Workshop on Earlier Egyptian Grammar (Editor)

JOHN STEELE

■ The Circulation of Astronomical Knowledge in the Ancient World (Editor)

KEVIN MCLAUGHLIN

■ Points of Departure: Samuel Weber between Spectrality and Reading (Editor)

LINGZHEN WANG

■ Chinese Sex/Gender: Historical Differences (Editor)

KEVIN ARMSTRONG

■ Norton Critical Edition of Joseph Conrad, Heart of Darkness (Editor)

JACQUES KALIP

■ Constellations of Contemporary Romanticism (Editor)

JAMES KUZNER

■ Shakespeare as a Way of Life: Skeptical Practice and the Politics of Weakness

THANGAM RAVIRATHAN

■ Donner le change: L’imposé animal

GRETCHEN SCHULTZ

■ Fairy Tales for the Disillusioned: Enchanted Stories from the French Decadent Tradition (Editor)

LEWIS SEIFERT

■ Fairy Tales for the Disillusioned: Enchanted Stories from the French Decadent Tradition (Editor)

DANIEL WILLIS

■ Transnation: Theories of Inorganic Life

GERHARD RICHTER

■ Denk mal! Deutsch ohne Grenzer, 2nd Edition

CHRISTINA MENDICINO

■ Prophecies of Language: The Confusion of Tongues in German Romanticism

GERHARD RICHTER

■ Denk mal! Deutsch ohne Grenzer, 2nd Edition

MARY GLUCK

■ The Invisible Jewish Budapest: Metropolitan Culture at the Fin de Siècle

ZACHARY SNG

■ New Work on German Romanticism, “Special Issue of Romantic Circles” (Editor)

JANE SOKOLOSKYSK

■ Die Macht der Worte—Mondbüchse (German Studies)

JONATHAN CONANT

■ North African under Byzantium and Early Islam (Editor)

NANCY JACOBS

■ Birders of Africa: History of a Network

With more than 700 regular faculty and hundreds more in clinical and other categories, Brown produces an enormous range of research. The Brown Research Index captures some of this through their published books and selected faculty honors.
Selected Faculty Research Honors

During the academic year 2016–17, faculty won dozens of honors from national and international organizations.

DAN ABRAMOVICH
Professor of Mathematics
Fellow, American Mathematical Society, 2017

JEFFREY BROCK
Professor of Mathematics
Fellow, American Mathematical Society, 2017

ANTHONY A. CALDAMONE
Professor of Surgery
Post-Keynesian Society

THOMAS DIPETRILLO
Associate Professor of Radiation Oncology
Lancet and American Cancer Society

E. JANE CARTER
Associate Professor of Medicine
American Urological Association

Oriel Feldmanhll
Assistant Professor of Cognitive, Linguistic, and Psychological Sciences

MICHAEL FRANK
Professor of Cognitive, Linguistic, and Psychologi- cal Sciences

SUSAN GERBI
George D. Eggleston Professor of Biochemistry
Kappa Delta Award, Orthopedic Research Society/American Academy of Orthopedic Surgeons

J. J. TERE CRISCO
Henry K. Livett Professor of Orthopedics

SAKIRA MOHAN
Senior Leadership Award, Women in Cell Biology Committee
George W. Beadle Award, Genetics Society of America

PEDRO GOZALO
Associate Professor of Health Services, Policy, and Practice (Research)
D.L. Hart International Research Award

YAN GUO
Professor of Applied Mathematics
Fellow, American Mathematical Society, 2017

PAUL GUYER
Jonathan Nelson Professor of Humanities and Philosophy
Fellow, American Academy in Berlin, 2017

JAMES HEAD
Louis and Elizabeth Scherck Distinguished Professor of Earth, Environmental, and Planetary Sciences
Foreign Member of the Russian Academy of Sciences, 2016

SUSAN GERBI
E. J. Guyer Professor of Biochemistry
Scientific Research, Young Investigator Award, 2017

DAVID HENANN
James R. Rice Assistant Professor of Engineering
Pi Tau Sigma Gold Medal, American Society of Mechanical Engineers, 2016

BONNIE HONIG
Nancy Duke Lewis Professor of Modern Culture and Media and Political Science
Presidential Faculty Award, Fall 2017

KYUNG-SUK KIM
Professor of Engineering
Daniel C. Drucker Medal, American Society of Mechanical Engineers, 2016

GEORGE KONIDARIS
Assistant Professor of Computer Science
Air Force Office of Scientific Research, Young Investigator Award, 2017

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Assistant Professor of Computer Science
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CRACKING THE LEAF CODE:
Through his research, Thomas Serre, associate professor of cognitive, linguistic, and psychological sciences at Brown, has developed a computer-aided method to identify and classify leaves, with the goals of improving fossil classification and the understanding of plant evolution.

SHOWN HERE:
A leaf of a Bauhinia divaricata flowering shrub.