

Research *at* Penn

*The Largest Ever
Cosmic Microwave
Background Camera*

Page 8

Year 2023 | Volume 21

Penn's Research Enterprise



Beth Winkelstein
Interim Provost

Did you know that light-to-moderate alcohol consumption is associated with reductions in overall brain volume? Or that countries with well-funded public media have healthier democracies? Or that cats can catch the coronavirus?

These are just a few of the pioneering and captivating findings featured in the 2023 edition of *Research at Penn*. Published each year for the past 21 years, the brochure highlights research from each of Penn's 12 schools.



Dawn Bonnell
Senior Vice Provost
for Research

With more than \$1.47 billion in annual research and development expenditures, Penn is one of the nation's top research universities, not only generating important new knowledge in the fields of medicine, technology, business, science, and beyond, but applying this knowledge to improve the lives of individuals and communities at home and around the world. Innovative research that yields actionable knowledge is one of the cornerstones of Penn's vision for the future of the University.

Penn's integrated campus facilitates unique investigative collaborations across disciplines. Research at the University's centers and institutes represents some of the most cutting-edge investigations taking place in the world today.

To stay abreast of all University research, visit Penn's research website: upenn.edu/researchdir.

Year 2023 | Volume 21 | upenn.edu/researchdir

Research *at* Penn

*Advances in Knowledge
from the University
of Pennsylvania*

Research at Penn is produced by the University of Pennsylvania's Office of University Communications

CONTRIBUTING WRITERS AND EDITORS

Katherine Unger Baillie, Brandon Baker, Michele Berger, Heather A. Davis, Greg Johnson, Nathi Magubane, Dee Patel, Marilyn Perkins

DESIGN

[SwivelStudios, Inc.](https://www.swivelstudios.com)

OFFICE OF UNIVERSITY COMMUNICATIONS

215-898-8721

penntoday.upenn.edu

Vice President: Stephen MacCarthy

Associate Vice President: Moira Baylson

Director of News Publications: Heather A. Davis

OFFICE OF THE VICE PROVOST FOR RESEARCH

215-898-7236

upenn.edu/research

Senior Vice Provost: Dawn Bonnell

OFFICE OF GOVERNMENT AND COMMUNITY AFFAIRS

215-898-1388

upenn.edu/ogca

Vice President: Jeffrey Cooper

35

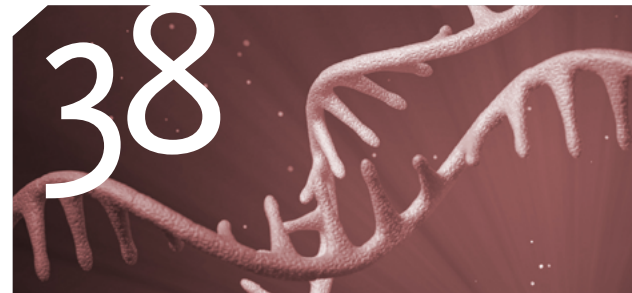
What's Inside



The next phase of reimagining the 23-acre Pennovation Works site is set to begin with a multimillion-dollar life sciences facility.



Doug Olson (center) has been in remission from leukemia for more than 10 years, thanks to CAR T cell therapy devised by a team of researchers at the Perelman School of Medicine.



An experimental immunotherapy can temporarily reprogram patients' immune cells to attack a specific target via a single injection of messenger RNA.



The Teaching Beyond September 11 program examines hate crimes and discrimination against Arabs and Muslims since 9/11.



Researchers found that teenagers who attended school virtually fared worse than classmates who went in person.

4

Predicting Lead Toxicity Risk in Philadelphia

Researchers developed a lead-toxicity-risk index that identified some of the most burdened areas of Philadelphia.

10

Halting 'The Great Resignation'

Creating a more fair, inclusive, and equitable workplace can help stem 'The Great Resignation.'

23

Fruit Flies Adapt Faster Than We Thought

Biologists found adaptations in an experimental population of fruit flies accumulating by the month.



29

William Shakespeare, Revisited

Using forensic analysis to uncover perceptions of Shakespeare.

Table of Contents

Decade-long Cancer Remission after CAR T Cell Therapy	1	Underwater Archaeology	20	Penn Astronomers Find Giant Comet in Outer Solar System.	37
Deer and COVID-19	2	Nurses were Key in Combatting COVID Misinformation	22	An Easier, More Scalable Way to Make a Powerful Immunotherapy	38
Parental Praise Promotes Persistence	2	Megaregions and America’s Future	22	Curbing COVID with Chewing Gum	40
How the Muridiyya Made a Home in Harlem.	3	Fruit Flies Adapt Faster Than We Thought.	23	The Effect of Lead on Childhood Stress, Behavior	41
Predicting Lead Toxicity Risk in Philadelphia	4	Improve Democracy Through a Well-funded Public Media.	24	At The Glass House, ‘A Colored Garden’	42
Barriers to Treating Opioid Use Disorder	6	Highlighting Gender and Race is Effective when Requesting Career Help	25	Remote Learning Affected High Schoolers’ Social, Emotional Health	43
Mice Lose Weight by ‘Sweating’ Fat	6	Making Batteries Smaller, Denser	25	Housing Repairs Associated with Drop in Crime	44
The Power of ‘Microswimmers’	7	Carbon Capture Now and in the Future	26	A New Way of Thinking About Soil.	45
Cosmology Team Preps Largest Ever Cosmic Microwave Background Camera	8	The Early Phases of Atopic Dermatitis	28	How Conspiracy Theories Stick	46
Halting ‘The Great Resignation’ through a More Inclusive Workplace.	10	COVID in a Cat	29	The Correlation Between Commuting Time and Eviction by Default.	48
Better Glass by Design	11	Shakespeare, Revisited	29	A New Metric for Designing Safer Streets.	49
Giving Credit for Time Served Harms the Innocent.	11	A Link Between Brain Size and Alcohol Consumption	30	Offspring of Nicotine Users More Likely to Also Use Nicotine	50
What’s Next for the Office in a Post-Pandemic World?	12	A Clue to COVID-19 Outcomes, Hidden in the Genome	31	Mapping Visual Landscapes in the Brain	52
Using Stem Cells for Nerve Repair.	13	How Data Science Can Win the Debate on Police Reform	32	A Snapshot of Life in China During Lockdown	53
Newly Discovered ‘Encrypted Peptides’ with Antibiotic Properties	14	The Importance of Teaching Beyond Sept. 11	33	Addressing Social Inequities Through Research	54
Limiting Free Speech is Most Harmful to the Powerless	15	A \$365 Million Development Will Expand Life Sciences Hub at Pennovation Works	35	Media Depictions of Tobacco and Their Effect on Young Adults	55
Preserving Fertility in a Deep Freeze	16	Assessing the Effectiveness of Philadelphia’s Vaccine Sweepstakes	37	The Long Reach of the Criminal Justice System in Black and Latinx Communities	56
Preserving the Legacy of Civil Rights and Black History	17				
In ‘Torn Apart,’ a Case for Abolishing Child Protective Services	19				

DECADE-LONG CANCER REMISSION AFTER CAR T CELL THERAPY



Carl June (right), pioneer of CAR T cell therapy, with Bill Ludwig, the first patient treated with CAR T cells as part of clinical trials of the therapy at Penn's Abramson Cancer Center.



Doug Olson (center), an early clinical trial participant for CAR T cells at Penn's Abramson Cancer Center, celebrates his 75th birthday with family after more than 10 years in remission from his leukemia.

In the summer of 2010, two patients were battling an insidious blood cancer called chronic lymphocytic leukemia (CLL). They had both received numerous treatments, and as remaining options became scarce, they volunteered to become the first participants in a clinical trial of an experimental therapy underway at the Abramson Cancer Center at the [Perelman School of Medicine](#). The treatment eradicated their end-stage leukemia, generated headlines across the globe, and launched a revolution in medicine, proving that a patients' own immune system can be reprogrammed to attack cancer. Called Chimeric Antigen Receptor (CAR) T cells, these genetically modified tumor-targeting cells are a living drug made for each patient out of their own cells.

In early 2022, an analysis of these two patients published in *Nature* by the Penn researchers and colleagues from the Children's Hospital of Philadelphia (CHOP) detailed the longest persistence of CAR T cell therapy recorded to date, showing that the CAR T cells remained detectable at least a decade after infusion, with sustained remission in both patients.

Penn scientists led research, development, and clinical trials of this pioneering CAR T therapy in collaboration with Novartis and CHOP. In 2017, the experimental therapy those early patients received became the first CAR T cell therapy

approved by the U.S. Food and Drug Administration for the treatment of pediatric and young adult patients with acute lymphoblastic leukemia. The therapy received subsequent approvals for certain types of lymphomas in 2018 and 2022.

Now, the team is focused on refining the personalized approach to improve both its efficacy and reach.

"Penn has begun testing next-generation T cells in more blood cancers, including lymphomas, and against the challenging solid tumor cancers, which to date have proven harder to attack through CAR T therapy," says senior author [Carl H. June](#), the Richard W. Vague Professor in Immunotherapy in Pathology and Laboratory Medicine and director of the Center for Cellular Immunotherapies at Penn. "Our team is working to develop ways to ensure that even more patients with more types of cancers—and even other diseases—can benefit from this groundbreaking therapy."

"Our team is working to develop ways to ensure that even more patients with more types of cancers—and even other diseases—can benefit from this groundbreaking therapy."

—CARL JUNE



PSYCHOLOGY

Parental Praise Promotes Persistence

How young children behave changes from moment to moment. On some days, dinner and bedtime go off without a hitch, but on others, even simple tasks pose a challenge. Traditional lab studies tend to miss this nuance because they typically involve just one or two visits. [Allyson Mackey](#), an assistant professor of psychology in the [School of Arts & Sciences](#), and Yale's Julia Leonard wanted a more realistic way to observe these behaviors, so they designed a protocol in which parents recorded their 3-year-olds brushing their teeth every evening for 16 consecutive days. Eighty-one families completed the study. Mackey and Leonard learned that on nights when parents used more praise, children brushed their teeth longer, findings the researchers published in the journal *Child Development*. "If you're trying to get your child to do something, flip to a positive narrative, think about how you can engage," Mackey says. "We found that praise was so much more effective than reminding them to keep going."

INFECTIOUS DISEASE

Deer and COVID-19



COVID-19 is not just a disease of people. Dogs, cats, gorillas, hamsters, and many more species have also had documented infections. A study led by [School of Veterinary Medicine](#) and [Perelman School of Medicine](#) researchers suggests that the virus can easily jump from people to white-tailed deer and then diversify—and did, multiple times, during the pandemic. Working through Penn Vet's Wildlife Futures Program, the researchers, including [Eman Anis](#) and [Erick Gagne](#) from Penn Vet and [Frederic Bushman](#) and Andrew Marques from Penn Medicine, obtained nasal swabs from 123 hunter-killed or road-killed deer during the fall and winter of 2021. Of these, 16% were positive for SARS-CoV-2 on a PCR test. Whole-genome sequencing performed in Bushman's lab indicated multiple "spillover" events between species. The findings, together with those of other groups, offer evidence that "deer getting infected isn't a one-off or rare event," says Gagne.

How the Muridiyya Made a Home in Harlem



Restaurants were decorated with visuals that reminded them of their homeland, street food reflected their culture, and they made new festivals of commemoration.

While doing research at Michigan State University for a graduate seminar paper on migration, [Cheikh Anta Babou](#), a native of Senegal and professor of history in Penn’s [School of Arts & Sciences](#), traveled to Central Harlem in New York City to visit a community known as Little Senegal. Passing through, he noticed familiar sights and sounds—in fact, it hardly felt like he’d left Senegal at all.

“I was asking myself, ‘How could these people achieve this?’” Babou recalls. Most arrived with very little formal education, did not speak English, and had no money. Yet they were able to make a space for themselves in New York City.

“I knew it was a story that shouldn’t be limited to a graduate seminar paper,” Babou says. “I needed to pursue this work.”

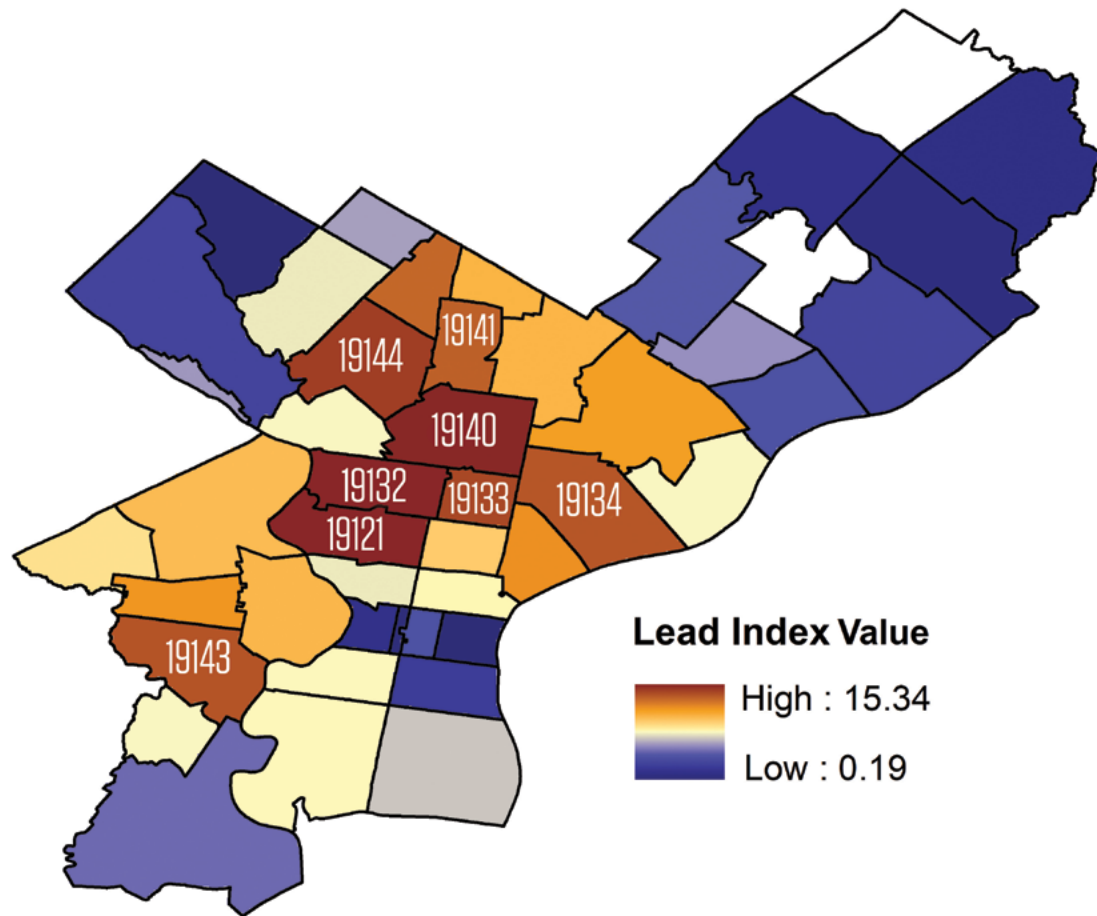
He put a pin in the topic until after he finished his first book in 2007, detailing the founding of the Muridiyya brotherhood in Senegal, a dominant Sufi order. In his latest book, “The Muridiyya on the Move,” published by Ohio University Press, he draws from historiographic and ethnographic research on three continents, following the footsteps of the Muridiyya migrants who came to New York City and the complex networks used to achieve their successful voyage.

Babou found that many first-generation migrants who left Senegal in the 1970s or ’80s had a similar journey: They would go to a big city in western Senegal, like Dakar, or Gabon along Africa’s coast, and then make their way to France, Spain, or Italy. As reforms tightened immigration in Europe, they would fly to the U.S. The book is organized in a way that tracks his fieldwork, with chapters on Senegal, Gabon, France, and the U.S.

What struck Babou was what he describes as the Muridiyya’s ability to turn “space into place.” Like other cultural enclaves, they made a secular space in Harlem their own: Restaurants were decorated with visuals that reminded them of their homeland, street food reflected their culture, and they made new festivals of commemoration.

“Power, to some extent, flows from the top down, where disciples at the bottom have no power or say,” he explains. “So what surprised me is the agency of these immigrants, the way they became change agents, very creative religiously and culturally speaking, inventing things that interestingly enough return back to home to inspire people there, so that the center for production of knowledge and power is not only located where the holy cities are, but produced in the diaspora.”

PREDICTING LEAD TOXICITY RISK IN PHILADELPHIA



In one piece of work, scientists from Penn and Haverford College developed a lead index, identifying the areas of Philadelphia at highest risk of lead exposure. ZIP codes in North and West/Southwest Philadelphia came out as the highest-risk zones.

Lead poisoning can deal a devastating blow to health, particularly in young children. In cities like Philadelphia, the risk of exposure to toxic levels of lead varies across racial and socioeconomic lines, making lead poisoning an environmental justice issue.

In two papers, researchers from Penn developed a lead-toxicity-risk index that identified some of the most-burdened areas of the city, concentrated in North and West Philadelphia, then took a finer-scale look at some of those at-risk communities. [Reto Gieré](#), a professor in the Department of Earth & Environmental Science in the [School of Arts & Sciences](#) and an author on the publications, describes the studies, their findings, and the Penn team's thoughts about what actions should come next.

Q: Why is the topic of lead toxicity especially important here in Philadelphia?

A: Philadelphia is an old city, and like many old cities, there are a huge number of homes that were painted with lead paint before it was banned in the late 1970s. Some homes still have lead drinking-water pipes. In addition, Philadelphia has had policies historically that favored home ownership, which is a great thing. But that means a lot of homeowners may not have the financial means to keep up with repairs on old houses. Children living in these dilapidated older homes may therefore have a higher exposure to lead.

Q: How did you go about looking for factors that influence lead toxicity risk?

A: We had about 1,300 soil samples from across the city collected by students and faculty, and combined the data for their lead content with those of another 1,270 samples from the U.S. Environmental Protection Agency. Combining these with publicly available data like household median income, percentage of homes built before 1980, percentage of minority population, and proportion of children six years of age and under with elevated blood-lead levels, we created maps and developed a lead-toxicity-risk index to highlight ZIP codes at greatest risk of lead exposure—and those were largely in North and West or Southwest Philadelphia. We published those findings in the *International Journal of Environmental Research and Public Health*.

The study also revealed that some of these ZIP codes were under-sampled, like the Strawberry Mansion neighborhood, and thus required collection of

Continued >



Researchers used data on soil lead content to inform their analysis of the contributing factors to lead exposure risk around Philadelphia. Many samples were collected during Academically Based Community Service courses taught at Penn.

additional soil samples. So, in the second paper, published in *GeoHealth*, we took more soil samples and used census tract data for some high-risk ZIP codes to evaluate various parameters that have been found to influence lead poisoning. It became clear that, in addition to the lead concentration in soil, there were some other factors that highly influence lead toxicity risk. Household income, home ownership, presence of lead paint, building code violations, race, and demolitions were among those. You can think of it like a vicious circle: Poverty may prevent residents from completing necessary home maintenance, which leads to housing-code violations and exposed and chipping lead paint, which in some cases may trigger demolitions. If these are improperly done, they may cause lead in the house to disperse into the air and local environment, putting more residents at risk.

Q: *What actions could make a dent in this problem?*

A: While demolition is necessary in some cases, it's supposed to occur only under strict conditions that minimize how much dust is released. Sadly, demolitions are often not done that way, so we need to have strong protocols and inspections that enforce the policies and prevent further harm from happening in these communities, which are already less privileged.

I think it's also critical to address the underlying social issues: What are the household-level issues that put certain residents at risk? It would be wonderful if we could offer assistance to low-income residents to help them make needed repairs in their homes. Obviously, this comes at a cost but it's worth it. Lead can do damage to any organ, and it's permanent.

PATHOLOGY

Mice Lose Weight by 'Sweating' Fat



Researchers from the [Perelman School of Medicine](#) have discovered that obese mice were able to shed 40% of their body weight by secreting fat through glands on their skin. The research, published in *Science* and led by [Taku Kambayashi](#), an associate professor of pathology and laboratory medicine, and medical student Ruth Choa, presents evidence that treating obese mice with a certain type of immune system protein can lead to significant abdominal fat and weight loss.

They were surprised to find that the fat loss was not associated with decreased food intake or faster metabolism. Instead, an immune signaling protein called TSLP was stimulating the immune system to release lipids through the skin's oil-producing sebaceous glands.

"This was a completely unforeseen finding, but we've demonstrated that fat loss can be achieved by secreting calories from the skin in the form of energy-rich sebum," says Kambayashi. "We believe that we are the first group to show a non-hormonal way to induce this process, highlighting an unexpected role for the body's immune system."

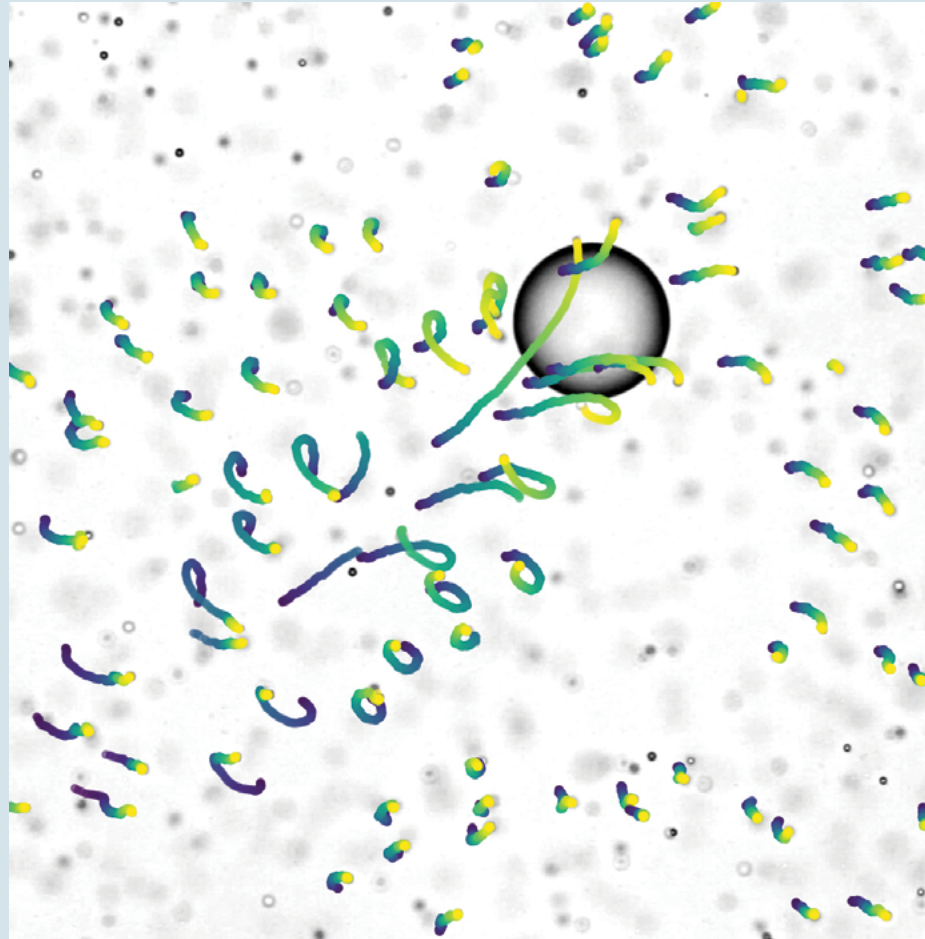
ADDICTION RESEARCH

Barriers to Treating Opioid Use Disorder

During the pandemic, health care providers were allowed to prescribe buprenorphine via telehealth for the first time. This heavily regulated prescription drug can help people addicted to opioids like heroin or oxycodone stop using. But a study published in the *International Journal of Drug Policy* from [Shoshana Aronowitz](#) of the [School of Nursing](#) and colleagues from the University of California, Los Angeles and the University of the Sciences found that pharmacists often red-flagged buprenorphine prescribed from such visits, citing factors like distance a patient traveled, someone's desire to pay in cash, or the use of slang to describe the medication. This gatekeeping, the researchers found, led to delayed or never-filled scripts, revealing that although telemedicine can remove some barriers to treatment, in the case of opioid use disorder, it seems to have erected others.



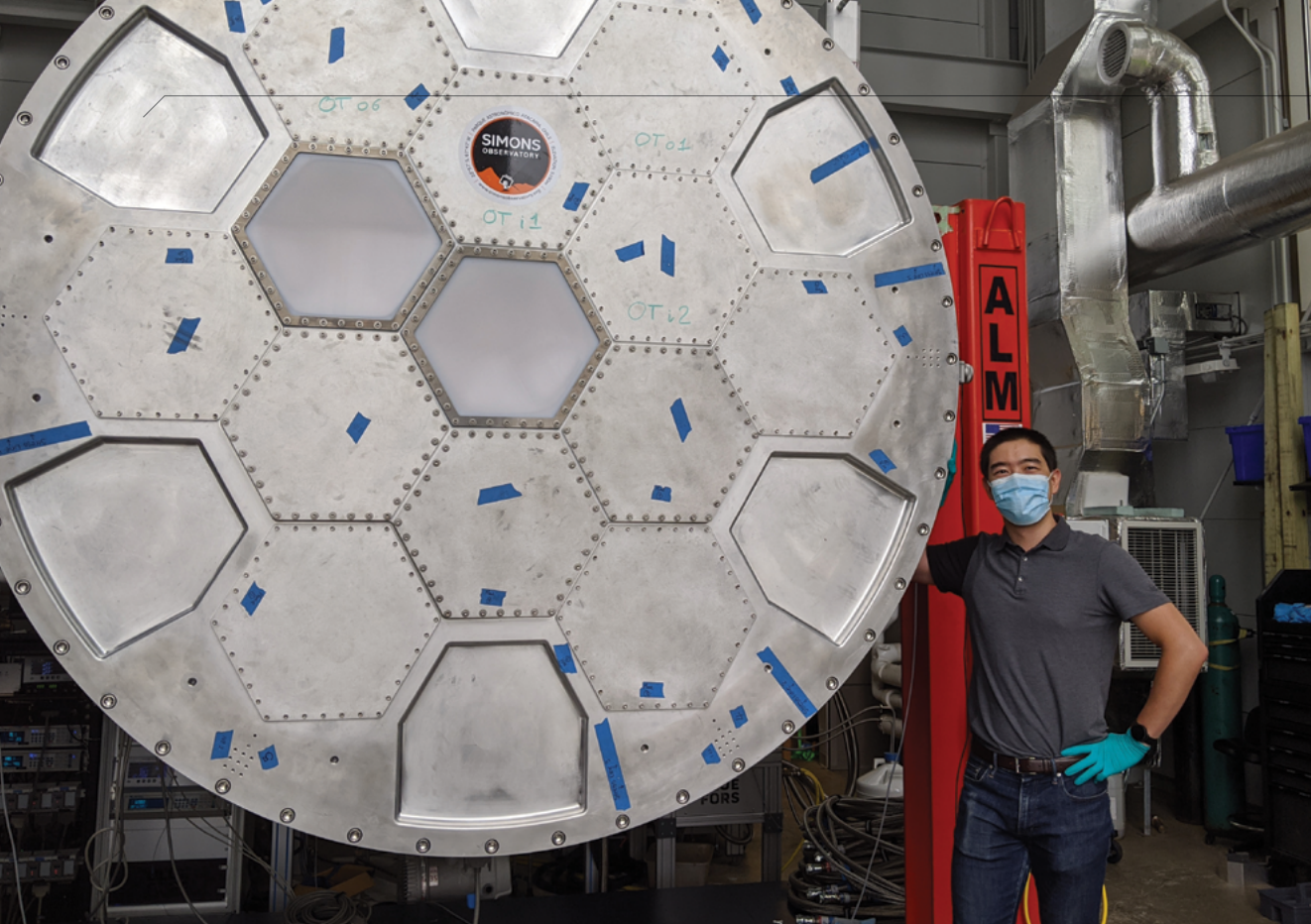
The Power of ‘Microswimmers’



Particle trajectories (shown as colored lines) as they are entrained by a swimming droplet (gray circle).

Physicist [Arnold Mathijssen](#) of the [School of Arts & Sciences](#) was at a conference dinner at the Georgia Aquarium when he and colleagues noticed that large schools of fish seemed to be carrying small particles in their wake. This occurs because of a process called hydrodynamic entrainment, in which an object moving through liquid generates a flow that causes nearby objects to be dragged along with it. “The hypothesis was that, if we can see this happening in the aquarium, maybe this is applicable in the microscopic world as well,” Mathijssen says.

In *Physical Review Letters*, Mathijssen and colleagues from the Max Planck Institute report that this was in fact the case: When a school of microscopic, self-propelled droplets known as “microswimmers” moves in the same direction inside a narrow channel, their cargo capacity—the number of particles they can carry—increases by tenfold or even more. The team’s insights are important for understanding microbial nutrient and oxygen transport, and they may also inform the design of drug-delivery systems or active coatings that lend materials dynamic features.



Cosmology Team Preps Largest Ever Cosmic Microwave Background Camera

A new study led by Ph.D. candidate Ningfeng Zhu details the design and validation of the cryogenic camera that will be the “heart” of the Simons Observatory Large Aperture Telescope.

COSMOLOGY

A study published in *The Astrophysical Journal Supplement Series* details the design and validation of the Large Aperture Telescope Receiver (LATR), the cryogenic camera that will be the “heart” of the Simons Observatory Large Aperture Telescope. Led by Ningfeng Zhu, a Ph.D. candidate working in the lab of [Mark Devlin](#) in the [School of Arts & Sciences](#), the paper describes the optimization, construction, and performance of the camera, an essential step toward the final tests and integrations that will allow the LATR to be installed at the observatory in Chile later this year.

The Simons Observatory will be comprised of a series of ground-based telescopes located at 17,000 feet in elevation on Cerro Toco, a dormant volcano in northern Chile. Here, researchers will study cosmic microwave background—the residual radiation left behind by the Big Bang—to understand more about the evolution of the universe.

“When I moved here, the Simons Observatory was just starting to get off the ground and they were looking for people to design this next-generation camera,” Zhu says. “It’s a lot of engineering and technical challenges, but in the end we’re after the science.”

These engineering and technical challenges include the need to verify that all of the components perform to required technical specifications, which range from maintaining stable temperatures, from 80 Kelvin all the way down to 0.1 Kelvin, sustaining optical alignment, limiting temperature gradients, and minimizing the time it takes to move between temperatures.

In the paper, the researchers detail these design considerations and how they struck a balance to achieve the technical

Continued >

Researchers will study cosmic microwave background—the residual radiation left behind by the Big Bang—to understand more about the evolution of the universe.



The shell of the Large Aperture Telescope Receiver arrived at Penn's campus and was installed in the Devlin High Bay in the summer of 2019. Since then, researchers have been addressing key engineering and technical challenges, which include holding temperatures at very precise stages, maintaining optical alignment, limiting temperature gradients, and minimizing the time it takes to move between temperatures.

specifications required for the LATR. The paper also specifies the results of essential validation tests that confirmed that the instrument worked as predicted, a key step in being able to install LATR for on-site testing at the observatory.

“The testing is still ongoing. We will receive more detectors to test, more components to integrate, and we will be gearing toward getting ready for shipment,” Zhu says. After the LATR is installed in Chile, he says, there will be a series of engineering runs and then, if it passes all the tests, the large telescope will be fully operational.

The designs detailed in the paper not only allow for future improvements at the Simons Observatory but can also be used to help researchers in other fields, such as quantum computing, that also require instruments that can work at ultra-low temperatures.

This work was all a massive team effort, says Zhu, and he is excited for the science that will be possible once the telescope is up and running.

“We’ll have a level of accuracy that’s never been done before, and with this amount of accuracy, there’s a lot of science to be done,” he says.

HALTING ‘THE GREAT RESIGNATION’ THROUGH A MORE INCLUSIVE WORKPLACE



During the COVID-19 pandemic, employers and employees pivoted their operations to meet new challenges. Drove of workers have left their jobs over the past few years, an exodus that has been dubbed “The Great Resignation.”

While there are countless reasons behind the rising discontent among employees, [Stephanie Creary](#), an assistant professor of management at the [Wharton School](#), says there is one important action that companies can take to stem the unemployment tide: Create a more fair, inclusive, and equitable workplace.

Creary and [Nancy Rothbard](#), deputy dean and the David Pottruck Professor of Management at Wharton, co-authored the report, “Improving Workplace Culture Through Evidence-based Diversity, Equity, and Inclusion Practices.” In it, they offer guidance on how firms can discover their shortcomings and fill in the gaps between what they say and actually do with diversity, equity, and inclusion.

“The goal was to find actionable processes that help people in organizations,” Rothbard says. “A lot of my research in the diversity space is documenting what the issues are, but this is really focused on solutions.”

Organizations that are creating a people-first strategy are future-focused, Creary says, which means being open to new ways of meeting talent, creating a meaningful culture, and considering different types of workplace models.

“One of the things that becomes increasingly important to understand is that creating more inclusive, equitable, and diverse workplaces is an aspiration for many organizations,” she says. “And what organizations often lack insight into are the discrete practices that they should be putting in place at the organization level in order to reach that more diverse, equitable, and inclusive workplace.”

Some key recommendations from the report are: put an emphasis on diversity, equity, and inclusion; assign meaningful work; invest in professional growth opportunities; be transparent about hiring policies; reinforce a no-tolerance policy for disrespectful behavior; and encourage team members to speak up, even if they have dissenting opinions.



LAW AND PHILOSOPHY

Giving Credit for Time Served Harms the Innocent

Throughout the United States, almost a half a million defendants are detained pretrial on any given day, and a disproportionate number are people of color.

Every jurisdiction in the United States gives criminal defendants “credit” against their sentence for the time they spend detained pretrial. While the practice appears to be a show of mercy, [Kimberly Kessler Ferzan](#), a professor of law and philosophy at the [University of Pennsylvania Carey Law School](#), says time served encourages the unnecessary detention of the guilty and fails to compensate the innocent.

In her paper, “The Trouble with Time Served,” published in the *Brigham Young University Law Review*, Ferzan analyzes the rationales for pretrial detention and their relationship to credit for time served.

“The analysis reveals that crediting time served is a destructive practice on egalitarian, economic, expressive, and retributive grounds,” she writes. “Time served should be abandoned.” She advocates a compensatory scheme instead.

CHEMISTRY

Better Glass by Design

Researchers from the [School of Arts & Sciences](#) have described a new liquid phase in materials known as thin films, which forms a high-density glass.

The work, published in the *Proceedings of the National Academy of Sciences*, was led by [Zahra Fakhraai](#), an associate professor in the Department of Chemistry, and recent Ph.D. graduate Yi Jin, with help from collaborators in Brookhaven National Labs. Their results demonstrate how these glasses and other similar materials can be fabricated to be denser and more stable, paving the way for developing improved components for electronic devices and other new applications through better designs. The researchers circumvented some of the physical and material limitations of glass made into thin films by using a technique known as “vapor deposition,” where a material directly transitions from a gaseous state to a solid without going through a liquid phase. They were surprised to find a new type of liquid phase that could be used to create very dense thin-film glasses.

“This work is crucial for gaining a better understanding of the physics of glass transition in general,” says Fakhraai.



What's Next for the Office in a Post-Pandemic World?



In his book “The Future of the Office: Work from Home, Remote Work, and the Hard Choices We All Face,” published by Wharton School Press, [Peter Cappelli](#) of the [Wharton School](#) discusses the tradeoffs employers and employees may have to accept in a changing work world transformed by the pandemic.

Cappelli, the George W. Taylor Professor of Management, talks about some of the issues the book addresses, such as the complications with return-to-office hybrid models and how employees and employers can make the best choices about how to proceed.

Q: Could you share your overall message about what you believe is at stake for the future of the office?

A: I don’t think it’s going to surprise many people to get the sense of how big an issue this is, about whether we go back to the office or not. If you think about the value of commercial real estate, what happens if we don’t need offices and all the supporting services and the little businesses and restaurants that support offices? And commuting? All those sorts of things matter. In addition to whether this might be better for employees, one of the things we know is that not everybody agrees that they want to work from home. There is the issue of whether it’s actually going to work for the employers, and that’s not completely clear.

Q: What’s your best advice for those employees who dread a return to an in-person workplace?

A: I think the variation in people’s experience in working from home is quite remarkable. There are some people who liked it; there are some people who didn’t. A lot of that depends on your life circumstances. Even

those who were grateful to be able to do it weren’t necessarily having fun. There’s evidence that stress levels are up and hours of work were up for people working from home. Returning to the workplace means something different than it did when we were thinking about this during the pandemic.

The people who are grateful for the opportunity to keep working from home are thinking about the alternative, which was no job or trying to work in the office without child care or with sick parents they have to take care of, and all those things. To some extent, I don’t think we’re quite making the right comparison. What we’re thinking about now is something that happened about two years or so before, when we think about what normal used to be. For most people, it wasn’t so bad, and it wasn’t like imagining working in the office during the pandemic.

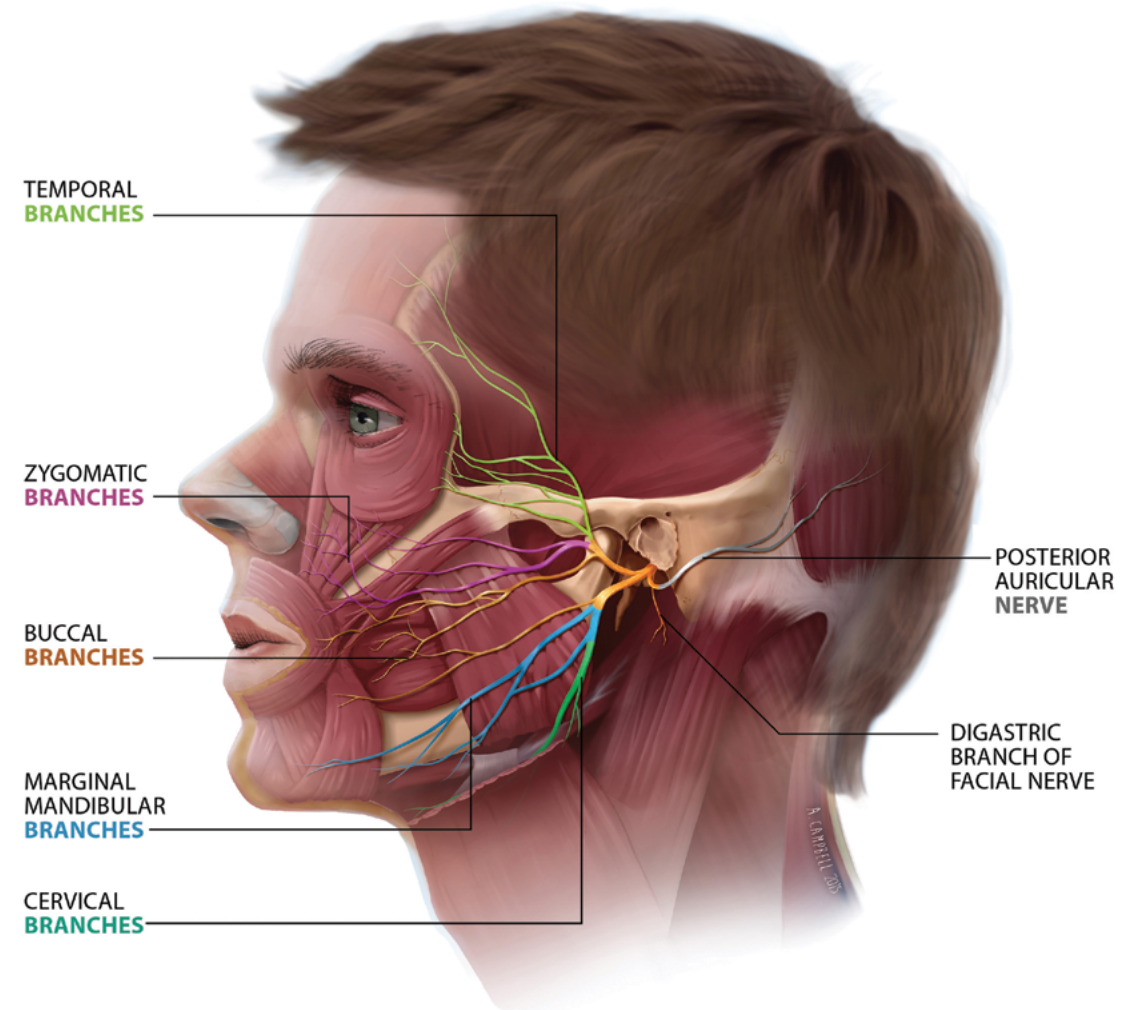
Q: What do you believe employers have to do to make their employees feel engaged about future plans in the near term and in the longer term?

A: The problem that employers have if they want to go back to the way they were operating before, which means bring everybody back to the office, is that the discussions in the broader community and in the press have given people the impression that you don’t have to do that and that you can keep working from home. [Employers] have to fight this expectation that has been created. Some of that is about communication and explaining to employees why it is important for them to come back to work, why it is a business necessity and not something quirky that the boss happens to want to do. If you can’t come up with that story, then you’d better rethink what your policies are.

Using Stem Cells for Nerve Repair

Penn scientists used stem cells from human gums to repair facial nerve injuries in rats. In a study published in the journal *npj Regenerative Medicine*, researchers led by the [School of Dental Medicine's Anh Le](#) and [Qunzhou Zhang](#) and the [Perelman School of Medicine's Kacy Cullen](#) showed that a commercially available collagen scaffold infused with human gingiva-derived mesenchymal stem cells (GMSCs) helped repair damaged facial nerves.

The GMSCs produced Schwann-like cells, which have pro-regenerative effects. Their technique matched the effectiveness of the current standard of care, an autograft procedure, which requires sacrificing a healthy nerve to replace the damaged one. The researchers believe the Schwann-like cells encourage neural regeneration because they support the growth and survival of neurons and help regulate the immune system. They hope these findings will lead to better treatment options for patients with peripheral nerve damage.



NEWLY DISCOVERED 'ENCRYPTED PEPTIDES' WITH ANTIBIOTIC PROPERTIES



Presidential Assistant Professor César de la Fuente of the [Perelman School of Medicine](#) and the [School of Engineering and Applied Science](#).

Global public health officials are concerned about the rise of drug-resistant microbial infections, which are estimated to cause 10 million deaths each year by 2050, a crisis exacerbated by the lack of research and development investment, which has led to a dearth of new antibiotics.

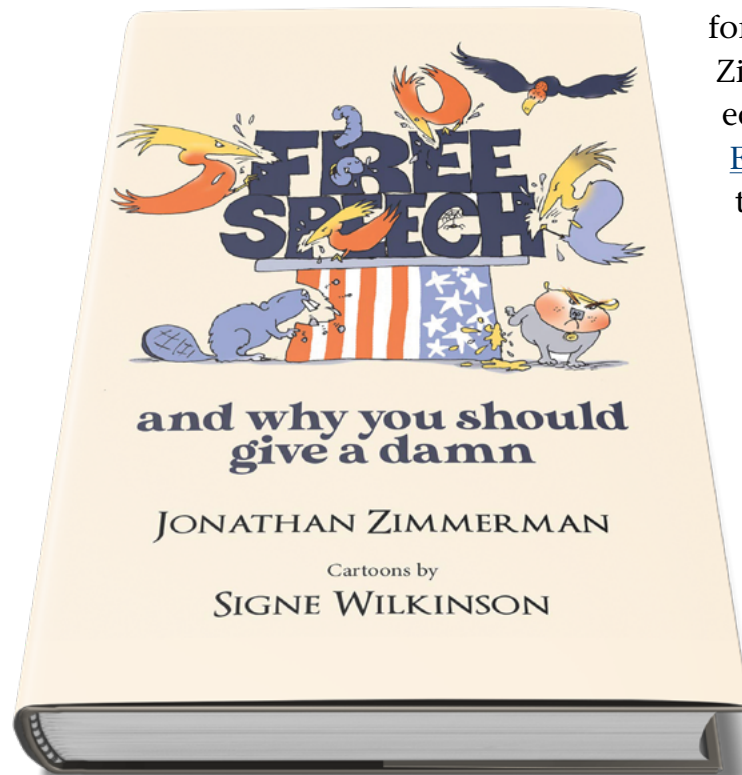
To address this challenge, researchers in the lab of Presidential Assistant Professor [César de la Fuente](#) have been looking for new, natural resources for antibiotic molecules. In a previous study from the group, the researchers were able to locate novel peptides, chains of amino acids that are the building blocks of proteins that had the potential to fight harmful bacteria.

In a study published in *ACS Nano*, the researchers identified three distinct antimicrobial peptides, coined “encrypted peptides” by the researchers, taken from a protein in human plasma.

Each of the three peptides was able to break through bacterial membranes, kill the bacteria cell, and impede the growth of biofilms. The researchers also demonstrated these peptides’ antimicrobial abilities in a mouse model and found that, when used in combination with each other or with commercial antibiotics, their antibiotic effect increased significantly.

“What is unique in the peptides we are examining is their ability to attack the bacterial membrane, a structure that requires multiple genes to build and maintain,” says de la Fuente. “Typical antibiotics only target one gene or aspect of bacterial cells, making it relatively easy for bacteria to develop resistance. The antimicrobials such as the peptides we describe here that attack multiple targets at once, including the membrane, are more successful at impeding bacterial resistance.”

Limiting Free Speech is Most Harmful to the Powerless



“Freedom of speech has always been a weapon of people at the bottom, without power. And we need to remember that, because if we limit it, it’s the people at the bottom who will lose.”

—JONATHAN ZIMMERMAN

If the title of [Jonathan Zimmerman’s book](#), “Free Speech and Why You Should Give a Damn,” seems jarring or uncomfortable, that’s because that’s exactly his point: Free speech often doesn’t feel very good.

“Speech hurts!” Zimmerman exclaims.

It’s precisely this rationale that’s historically made free speech an effective tool for people along the margins, he says. Zimmerman, a professor of history of education in the [Graduate School of Education](#), wrote the book in response to what he felt he was seeing in his classroom and in the behavior of his young daughters, who he felt needed reminding of the progressive role and potential of free speech.

“The fundamental takeaway of the book is that freedom of speech has always been a weapon of people at the bottom, without power,” he says. “And we need to remember that, because if we limit it, it’s the people at the bottom who will lose.”

The book began when Pulitzer Prize-winning illustrator and editorial cartoonist Signe Wilkinson, a reader of Zimmerman’s newspaper columns, reached out and suggested she contribute cartoons to a short book on the subject of free speech. Zimmerman, flattered and even a little star-struck, couldn’t refuse.

“I’ve never encountered a genius until I worked with Signe,” Zimmerman says. “She can capture something in a single drawing that takes me 40 pages to explain. So this book was a huge education for me.”

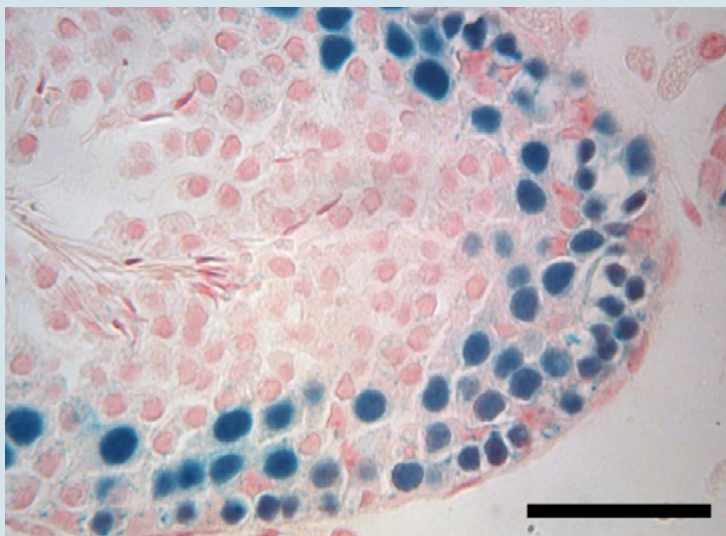
The book, published by City of Light Publishing, is organized as a history of free speech that touches on everything from the arts to slavery, gay rights to the right to speak against war. It invokes figures like Mary Beth Tinker, a free speech activist who famously protested the Vietnam War by wearing a black armband to her school in mourning of the dead on both sides, as well as abolitionist Frederick Douglass, who called free speech the “great moral renovator of society and government.”

Though Zimmerman typically produces scholarship through primary sources, he says his work compiling the book and developing a succinct overview of the history of free speech has helped ground his thinking about future studies.

“The rest of my work has been around the way schools and universities address or don’t address controversial questions, the way that different people imagine schools and universities—and how we as a democracy address that or not,” Zimmerman says. “And I’d say that’s all premised on a certain ideal of free speech, that if we don’t have those freedoms and counterpoints we can’t engage in those dialogues.”

“I think free speech isn’t a sufficient condition for that dialogue, but it is certainly a necessary one,” he says, “and that’s what I learned in doing the book.”

Preserving Fertility in a Deep Freeze



After being transferred to an infertile mouse, testis tissue from a rat that had been frozen for more than two decades gave rise to sperm.

The rate of survival for childhood cancers has increased dramatically in the past several decades, but a serious side effect of treatment is a diminished or complete loss of fertility later in life. A potential treatment for boys facing cancer treatment would be to harvest, freeze, and—after their cancer is cured—reimplant stem cells isolated from their testicular tissue, which could give rise to sperm.

What happens to that tissue during the long freeze that could be necessary to preserve it, however, has remained unclear.

A study in rats published in *PLOS Biology* by [School of Veterinary Medicine](#) researchers has shown that male testis tissue that is cryopreserved can be reimplanted after more than 20 years, and will go on to make viable sperm. The work was led by Penn Vet’s Eoin C. Whelan, a senior research investigator, and performed in the lab of [Ralph Brinster](#), the Richard King Mellon Professor of Reproductive Physiology at Penn Vet and a renowned scientist of reproductive biology.

While the long-frozen testicular tissue could produce sperm and had a similar gene expression profile compared to tissue that was only briefly frozen, the team found the delay did come with a cost in reduced sperm production. The results have important implications for treatment of prepubertal boys with cancer,

for whom chemotherapy may be preceded by harvesting and freezing of testicular tissue for eventual reimplantation.

“The glass-half-empty way of looking at this is that stem cells do seem to be compromised in their ability to regenerate sperm after a long freezing time,” Whelan says. “But the good news is that sperm can be produced, and they seem to be transcriptionally normal when we examined their RNA.”

“The research has broad relevance to freezing of all types of stem cells, which could undergo similar changes in gene regulation.”

—RALPH BRINSTER

The findings also raise numerous follow-up questions for the Penn Vet team and other scientists to pursue, including how to effectively preserve other types of stem cells, which are increasingly being investigated in a range of therapeutic applications.

“I think the research has broad relevance to freezing of all types of stem cells, which could undergo similar changes in gene regulation,” says Brinster.

Preserving the Legacy of Civil Rights and Black History



“We can’t just nominate individual sites to the historic register and expect that to have a lasting effect. Instead, we need to find a way to protect and bring life to sites by building the capacity of activists and historians everywhere to make civil rights stories visible.”

—RANDY MASON

Located near Tuskegee University, the Armstrong School was built in 1906 to support education for rural Black children. Amidst ongoing emergency stabilization efforts by students and faculty from Tuskegee University, researchers from Penn’s Center for the Preservation of Civil Rights Sites documented the school’s history and have helped develop a preservation plan for the site.

S spurred by a partnership between [Randy Mason](#) of the [Stuart Weitzman School of Design](#) and Kwesi Daniels of Tuskegee University, Penn’s Center for the Preservation of Civil Rights Sites (CPCRS) aims to amplify, commemorate, protect, and preserve the legacy of civil rights and Black history in the United States through teaching, research, and field projects.

As part of its teaching objective, Mason, a professor in the Graduate Program in Historic Preservation, and Brent Leggs, an adjunct associate professor at the Weitzman School and executive director of the African American Cultural Heritage Action Fund, co-teach the studio course *Reckoning with Civil Rights Sites*. During its first iteration in Spring 2021, for a final project, students developed conservation plans for Black heritage sites in Alabama and Pennsylvania.

Located near Tuskegee University, the Armstrong School is a one-room schoolhouse designed by Robert R. Taylor, the first known Black architecture school graduate, in 1901, more than a decade before later versions of the same building type were adopted by the Tuskegee Rosenwald Community School program. The Armstrong School is part of the St. Paul Baptist Church and Armstrong School National Historic District. The district exemplifies the early and ongoing relationship between Booker T. Washington’s Tuskegee Institute and rural Black communities in Macon County to improve education through the construction of schoolhouses and prolonged school terms. Collaborating with students and faculty from Tuskegee University, CPCRS manager [Sarah Lerner](#) documented a more complete history of the school and continues to help develop a preservation plan for the site.

Across the state in Marion, the Perry County Jail was at the center of peaceful voter registration protests that led to the murder of Black veteran and civil rights activist Jimmy Lee Jackson by police officers, which spurred

Continued >



Researchers at Penn's Center for the Preservation of Civil Rights Sites and Tuskegee University are collaborating on stabilizing the structure and developing an interpretation plan for the historic Armstrong School.



Recent Historic Preservation master's graduate Hanna Stark drafted a National Register of Historic Places nomination for Perry County Jail. The site was at the center of peaceful voter registration protests that led to the murder of Black veteran and civil rights activist Jimmy Lee Jackson by police officers, which spurred the Selma to Montgomery march of 1965.

the Selma to Montgomery march of 1965. Hanna Stark, a recent graduate of Penn's Historic Preservation master's program, drafted a National Register of Historic Places nomination for the jail, conducted archival research, and began drafting a historical narrative about the jail and the events surrounding it.

The Center is also working to preserve Philadelphia's Black heritage. CPCRS is a committed partner in the collaborative effort to save the Henry O. Tanner House located at 2908 W. Diamond St. in the Strawberry Mansion section of North Philadelphia, and transform it into a dynamic hub of community arts and culture activity. Built in 1871 and listed as a National Historic Landmark in 1976, the Tanner House was once deemed by Black scholar Carter G. Woodson as "the center of Black intellectual life in Philadelphia" due to its association with 19th century painter Henry O. Tanner and his influential family of Black Philadelphia excellence. CPCRS is working with the Friends of the Henry O. Tanner House and other local Black cultural workers and preservationists to recognize the persistently undermined value present within Philadelphia's rich historic African-American legacies.

"This project aspires to far more than traditional building preservation and house-museum curation; our partnership seeks to reflect specific ways Black folks have shaped and reshaped the city," says Lerner. "More profoundly, it will grow and sustain a transformative community cultural platform for and by the heart, hands, and imagination of Black folk."

Moving forward, Mason says he wants to make sure that CPCRS research, design proposals, and investments, and the attention garnered by garnered by civil rights stories are not just fragmented but contribute to a bigger narrative.

"We can't just nominate individual sites to the historic register and expect that to have a lasting effect," he says. "Instead, we need to find a way to protect and bring life to sites by building the capacity of activists and historians everywhere to make civil rights stories visible."

In ‘Torn Apart,’ a Case for Abolishing Child Protective Services

For [Dorothy Roberts](#), a Penn Integrates Knowledge professor with appointments in the [University of Pennsylvania Carey Law School](#) and the [School of Arts & Sciences](#), the problem with the U.S. child welfare system is fundamental: It doesn’t protect children. Instead, it polices families.

In “Torn Apart: How the Child Welfare System Destroys Black Families—And How Abolition Can Build a Safer World,” published by Basic Books, Roberts draws on decades of research and a wealth of interviews to dissect the harms imposed by Child Protective Services (CPS), which she concludes unjustly regulates and disrupts marginalized families, especially those that are Black and Indigenous, and confuses “neglect” with poverty. Only 17% of children who enter foster care do so on grounds they were physically or sexually abused, she points out.

The book tells painful stories of families that were separated by CPS. In one instance, a Chicago mother lost custody of her children because her apartment was infested with roaches and rodents, placing the blame on her rather than a negligent landlord. Vanessa Peoples became embroiled with CPS when her toddler momentarily wandered off from a family picnic and a passerby called the police. Peoples was ticketed by an officer for child abuse and later

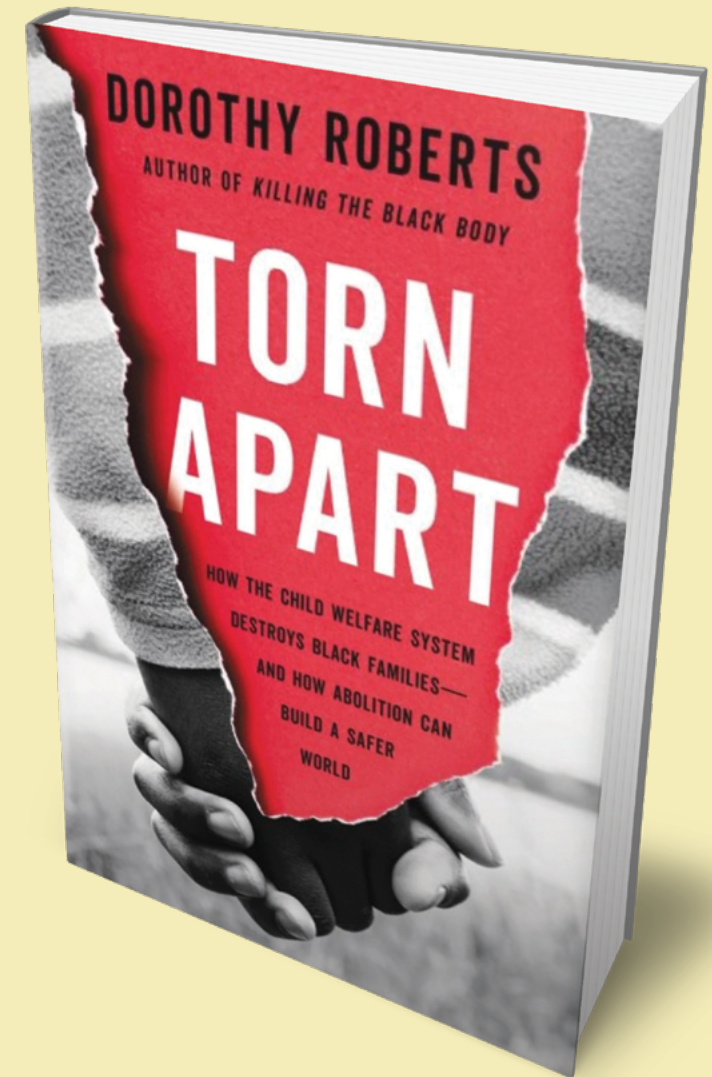
assaulted by police when they accompanied a case-worker to inspect her home.

“What happened to her son is not what most people would think of as abuse or even neglect,” Roberts says.

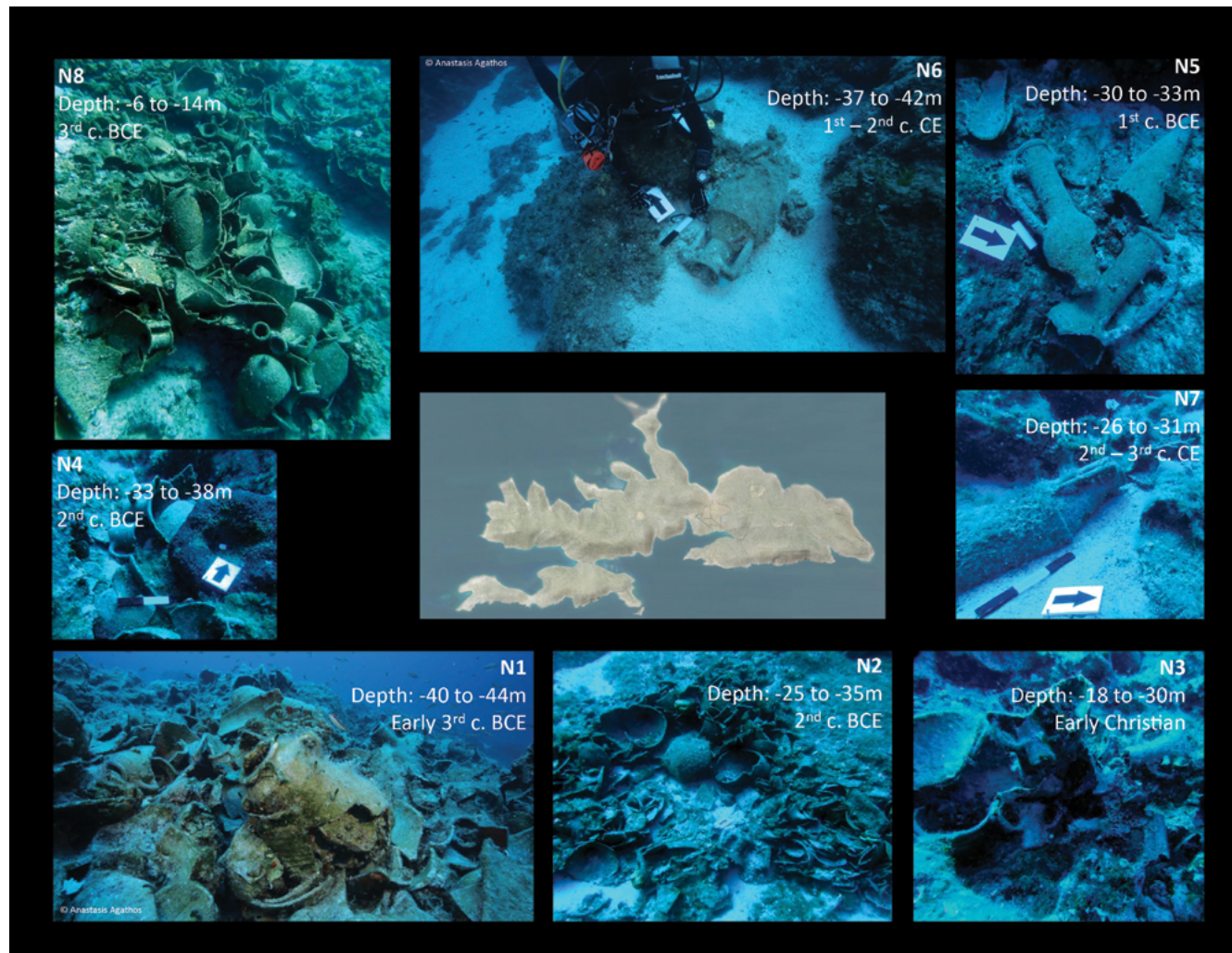
In a previous book, Roberts called for dismantling CPS, but this is the first time she’s laid out a detailed case for why it needs to be abolished and replaced rather than reformed.

“This is why I believe that you can’t reform the system: because the system is based on the foundational ideology that parents are to blame for the unmet needs of their children, while their needs are actually unmet because of structural inequities,” Roberts says. “Tearing families apart takes our attention away from the need to restructure our society in a more equitable way.”

Roberts argues that money spent on taking children away from families and maintaining them in foster care should instead be spent giving family caregivers income through direct cash payments, similar to the COVID relief payments. She says community-based investments should be made to ensure material resources for families, including high-quality drug treatment and mental health care, universal health insurance, secure housing, child care, and adequate nutrition—structural changes necessary to meet children’s and family caregivers’ needs.



Underwater Archaeology



Most archaeological surveys focus on land. But what can we learn about history from what's beneath the ocean?

This is a question [Mantha Zarmakoupi](#), the Williams Assistant Professor in Roman Architecture in the [School of Arts & Sciences](#)' Department of History of Art, is interested in asking. In Greece, she participated in a seven-year underwater survey around Delos (2014-21), and, in 2019, she surveyed areas around the islands of Levitha, Kinaros, and Maura alongside co-director George Koutsouflakis of the Hellenic Ministry of Culture and Sports in Greece.

A primary interest of the survey was Levitha, an island in the eastern Aegean Sea that's bigger than Delos. The island has recently been uninhabited, except for a single family that tends to goats and operates a small restaurant. It's a place of respite for seafarers who need a port stop to rest for a couple of days on their way to somewhere else.

But the historical conditions of that journey are partly what's of interest. It's in a path of significant trade routes

Continued >



Mantha Zarmakoupi, the Williams Assistant Professor in Roman Architecture in the School of Arts & Sciences.



“This research contributes to our knowledge about trade and sailing routes, which were not able to be investigated before these systematic underwater surveys.”

—MANTHA ZARMAKOUPI

headed to the island of Delos, home of the sanctuary of Apollo since the 9th century BCE, which became a major point of trade during the late Hellenistic period because boats didn't have to pay taxes coming through. It's also a known point of trade for people who were enslaved in that period.

Beyond what can be gleaned from interviews with the island's local family and fishers, little is known about Levitha. So, Zarmakoupi—a skilled diver and historian—wanted to know why it was important. She and her team explored underwater for two weeks to document and study items from eight nearby shipwrecks—all cargo ships—dated from the Hellenistic to the Byzantine periods. One shipwreck's cargo shows wine trade connections between the Levantine coast (Ashkelon, Tyre, or Sidon) and the Aegean. The survey revealed that the island was a major node in the sailing navigation network and that it remains so today. Taking into account preexisting knowledge about land fortifications—an acropolis and a watchtower—on the island, it also confirms a notion that the island acquired a strategic role when competing Hellenistic powers sought to take control of the Aegean Sea and paints a fuller story of politics and trade in the region.

“This research contributes to our understanding of economic networks central in conversations of the Greek and Roman world right now,” Zarmakoupi says. “It also contributes to our knowledge about trade and sailing routes, which were not able to be investigated before these systematic underwater surveys. Evidence was not available previously, because people were only focusing on land.”

NURSING

Nurses were Key in Combatting COVID Misinformation



Antonia M. Villarruel, the Margaret Bond Simon Dean in the School of Nursing.

Nurses played a crucial role in combatting the misinformation pervasive during the COVID-19 pandemic, according to a paper published in *American Nurse Journal* by [Antonia M. Villarruel](#), the Margaret Bond Simon Dean in the [School of Nursing](#), and Richard James, formerly of Penn Libraries. They found that families and patients turn to nurses as trusted health care professionals, and as such, these providers have a responsibility to provide credible information that details the best scientific evidence available at the time. “Nurses have access to a wealth of tools, principles, and approaches for ensuring that patients and communities receive evidence-based, up-to-date, and credible health information,” Villarruel says. Specifically, nurses should create an environment of trust by proactively engaging with patients, using technology and media platforms to share accurate health information, and partner with other trusted sources to prevent and address health misinformation.

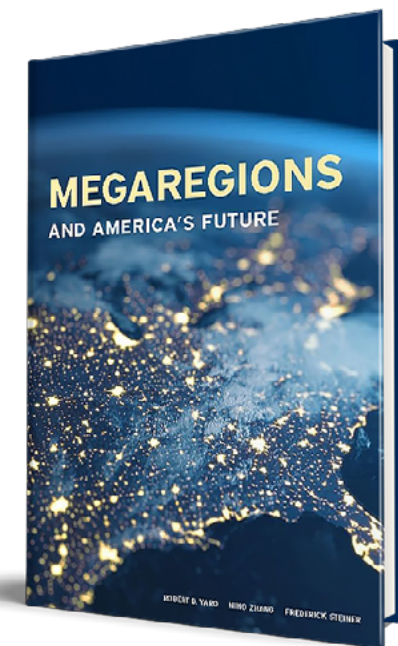
CITY PLANNING

Megaregions and America’s Future

Dean [Frederick Steiner](#) of the [Stuart Weitzman School of Design](#) and Emeritus Professor of Practice [Robert Yaro](#) co-authored a book discussing how megaregions—urbanized metropolitan cities that support almost 90% of the country’s economy and where 8 out of 10 Americans live—can address a range of complex challenges. Their book “Megaregions and America’s Future” provides fresh insights into U.S. megaregions and, through a highly analytical presentation, the most detailed description of these 13 regions.

“As we were writing the book, COVID came along,” says Yaro. “We were fascinated to see that in seven or eight of the megaregions, groups of states were collaborating at the megaregional scale on both shutting down and then bringing back economies, all without any incentive from Washington.”

“Megaregions and America’s Future” also outlines recommendations for planners, policymakers, academics, and decision-makers on tackling issues related to housing, the environment, and climate change.



BIOLOGY

Fruit Flies Adapt Faster Than We Thought



“The direction of natural selection is changing, the targets are changing, and they’re changing really quickly.”

—SETH RUDMAN

When we think about evolution, most of us picture a gradual change that takes place over thousands or even millions of years. But when Penn biologists followed an experimental population of fruit flies, they found adaptations accumulating by the month.

In a study published in *Science*, biologists from the [School of Arts & Sciences](#) monitored thousands of fruit flies over the course of four months. Using a specially designed experimental orchard on the Pennovation Works campus, the flies were exposed to natural changes in the environment like heat, cold, and rain, but were kept in an enclosure that prevented them from coming or going. That way, the biologists were confident that any genetic changes that arose were due to environmental pressures and not a new gene pool.

Once a month, the researchers analyzed the genomes of the flies. Their results? “The populations were constantly evolving and shifting throughout the entire experiment,” says [Paul Schmidt](#), a biology professor and senior author on the paper.

Observing this phenomenon of rapid, constant changes driven by environmental change—called adaptive tracking—reframes how scientists understand the time scale of evolution. After four months and 10 generations, more than 60% of the flies’ genome had changed. While not all these changes were direct responses to the environment—some DNA can get pulled along due to “genetic draft”—it’s nonetheless a more dramatic result than expected.

Modifications in the flies’ DNA weren’t always unidirectional, either. As environmental conditions changed, so too did the direction of the adaptations, swinging back and forth like a pendulum. The researchers believe this may be why previous studies underestimated the pace of adaptations; over larger time scales, bidirectional changes may cancel out, giving the appearance of no change at all.

“This paints a picture of adaptation and selection being really dynamic,” says Seth Rudman, who led the work as a postdoc in Schmidt’s group and is now on the faculty at Washington State University. “The direction of natural selection is changing, the targets are changing, and they’re changing really quickly.”

Since the original study, the team has also detected adaptive tracking in wild fly populations in Pennsylvania, Massachusetts, and Virginia. And while they can’t generalize beyond fruit flies yet, they don’t rule out the possibility of rapid adaptation in longer-lived and slower-regenerating species like humans.

“This could be a general phenomenon,” says Schmidt. “The burden is now on us to determine the time scale on which it is occurring.”

MEDIA STUDIES

Improve Democracy Through a Well-funded Public Media

A study from media scholar [Victor Pickard](#), a professor and co-director of the Media, Inequality, & Change Center at the [Annenberg School for Communication](#), has found that countries with well-funded public media have healthier democracies, and explains why investment in U.S. public media is an investment in the future of journalism and democracy alike.

In their paper “Funding Democracy: Public Media and Democratic Health in 33 Countries,” published in *The International Journal of Press/Politics*, Pickard and co-author Timothy Neff, a lecturer in journalism at the University of Leicester, reveal that countries with independent and well-funded public broadcasting systems also consistently have stronger democracies.

As commercial news continues experiencing structural and financial issues, Pickard advocates for a promising alternative: increased government investment in nonprofit and public media.

The study also shows that while other democracies have recognized the value of public media systems, America is a major outlier. Despite having the world’s largest gross domestic product, America spends a comparatively miniscule fraction—less than half of a percent—on public media funding.



MECHANICAL ENGINEERING

MAKING BATTERIES SMALLER, DENSER



Batteries have a tough job today: They need to be lightweight to fit in smaller products of increasingly diverse varieties, ranging from wearables to robots. Making the battery smaller, of course, means cutting its energy density, and thus, its capacity to keep a charge.

A study from the [School of Engineering and Applied Science](#) published in the journal *Advanced Materials* found a novel way to quadruple a microbattery's energy density by redesigning a current collector and developing a high-energy-density cathode that increases the fraction of materials that store energy while doubling as its protective shell. The shell, often, can be a roadblock—albeit a necessary one—for making a battery more compact.

“We essentially made current collectors that perform double duty,” says [James Pikul](#), an assistant professor in the Department of Mechanical Engineering and Applied Mechanics and a leader of the study. “They act as both an electron conductor and as the packaging that prevents water and oxygen from getting into the battery.”

CAREER STUDIES

Highlighting Gender and Race is Effective when Requesting Career Help

A [Wharton School](#) research team found that when seeking career support, women and racial/ethnic minorities benefit from explicitly stating their identities.

The research, published in *Nature Human Behavior*, was led by Wharton alum Erika Kirgios, along with Wharton Ph.D. candidate Aneesh Rai; [Katy Milkman](#), the James G. Dinan Professor; and Wharton alum Edward Chang.

The research tested whether women and racial/ethnic minorities benefit from explicitly mentioning their demographic identity in requests for help. Mentions of demographic identity include statements like: “As a woman in tech ...” or “As a young Black man in venture capital ...” or “I’m a Latino entrepreneur.”

The researchers believe that when a marginalized identity is made explicit, prospective helpers are motivated by a desire to avoid feeling or appearing prejudiced. In other words, they want to prove to themselves and to others that they do not discriminate.



Carbon Capture Now and in the Future

Even as renewable energy gains momentum, transitioning away from fossil fuels will take years. That means carbon capture technologies will be more important than ever, says [Peter Psarras](#), research assistant professor in the [School of Engineering and Applied Science](#).

Psarras is running the Clean Energy Conversions Laboratory in the Kleinman Center for Energy Policy while Jennifer Wilcox, Presidential Distinguished Professor in Chemical Engineering and Energy Policy, serves in the Department of Energy for the Biden administration.

The lab studies carbon capture technologies, which “are needed at a great scale,” says Psarras. “But if we just go for broke and deploy it without much thought, we could bring a lot of unnecessary burden to communities.”

Open-pit mines like this generate millions of tons of waste annually, waste that could become carbon-storing rocks.



Q: What type of carbon capture technology does the lab study?

A: There’s direct air capture, which ‘sucks’ [carbon dioxide] out of the atmosphere like a vacuum; you can place it anywhere in the world. Point source capture, on the other hand, is fixed. It’s good for large industrial plants that you can’t move, but you can slap a filter on and prevent more CO₂ from entering the atmosphere.

Q: Has the lab developed any of its own carbon capture technologies?

A: We have two. They both use minerals to take CO₂ out of the atmosphere and store it—this is called carbon mineralization. Rocks do this on their own, but they take tens of thousands of years. We try to speed that up to a few days or a few hours. One of these technologies is called heirloom carbon, which uses limestone to absorb and store CO₂. We also have another approach that takes rocks in the form of industrial waste and carbonates them. So, you get a two-for-one special: You mitigate waste and store carbon at the same time.

Continued >



(Left to right) Master's student Haarini Ramesh, research lab manager Daniel Nothhaft, and Peter Psarras, interim director of the CECL, show the different stages materials move through in the lab's process to repurpose and store mine waste.

Q: *What about nature-based approaches?*

A: Plants, trees, and regenerative agriculture can all capture carbon, too. Some of the nature-based solutions are way more economical, but they can require arable land and are more of a wildcard in terms of how long the carbon will stay stored. For example, if you're thinking about locking CO₂ into trees in a wildfire-prone area like in California, you may want to look at something like carbon mineralization instead.

Q: *What's the political landscape around carbon capture?*

A: Carbon capture is an expensive proposition, but the Inflation Reduction Act laid out a wonderful host of incentives to help carbon capture succeed. Still, we want to think about policy guardrails to ensure we avoid the moral hazard argument—the dark side of carbon capture technologies is that they could enable business as usual.

Q: *How do you incorporate environmental justice into carbon capture technologies?*

A: We're trying to rewrite the paradigm of how we, as chemical engineers, think about these technologies. There's been a historical practice of ignoring competing needs and enacting solutions that benefit a small subset of actors. It's not really our role as engineers to make those decisions for communities. It is our role, though, to listen to their needs. We work to amplify their voices to policymakers to ensure that they're assessing the costs and benefits of these solutions and take their ideas all the way back to our bench-scale research.

The Early Phases of Atopic Dermatitis

A **serendipitous discovery** gave way to new insights into the common skin disease atopic dermatitis, thanks to a collaboration between experts from the [School of Dental Medicine](#), the [Perelman School of Medicine](#), and the Oak Ridge National Laboratory. Their findings, which revealed a cascade of inflammatory signaling that occurs early in disease development, may help identify potential molecular targets for therapeutic intervention.

“Without this interdisciplinary collaboration, that initial finding would not have gone anywhere,” says [Dana Graves](#), a co-corresponding author on the paper, published in *Science Translational Medicine*, and a professor and vice dean for research and scholarship at Penn Dental Medicine.

[John Seykora](#), a co-corresponding author and professor of dermatology at the Perelman School of Medicine, agrees.

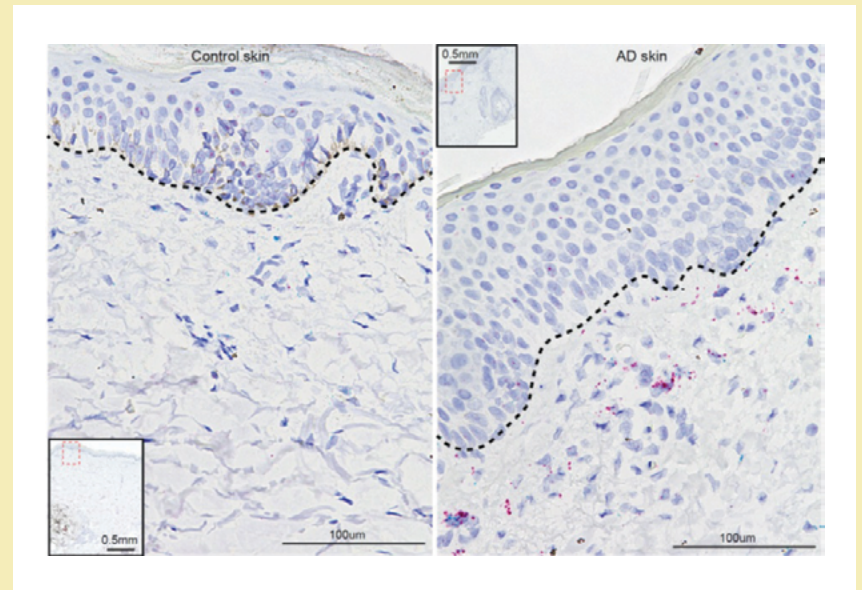
“This shows one of the benefits of being part of a university with experts across fields,” he says. “Our Dental School colleagues developed a mouse that manifested a particular skin phenotype, and the question was, what was this and did it resemble any disease we might know? And in the end, it did, and it’s providing some novel insights into a very common skin condition in humans.”

The “happy accident” began when [Kang Ko](#), then a graduate student in Graves’ lab and now a Penn Dental Medicine assistant professor, was studying how diabetes affects bone fracture healing. When Ko, Graves, and colleagues developed a mouse model that lacked an activator of nuclear factor kappa-B—a master regulator of inflammatory responses—they found that the animals developed skin lesions as they became young adults.

They turned to Seykora, who confirmed that their condition was effectively “the mouse version” of atopic dermatitis. Then, teaming with computational biology experts from Oak Ridge, the scientists analyzed single-cell RNA sequencing data, and discovered that the cell type that appeared responsible for these effects was fibroblasts, a major component of the skin’s dermis layer and typically thought to support the structural integrity of skin.

After working out the mechanism in the mouse model, the team found similar patterns of gene expression in people with atopic dermatitis—a sign that targeting the molecular pathways they identified could present an effective strategy for treating disease.

Looking at skin samples from people with atopic dermatitis (right), the researchers found that those affected had more fibroblasts—a type of skin cell—that expressed an inflammatory marker called CCL11 than people without the skin condition.



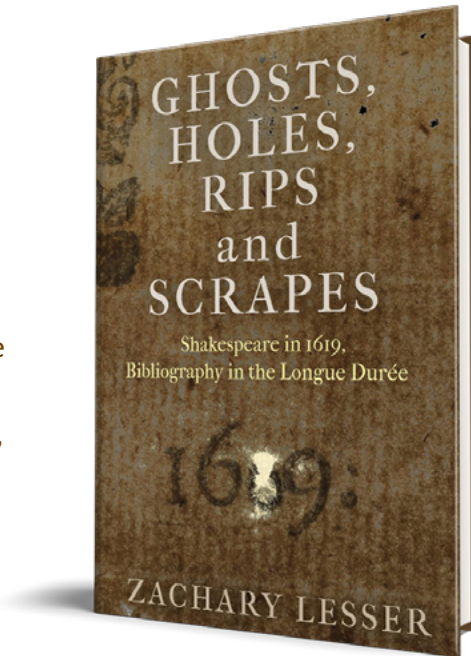
The “happy accident” began when Kang Ko was studying how diabetes affects bone fracture healing.

HUMANITIES

SHAKESPEARE, REVISITED

[Zachary Lesser](#), the **Edward W. Kane Professor of English** in the [School of Arts & Sciences](#), first began thinking about the history of Shakespeare’s bootleg-like collection of plays, the 1619 Pavier Quartos, seven years ago after co-teaching a course. Through a research method called analytic bibliography—“a forensic analysis of books,” as Lesser puts it—he wanted to uncover what this collection, published four years before the First Folio, said about the perception of Shakespeare at the time.

The result is “Ghosts, Holes, Rips and Scrapes: Shakespeare in 1619, Bibliography in the Longue Durée,” published by the University of Pennsylvania Press. The book reads like a detective story, an unfolding of Lesser’s process of studying 350 copies of the plays in the group, from 35 libraries, ranging from London to Penn’s own Kislak Center. It all adds up to a history of the publishing and reading of Shakespeare, with a focus on “ghosts,” or faint images left by interaction with another page for a long time; “holes” that indicate whether a play was initially sold in a collection or individually; and “rips and scrapes” that show how the date of publication was disguised.



VETERINARY MEDICINE

COVID in a Cat



When a domestic house cat came to the [School of Veterinary Medicine](#)’s Ryan Hospital with gastrointestinal symptoms soon after its owner was infected with COVID-19, researchers wondered whether the virus had jumped between the two—and, if it did, whether novel mutations enabled the cross-species transmission. In a study published in the journal *Viruses*, a team led by Penn Vet’s [Elizabeth Lennon](#) found evidence of SARS-CoV-2 in the cat’s fecal matter. They reported that the virus’ genetic material was nearly identical to the delta variant circulating in humans at the time. “A main takeaway here is that as different variants of SARS-CoV-2 emerge, they seem to be retaining the ability to infect a wide range of species,” says Lennon.

A Link Between Brain Size and Alcohol Consumption



While a few beers or glasses of wine a week may seem like a modest level of alcohol consumption, a study from [Wharton School](#) and [Perelman School of Medicine](#) researchers suggests it may pose a risk to brain health. Their analysis of data from more than 36,000 adults found that light-to-moderate alcohol consumption was associated with reductions in overall brain volume.

“The fact that we have such a large sample allows us to find subtle patterns, even between drinking the equivalent of half a beer and one beer a day,” says [Gideon Nave](#), a corresponding author on the study and assistant professor of marketing at Wharton. He collaborated with former postdoc and co-corresponding author Remi Daviet, now at the University of Wisconsin-Madison, and School of Medicine colleagues [Reagan Wetherill](#)—also a corresponding author on the study—and [Henry Kranzler](#), as well as other researchers.

The link grew stronger the greater the level of alcohol intake, the researchers showed. As an example, in 50-year-olds, as average drinking increases from one alcohol unit (about half a beer) a day to two (a pint of beer or a glass of wine), the associated changes in the brain are equivalent to aging two years. The team reported their findings in the journal *Nature Communications*.

“These findings contrast with scientific and governmental guidelines on safe drinking limits,” says Kranzler, who directs the Penn Center for Studies of Addiction. “For example, although the National Institute on Alcohol Abuse and Alcoholism recommends that women consume an average of no more than one drink per day, recommended limits for men are twice that, an amount that exceeds the consumption level associated in the study with decreased brain volume.”

While it was known that people who drink heavily have alterations in brain structure and size that are associated with cognitive impairments, this is the first time such a large dataset—obtained from the UK Biobank, which holds genetic and medical information from half a million middle-aged and older British adults—was used to probe the connection in more moderate levels of drinking.

And though the researchers emphasize that their study looked at only correlations, not causation, they say the findings may prompt drinkers to reconsider how much they imbibe.

GENETICS

A Clue to COVID-19 Outcomes, Hidden in the Genome

For one person, COVID-19 may manifest like a mild cold, while it lands another in the ICU. Underlying medical conditions undoubtedly play an important role, but so do genetics. Research from the groups of Penn Integrates Knowledge Professor [Sarah Tishkoff](#) and the [Perelman School of Medicine's Giorgio Sirugo](#) identified dozens of genomic variants that may drive these hard-to-predict differences in clinical outcomes.

According to their study, published in the journal *Proceedings of the National Academy of Sciences*, genomic variants in four genes that are critical to SARS-CoV-2 infection, including the ACE2 gene, were targets of natural selection and associated with health conditions seen in COVID-19 patients.

The investigation, which used genomic data from diverse global populations, suggests that these variants may have evolved in part due to a response to past encounters with viruses similar to SARS-CoV-2.

"This study exemplifies my lab's approach to genomic studies: We use what happens in nature and signatures of natural selection to identify functionally important variants that impact health and disease," says Tishkoff, who has appointments in the [Perelman School of Medicine](#) and the [School of Arts & Sciences](#).

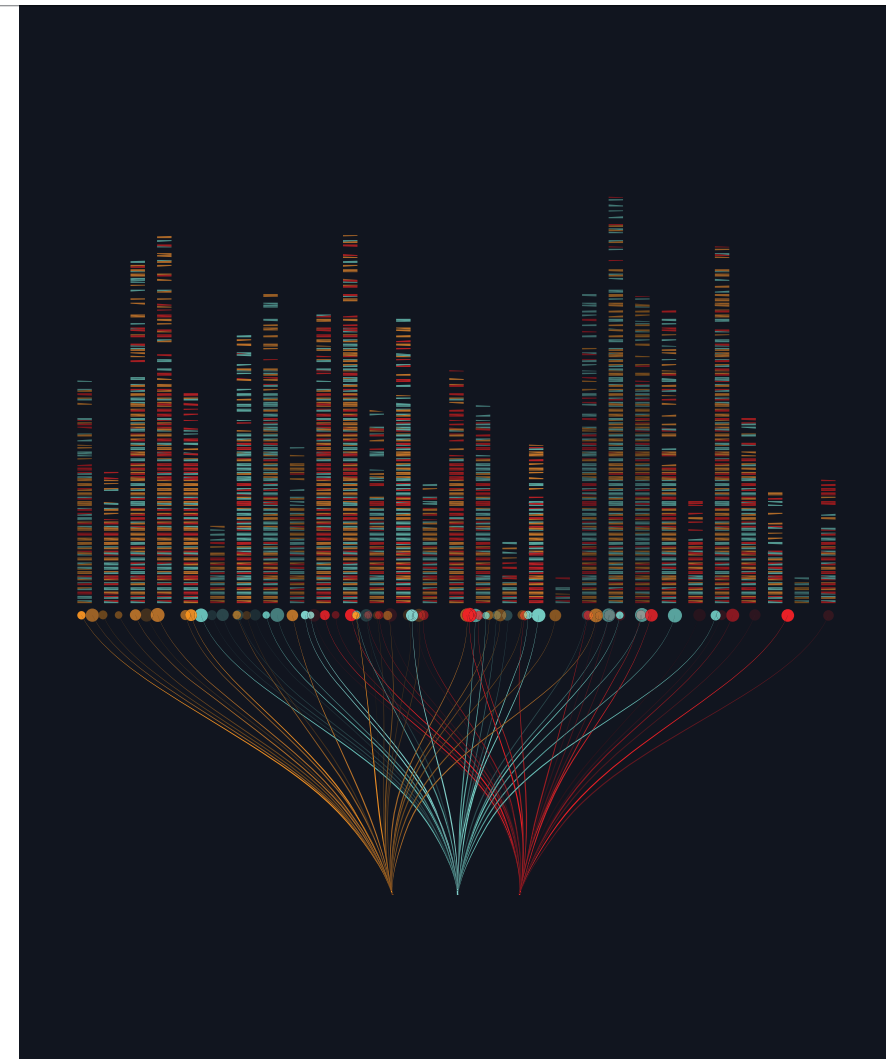
The team analyzed genomic data from 2,012 ethnically diverse Africans as well as 15,977 people of European and African heritage from the Penn Medicine BioBank (PMBB), all of whom had associated electronic health record data available. Comparing the variants their analysis turned up with clinical data, the researchers found associations with conditions related to COVID-19, including respiratory disorders, infection with respiratory syncytial virus, and liver disease.

Further exploration of key genetic variants could reveal a lot about how proteins function in the context of COVID-19 or other diseases, Sirugo notes.

"From a medical point of view, you could identify novel therapeutic targets or even provide some personalized treatment, depending on which variants a person had," he says. "Furthermore, our effort demonstrates the value of the PMBB as a unique resource for medical research and discovery."

The team also underscores the importance of looking in diverse populations for genome studies, as some of the newly identified variants that could be clinically significant were only identified in African populations that had not been previously investigated in this way.

"That is a deeply important and unique aspect of this study," Tishkoff says.



"We use what happens in nature and signatures of natural selection to identify functionally important variants that impact health and disease."

—SARAH TISHKOFF

How Data Science Can Win the Debate on Police Reform

The deaths of Walter Wallace Jr., George Floyd, Breonna Taylor, Philando Castile, and a number of other Black people who have lost their lives during interactions with law enforcement officers have drawn national attention to the topic of police reform. The phrase “defund the police” became a rallying cry across many American cities over the summer as protesters marched for social justice. But police reform isn’t as simple as a catchphrase.

Two scholars who have been studying the issue for years say solving the problem starts with better data and more careful analysis. [Dean Knox](#), a professor of operations, information, and decisions at the [Wharton School](#), and Jonathan Mummolo, a professor of politics and public affairs at Princeton, have published numerous papers on racial bias in policing. With the help of Analytics at Wharton, they also co-founded Research on Policing Reform and Accountability, an organization dedicated to bringing academic rigor and science to what is often an emotional debate.

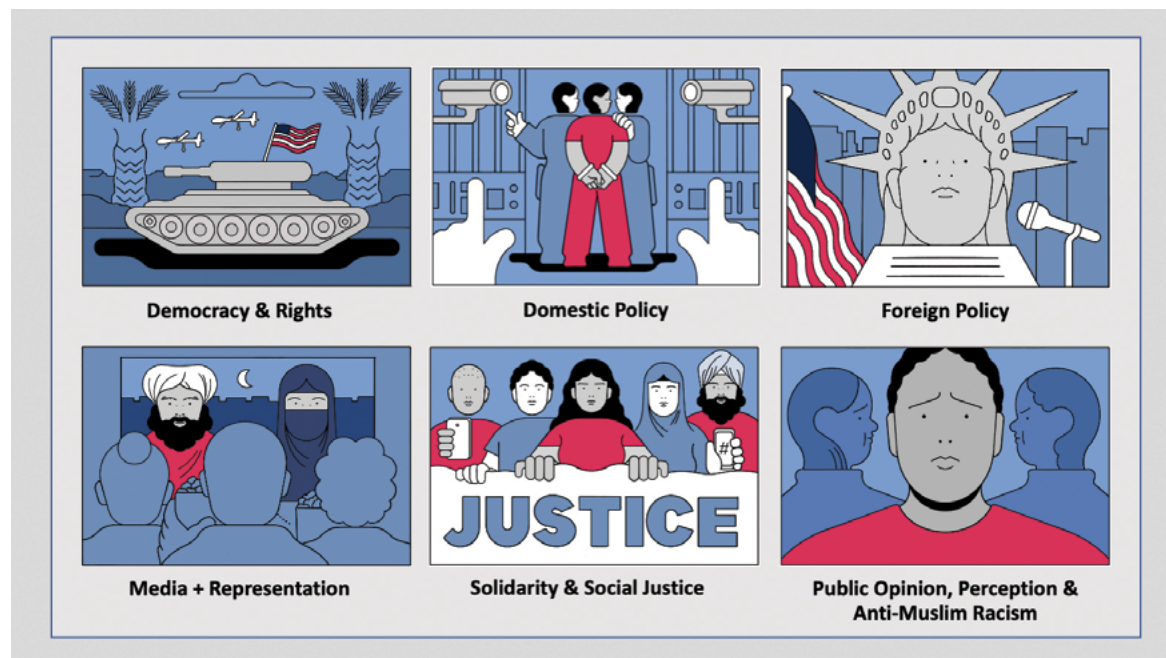
“These cases grab our attention because the facts are just so outrageous,” says Knox. “That’s important because it brings attention to this important issue. But for those of us who are seeking to reform policing, we need to keep in mind that these are instances of what is unfortunately a very common problem. The issue is we know far less than we need to know about police-civilian interactions, because they’re so inconsistently documented. What we’ve shown again and again is that as a consequence, prior research has massively underestimated the problem because of poor analyses that fail to account for these data limitations.”

Improved statistical methodology to deal with selective reporting and other data quality issues is one avenue to improved analysis, but Knox and Mummolo also emphasize the need to push beyond the standard police datasets that form the basis of existing work. Their work pulls information from new sources, including traffic sensors, vehicle accident reports, smartphone location pings, and body-worn camera videos to paint a more complete picture of police-civilian interactions and help guide reform.



With the help of Analytics at Wharton, Knox and Mummolo co-founded Research on Policing Reform and Accountability, an organization dedicated to bringing academic rigor and science to what is often an emotional debate.

The Importance of Teaching Beyond Sept. 11



Much of the scholarship concerning the Sept. 11, 2001, attacks has focused on terrorism and U.S. foreign policy. Indeed, these are important topics, but very little attention has been given to the increase in hate crimes and discrimination against Arabs, Muslims, and those perceived to be Muslim since 9/11, and how these communities have responded.

Funded by Penn Global with support from the [Graduate School of Education](#) (GSE) and the Penn Libraries, the Teaching Beyond September 11th multimodal curriculum was designed to fill that void. Created by a team of educators from Penn in collaboration with national and international scholars, practitioners, and community activists, the program provides multiple entry points for educators to discuss Islamophobia, xenophobia, civil liberties, long-lasting wars, media and representation, and other pertinent topics.

[Ameena Ghaffar-Kucher](#), a senior lecturer at GSE and project director and curriculum lead of Teaching Beyond September 11th, discusses the birth of the project, its contents and audience, and what she hopes users take away from it.

Q: *How did the project come about?*

A: One of my colleagues, [project co-lead] Deepa Iyer, called me in 2018 and said, ‘We should really do something for the 20th anniversary of 9/11,’ and we started thinking about ideas. Because I’m a curriculum person, I said, ‘What if we created some lesson plans for teachers, something that would really be helpful in the classrooms and really showcase the work that young activists and scholars have been doing, and really bring together a diverse group of people?’ Deepa is a lawyer and activist, and she really liked that idea, and we started applying for funding.

Q: *The program is designed for U.S. and world history teachers, high school juniors and seniors, and first-year college students?*

A: That is our target group, but we really want it to be for anyone. There are ways to further complexify the curriculum for even third- or fourth-year college students, but also simplify it for younger kids.

Continued >

“What if we created some lesson plans for teachers, something that would really be helpful in the classrooms and really showcase the work that young activists and scholars have been doing, and really bring together a diverse group of people?”

—DEEPA IYER

Q: *Can you explain how the curriculum is organized?*

A: In 2019, when we were developing the curriculum, we did a media analysis to see how 9/11-related groups/events had been covered over the past 18 years. Most stories were on foreign policy and terrorism but less on how 9/11 impacted people from [Arab, Middle Eastern, Muslim, and South Asian] communities who have been thrown in the limelight since 9/11. So we made sure to include themes about representation, solidarity, social justice, democracy, etc. In the end, we had 20 modules across six themes, each grounded in a particular event between 2001 and 2020. The curriculum highlights the unfolding of events across time and space, almost like a time machine. For example, the 2002 module on surveillance connects to the 2010 NYPD surveillance scandal. Similarly, the 2010 module on youth activism makes connections between the Arab Uprisings and Occupy Wall Street.

Q: *How many people have used your materials?*

A: Because we house all of this on the Library repository, we’re able to get some really interesting data about where our curriculum is being downloaded. The latest data suggests it has been downloaded in 105 countries across the world.

Q: *What do hope that people take away from the project?*

A: I hope it gives them additional perspectives to consider. At the very least, I would like them to think about how this event has really impacted the lives in communities who’ve borne the brunt of 9/11 policies. The 2015 module is about Muslim youth and resistance. We interviewed young activists who talk about growing up in the shadow of 9/11. They were young children, like 5, 6, 7 years old when 9/11 happened, and it was such a pivotal life-changing moment for them, leading many of them on a path to activism. We want people to stop and pause, and really hear these stories from the perspective of people who have experienced this change in the world.

A \$365 Million Development Will Expand Life Sciences Hub at Pennovation Works



A rendering of the new research, development, and biomanufacturing facility from the intersection of Grays Ferry Avenue and 34th Street on the Pennovation Works property.

“What you’re seeing all across Philadelphia now is that there is no shortage of projects that are looking to expand, especially in this science and technology sector.”

— CRAIG CARNAROLI

Pennovation Works, the 23-acre Penn property just across the Schuylkill River from the main campus, has long been a site for innovation. Home to a ferry business in the 18th century, a paint company in the 19th century, and a DuPont chemical research facility for much of the 20th century, the space underwent a further transformation in 2016 with the establishment of the Pennovation Center, an incubator for science and technology startups, many of which have their origins within the University. In 2021, the 65,000-square-foot Pennovation Lab opened, offering larger lab spaces for companies outgrowing their previous locations.

Now, the next phase of reimagining this site is set to begin.

With a 75-year ground lease, Longfellow Real Estate Partners will develop, finance, and operate a 455,000-square-foot life sciences facility along 34th Street and Grays Ferry Avenue. The building will include roughly 387,000 square feet dedicated to biological research and development and 68,000 square feet for biomanufacturing. Construction on the building, designed by architectural firm Jacobs to integrate visually with the existing Pennovation Works campus structures, is scheduled to begin in 2023, with the opening planned for 2025.

With the flourishing cell and gene therapy programs at Penn, as well as the successes and future promise of mRNA as a therapeutic, the lab and biomanufacturing facilities will offer an opportunity for biotech companies to remain in Philadelphia, adjacent to Penn’s campus, as they expand.

Executive vice president since 2004, [Craig Carnaroli](#) has been shaping the campus broadly in his role, including the Pennovation Works site since it was acquired in 2010. From its early days under Penn ownership, the site has hosted a diversity of tenants, from the [School of Engineering and Applied Science](#)’s GRASP Lab in robotics, to the work that Henry

Continued >



Integrating into the existing campus and infrastructure of Pennovation Works, the Longfellow Real Estate Partners development is intended to foster the site's, and the city's, innovation ecosystem.



The new building will offer significant growth space for companies in cell and gene therapy to expand, conveniently adjacent to Penn's campus.

Daniell of [Penn Dental Medicine](#) is doing with drug delivery through plants, to the scent-detecting canines at the Penn Vet Working Dog Center.

“The investment we made in the Pennovation Center provided a launch pad for entrepreneurs and young companies,” Carnaroli says. “But we’ve also seen that the space needed to grow further, so we’ve added the renovation of the Pennovation Lab building. That has provided needed growth space for young companies.”

Carnaroli says now is the perfect time for the next stage of building out Pennovation Works due to a confluence of dynamics, such as successes the University has seen in the [Perelman School of Medicine](#), particularly in the cell and gene therapy space.

“There’s an increased number of startup companies coming out of Penn and an increased demand for lab space,” he says. “And as more tenants have come in, they’re wondering, ‘If I don’t see my growth space here, am I going to have to move elsewhere?’”

“Say you start out in a lab in the Pennovation Center with 1,000 square feet and you want to expand to a 2,000- or 4,000-square-foot facility. You can look to the Pennovation Lab building for that. But what happens when you need 10,000 square feet? We are showing people their potential trajectory. That’s partly what is driving this project.”

Carnaroli says Pennovation Works—and Philadelphia broadly—is the right space for this type of development because of the long-term view of how the site could evolve, along with the early vision and master plan developed by Facilities and Real Estate Services.

“Looking to the city, what you’re seeing all across Philadelphia now is that there is no shortage of projects that are looking to expand, especially in this science and technology sector,” he says. “The proximity of Pennovation Works to the whole Penn Medicine complex, as well as Penn Engineering and other schools, is a huge asset. And because it’s owned by Penn, we can be a little more flexible with Penn tenants.”

“Penn put capital into the acquisition and initial development of the site, and now, having an entity like Longfellow that is capitalized and willing to do the next step, it’s an affirmation of the investment we made and the success of it. It’s nice to see.”

PUBLIC HEALTH

Assessing the Effectiveness of Philadelphia's Vaccine Sweepstakes

Penn researchers and Philadelphia policymakers launched the Philly Vax Sweepstakes in 2021, a project designed to increase COVID-19 vaccinations and evaluate vaccine lottery effectiveness.

[Katy Milkman](#), the James G. Dinan Professor at the [Wharton School](#) and co-director of the Behavior Change for Good Initiative at Penn, is the lead author of a study published in the journal *Nature Human Behaviour* assessing the lottery.

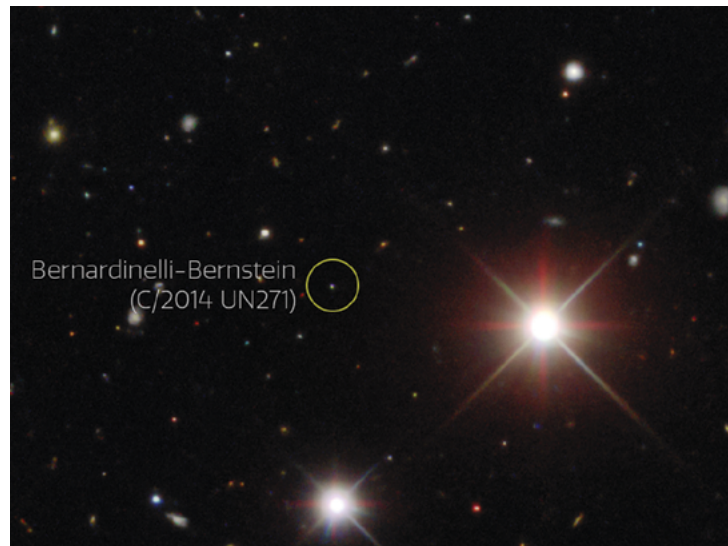
Philadelphians were treated to a “regret lottery” in which they were automatically entered for a cash prize if they lived in the city (whether or not they'd been vaccinated). However, they could only accept their winnings if they had previously been vaccinated.

It's unclear whether the overall lottery increased vaccinations compared to surrounding counties, but the results appear promising. However, the study tested whether giving residents of some ZIP codes greater odds to win the lottery—making them 50 to 100 times likelier—boosted vaccinations. It didn't.



ASTRONOMY

Penn Astronomers Find Giant Comet in Outer Solar System



Comets are icy bodies that evaporate as they approach the sun's warmth, growing a characteristic “coma” and tail composed of clouds of gas and dust. In a comprehensive data search of 80,000 sky images taken from a Chilean mountaintop by the Dark Energy Survey, Penn astronomers Pedro Bernardinelli and [Gary Bernstein](#) discovered that single dots in 42 of those images connected to track a new giant comet entering the solar system for the first time in 3.5 million years.

The search software detected more than 800 individual objects orbiting the sun beyond Neptune. Comet Bernardinelli-Bernstein stands out among them because it ventured more than 1,000 times as far as Neptune before returning. At roughly 80 miles across, it is the largest body ever discovered re-entering the solar system after spending its life in distant frozen realms.

“We have the privilege of having discovered perhaps the largest comets ever seen, or at least bigger than any well-studied one,” says Bernstein.

Comet Bernardinelli-Bernstein will be followed intensively by the astronomical community to understand the composition and origin of the massive relic from the birth of the solar system's planets.

IMMUNOTHERAPY

An Easier, More Scalable Way to Make a Powerful Immunotherapy

An experimental immunotherapy can temporarily reprogram patients' immune cells to attack a specific target via a single injection of messenger RNA (mRNA), similar to the mRNA-based vaccines for COVID-19, according to a study from researchers in the [Perelman School of Medicine](#).

The researchers, whose work is published in *Science*, demonstrated the new approach with an mRNA preparation that reprograms T cells—a powerful type of immune cell—to attack heart fibroblast cells. In experiments in mice that model heart failure, the reduction in cardiac fibroblasts caused by the reprogrammed T cells led to a dramatic reversal of fibrosis and normalization of heart function.

“Fibrosis underlies many serious disorders, including heart failure, liver disease, and kidney failure, and this technology could turn out to be a scalable and affordable way to address an enormous medical burden,” says senior author [Jonathan A. Epstein](#), chief scientific officer for Penn Medicine, executive vice dean, and the William Wikoff Smith Professor of Cardiovascular Research. “But the most notable advancement is the ability to engineer T cells for a specific clinical application without having to take them out of the patient’s body.”

The new technique is based on Chimeric Antigen Receptor (CAR) T cell technology, which, until now, has required the harvesting of a patient’s T cells and their genetic reprogramming in the lab to recognize markers on specific cell types in the body.

CAR T cell technology is currently used primarily for treating cancers. But after seeing dramatic results in many otherwise difficult cases, its developers have long envisioned harnessing the approach for other diseases.

However, this standard CAR T cell strategy would be problematic when directed against heart failure or other fibrotic diseases in humans. Fibroblasts have a normal and important function in the body, especially in wound-

Continued >

“The most notable advancement is the ability to engineer T cells for a specific clinical application without having to take them out of the patient’s body.”

—JONATHAN A. EPSTEIN

healing. CAR T cells that are reprogrammed genetically to attack fibroblasts could survive in the body for months or even years, suppressing the fibroblast population and impairing wound-healing for all that time.

Therefore, in the new study, Epstein and colleagues devised a technique for a more temporary and controllable, and procedurally much simpler, type of CAR T cell therapy.

“Standard CAR T cell technology involves modifying patients’ T cells outside the body, which is expensive and difficult to scale for common diseases or for use in less wealthy countries,” says study co-author [Drew Weissman](#), the Roberts Family Professor in Vaccine Research. “Making functional CAR T cells inside the body greatly extends the promise of the mRNA/LNP [lipid nanoparticle] platform.”

Injected into mice, the encapsulated mRNA molecules are taken up by T cells and act as templates for the production of the fibroblast-targeting CAR, effectively reprogramming the T cells to attack activated fibroblasts. This reprogramming is temporary, however. The mRNAs are not integrated into T-cell DNA and survive within T cells for only a few days, after which the T cells revert to normal and no longer target fibroblasts.

The scientists found that, despite this brief duration of activity, injections of the mRNA-LNPs in mice that model heart failure successfully reprogrammed a large population of mouse T cells, causing a major reduction of heart fibrosis in the animals and a restoration of mostly normal heart size and function with no evidence of continued anti-fibroblast T cell activity one week after treatment.

The researchers are continuing to test this mRNA-based, transient CAR T cell technology, with the hope of eventually starting clinical trials.

CURBING COVID WITH CHEWING GUM

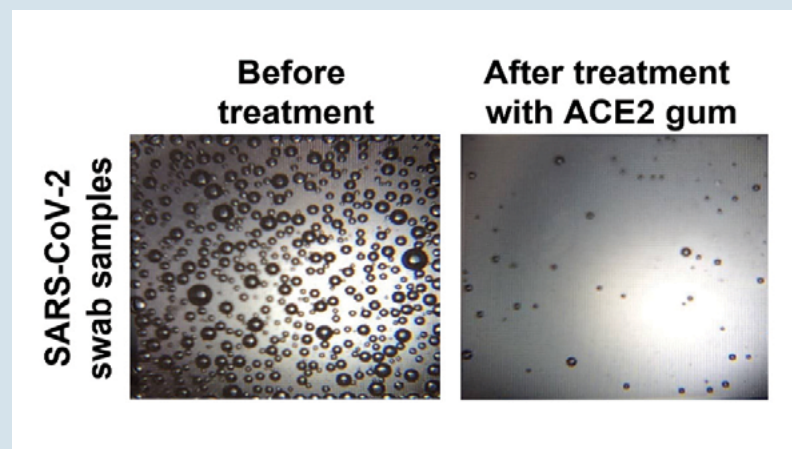
Vaccinations for COVID-19 changed the course of the pandemic, but don't stop disease transmission. But what if a chewing gum could tamp down this spread? Research led by [Henry Daniell](#) at the [School of Dental Medicine](#) could lead to a low-cost tool in the arsenal against COVID-19 and perhaps other respiratory diseases.

The experimental gum, containing a protein grown in plant cells that serves as a "trap" for the SARS-CoV-2 virus to reduce viral load in saliva, prevent entry into human cells, and potentially slow self-infection or transmission, entered clinical trials at Penn last fall. Daniell is also exploring an expansion to use the approach for influenza, herpes simplex virus, and respiratory syncytial virus.

"SARS-CoV-2 replicates in the salivary glands, and we know that when someone who is infected sneezes, coughs, or speaks, some of that virus can be expelled and reach others," says Daniell. "This gum offers an opportunity to neutralize the virus in the saliva and throat, giving us a simple way to possibly cut down on a source of disease transmission."



The plant material is freeze-dried and ground, and delivered by the chewing gum.



In a measure of viral load using microbubbles, the chewing gum infused with the ACE2 protein triggered a reduction in the amount of virus in samples taken from COVID-19 patients.

The Effect of Lead on Childhood Stress, Behavior

Jianghong Liu, the **Marjorie O. Rendell Endowed Professor in Healthy Transitions in the School of Nursing**, has studied the effect of lead on child development for more than a decade, both in Philadelphia and China.

Previous work of hers revealed a link between lead, cognitive function, and low IQ, as well as effects on behavior and sleep. Two recent studies, both published in the journal *Environmental Research*, take her work further: One focuses on how lead exposure influences heart rate variability, the other on blood lead levels and social adversity.



Q: Why is it important to keep studying lead?

A: Lead exposure may seem like an old topic—we’ve been talking about this for years—but it’s important we continue to do so because scientific evidence continues to show that even at low levels, lead has developmental outcomes.

Lead is regulated by the CDC. Every few years, they test a group of children in the United States to provide what they consider ‘safe’ reference levels. Ten years ago, 10 micrograms was safe. Then around 2012, they lowered it to five micrograms. Now it’s 3.5 micrograms. They continue to lower this because science, including my own, provides convincing evidence of the negative effects of lead exposure, even at levels viewed as safe just a short time ago.

Q: What did you find in the heart rate study?

A: In our psychophysiology lab in Jintan, China, we gave the children a stress test, then measured their heart rate. We found that those exposed to lead had dysregulated heart rate variability—in other words, their heart rate did not go up and down as it normally would—and they did not regulate stress well, compared to the controls who had no or low-level lead exposure. This has implications for our understanding of cardiovascular disease and metabolic disease.

Q: How about the social adversity study?

A: It’s well known that experiencing social adversity is associated with behavior problems, but what accounts for this relationship? I was looking at environmental exposure to lead. In this study, we were able to show that even low levels of lead can help explain the relationship between social adversity and behavior problems. This is the first time that has been documented. While there are some biological risk factors for child behavior problems, the finding highlights the fact that the social environment can actually be the source of these biological processes. It also emphasizes the role of social determinants of health in children.

Q: What are the implications of this research?

A: It’s important to understand these mechanisms and health outcomes for two reasons: One, so we can use this knowledge to better develop and refine interventions that target risk factors. The second is health policy regulation. Take the social adversity finding, for example. If we’re able to target the factors that put these children at risk—something like improving neighborhood conditions, for instance—kids are less likely to be exposed to lead and, consequently, to negative developmental outcomes.

FINE ARTS

At The Glass House, ‘A Colored Garden’

In spring 2021, [David Hartt](#) of the [Stuart Weitzman School of Design](#) debuted “A Colored Garden” at the Glass House, a historic house in New Canaan, Connecticut, built in 1949 by architect Philip Johnson. The location contains a collection of 20th-century paintings and sculptures and, in recent years, has become a site of re-examination of modern architecture, landscape, and art, including Johnson’s own troubled history.

Hartt’s commission to do a work for the site developed out of his interest in the theme of change and how it tracks the development of culture. His research touched on the work of Nicolas Poussin, an example of which is in the house collection. Hartt realized he wanted to work with the landscape surrounding the house instead of its interior. He wanted to, he says, “calibrate” the multi-faceted elements of the site.

The landscapes of Connecticut included several histories—including the exuberant flower gardens tended by Johnson’s partner, David Whitney. Another local reference point is the work of Charles Ethan Porter, an African American painter who worked in the late 19th and early 20th century. Drawn in by Porter’s still-life paintings, Hartt decided to do an analysis of every Porter painting he could find and then include flowers from them in a new garden, which would take on a circular shape inspired by other forms on the site.

“I made a matrix of all their blooming cycles and designed a garden that would allow it to be in constant bloom from early spring to late fall,” he explains. “The design calibrates that and sequences it so that you start off with peonies in early spring, and end with an array of zinnias in the late fall, and other flower types occur in other parts of the season—but all drawn from Porter still lifes.”

It was carefully designed to relate to the rest of the grounds and Johnson’s relationship with the landscape. Further, it sits on a meadow so that there is a sense of scale as the viewer approaches and can notice that it’s a circle.

“There’s a particular kind of charge that exists at the Glass House, so the work really tries to use the opportunities of the site that it provides, and in this case, I saw it as an opportunity to re-territorialize the space and add new narrative possibilities,” Hartt says.

The project continued in 2022 with an exhibition of Porter’s works in the site’s painting gallery and a screening of Hartt’s short film “Et in Arcadia Ego.” The garden will return in 2023 for its third season.



Hartt’s artworks often include video and music. In the “New Grit” exhibition, an original composition is actually broadcast on channel 87.5 in a 200-foot radius, referencing pre-internet global communications.



Hartt’s installation “A Colored Garden” at The Glass House in New Canaan, Connecticut, is created with everblooming flowers, based on a 19th-century painting.

Remote Learning Affected High Schoolers' Social, Emotional Health

Research from [Angela Duckworth and colleagues](#), published in the journal *Educational Researcher*, found that teenagers who attended school virtually fared worse than classmates who went in person, results that held even when accounting for variables like gender, race, and socioeconomic status.

Duckworth, the Rosa Lee and Egbert Chang Professor in the Department of Psychology in the [School of Arts & Sciences](#), and colleagues from the nonprofit Character Lab, the organization Mathematica, and Temple University, looked at data from more than 6,500 students in grades 9 through 12, some of whom attended virtual school full time, others who attended in person. Those who were remote reported lower levels of social, emotional, and academic well-being.

“There is a thriving gap,” says Duckworth, one of Character Lab’s founders. “On every measure tested, we saw a difference favoring kids who were in person versus learning at home and, therefore, alone. We’re inferring from this that, all things being equal, teenagers would really prefer to be with each other and with adults like their teachers, not home with Mom and Dad.”

Students completed the Student Thriving Index in February 2020, which asked them to rate facets of their well-being, including how well they think they fit in, whether there’s a trustworthy adult at school, how happy or sad they feel, and how interesting they find their classes. The researchers used this as a pre-pandemic baseline. The researchers’ survey took place during the pandemic in October 2020; at the time, 4,202 students were attending school remotely and 2,374 students were going in person. Because Duckworth and colleagues hadn’t randomly assigned



participants into these groups, they made sure to control for whatever variables they could.

For 10th, 11th, and 12th graders, the findings were clear: Those on Zoom for school struggled more than their peers taking classes in person. But for 9th graders, the divide between groups was much smaller.

“Maybe 9th graders had never experienced high school before, so their pandemic fall semester wasn’t as influenced,” Duckworth says. “But I think a different explanation—and one that makes sense to us as developmental psychologists—is that the older you are, the more you want to be independent. You want to separate from your parents. The period of adolescence is when you transition from being a dependent child to an independent adult.”

During the pandemic, researchers have paid a great deal of attention to young children, and rightly so, Duckworth says. But she says this work shows the importance of closely watching what’s happening to teenagers, too. She says their social and emotional needs should be part of the calculus when school districts determine and implement remote-schooling policies.

Like much about the pandemic, Duckworth notes it’s hard to say whether acute blips like this will become long-term challenges for teenagers. She expects that most young people will bounce back. “It would be consistent with what we know about adolescent development,” Duckworth says. “The most common response to adversity is resilience. It’s the rule, not the exception.” She and colleagues will continue collecting data to test that hypothesis and many others.



URBAN HEALTH

HOUSING REPAIRS ASSOCIATED WITH DROP IN CRIME

[Eugenia South](#) of the [Perelman School of Medicine](#), [Vincent Reina](#) of the [Weitzman School of Design](#), and [John MacDonald](#) of the [School of Arts & Sciences](#) have found that investing in structural home repairs in historically segregated, low-income, Black and Latino neighborhoods is associated with reduced crime rates.

In a study published in *JAMA Network Open*, the researchers reported that when a home in Philadelphia received structural repairs through the city-funded Basic Systems Repair Program, total crime dropped by 21.9% on that block, and as the number of repaired houses on a block increased, instances of crime fell even further.

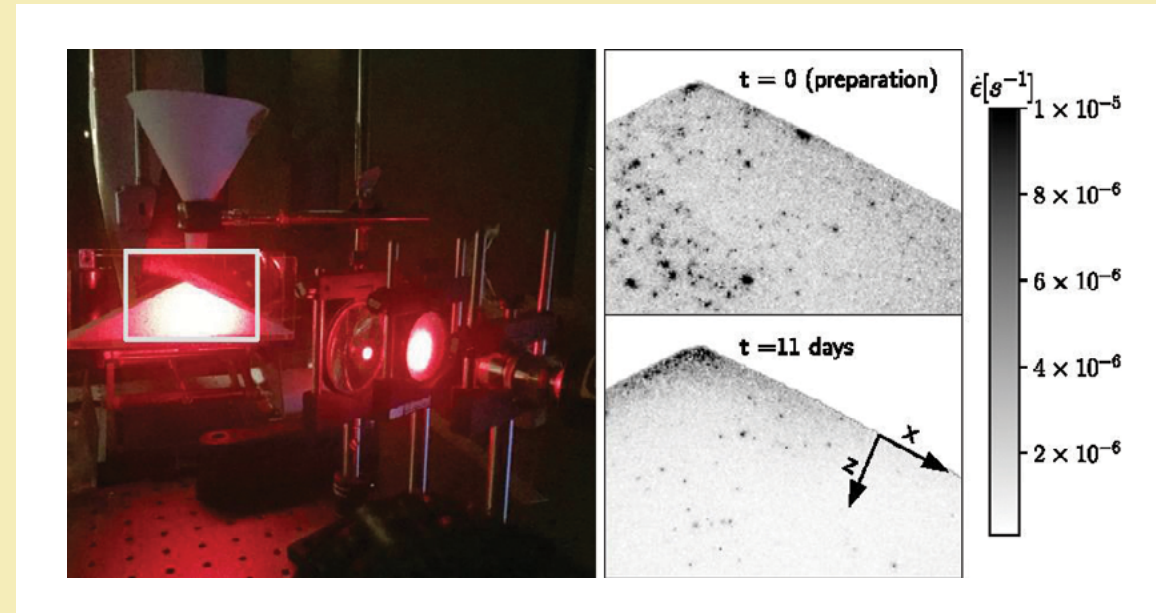
“We can now add structural home repairs to the growing list of place-based neighborhood interventions with strong evidence that they can help reduce violent crime,” says South, an assistant professor of emergency medicine and faculty director of the Penn Urban Health Lab.

A New Way of Thinking About Soil

Most people only become aware of soil movement on hillsides when soil suddenly loses its rigidity, a phenomenon known as yield. Researchers from the [School of Arts & Sciences](#), the [School of Engineering and Applied Science](#), and Vanderbilt University have discovered that piles of sand grains are in constant motion, even when undisturbed. The study, published in *Nature Communications*, used highly sensitive optical interference data to challenge existing theories in both geology and physics about how soils and other types of materials behave.

“Say that you have soil on a hillside. Then, if there’s an earthquake or it rains, this material that’s apparently solid becomes a liquid,” says senior author [Douglas Jerolmack](#), a professor in the Department of Earth & Environmental Science. “The prevailing framework treats this failure as if it’s a crack breaking. The reason that’s problematic is because you’re modeling the material by a solid mechanical criterion, but you’re modeling it at the point at which it becomes a liquid, so there’s an inherent contradiction.”

A model like this implies that below yield, the soil is a solid, and therefore should not flow, but soil slowly and persistently “flows” below its yield point



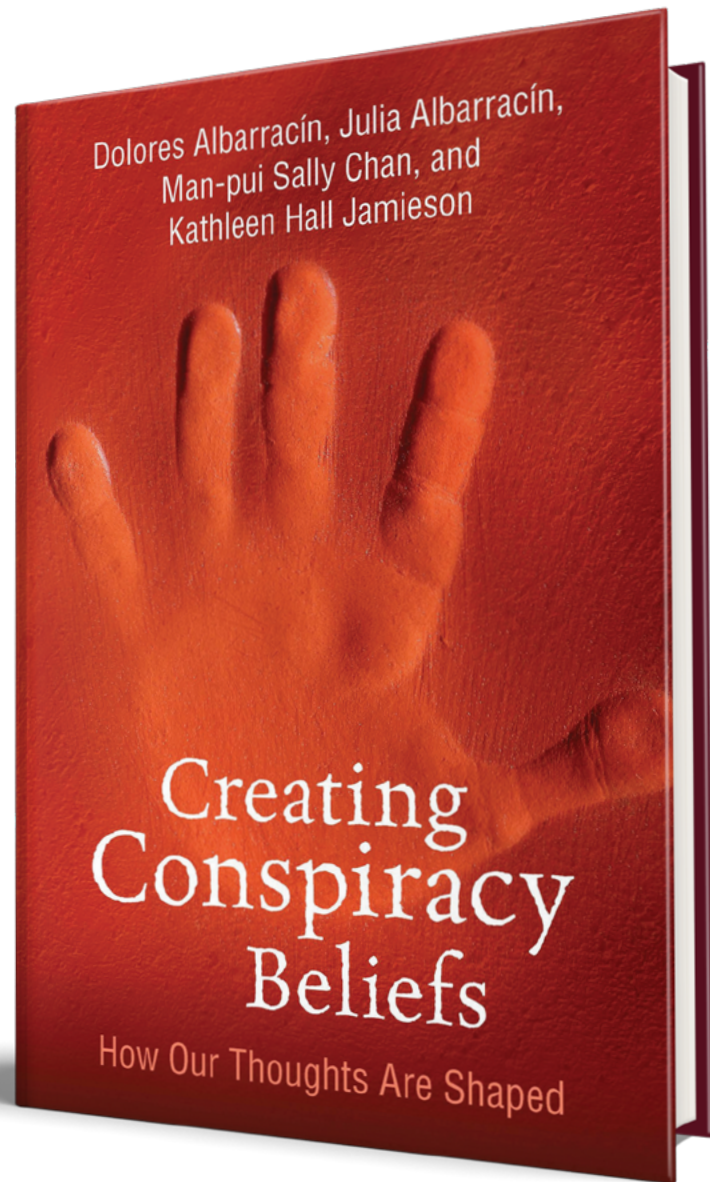
In the Jerolmack lab, diffusion-wave spectroscopy was used to study very small grain movements in piles of sand (shown in panel on the left). The data that was collected, depicted in strain rate maps (in panel on the right), shows that grain activity continues after 11 days without disturbance.

in a process known as creep. The prevailing geological explanation for soil creep is that it is caused by physical or biological disturbances, such as freeze-thaw cycles, fallen trees, or burrowing animals, that act to move soil.

In this study, lead author and recent graduate [Nakul S. Deshpande](#) was interested in observing individual sand particles at rest, which according to prevailing notions, should be immobile.

“Researchers have built models by presuming certain behaviors of the soil grains in creep, but no one had actually just directly observed what they do,” says Deshpande.

Deshpande and Jerolmack worked with Penn’s [Paulo Arratia](#) and Vanderbilt’s David Furbish and discovered that sand grain piles are in fact a mass of constant movement and behave like another “disordered” material, glass. By disordered, the researchers mean the material’s constituent particles move randomly at a rate dependent on temperature, whereas sand grains are too large to do so. As a result, physicists expect that a pile of sand would be “jammed” and unmoving, but these latest findings present a new way of thinking about soil for researchers in both physics and geology.



PSYCHOLOGY

How Conspiracy Theories Stick

How do conspiracy theories take hold? It's a question Penn Integrates Knowledge University Professor [Dolores Albarracín](#) has pondered for decades. "I grew up in Argentina in the '70s. The climate within the dictatorship was such that you couldn't really speak, and for a politically involved family like mine, you were instructed to not say anything," recalls Albarracín, who has appointments in the [Annenberg School for Communication](#), Annenberg Public Policy Center (APPC), and [School of Nursing](#). "That piqued my interest in secrecy, and in how people make inferences about events that have presumably been covered up."

As a social psychologist and communication scholar, Albarracín researches what happens when fringe ideas become consequential for society. She and her colleagues opted to study social influence, which she says had been surprisingly neglected by those who study conspiracy beliefs.

"That's what we're seeing with conspiracy theories today," Albarracín says. "Nobody can deny that these are wildly impactful and problematic."

She drills down into this phenomenon in a book she co-authored with Penn's [Man-pui Sally Chan](#) and [Kathleen Hall Jamieson](#), and Julia Albarracín of Western Illinois University. In "Creating Conspiracy Beliefs: How our Thoughts are Shaped," the team analyzes empirical research conducted on real examples of false plots—for instance, the alleged sex-trafficking ring Democrats ran out of a pizza parlor—pinpointing two factors that have driven recent widespread conspiracy theories: the conservative media and societal fear and anxiety.

"The idea of this book is to explain, in cross-disciplinary detail, how it is that people are susceptible to conspiracy beliefs and how their media consumption patterns play a role in increasing the likelihood that they hold those beliefs," says Jamieson, APPC director.

For this research, they conducted three cross-sectional surveys, an experiment, and a longitudinal panel study. They also analyzed 400,000 tweets. All the work focused on conspiracy theories for which no plausible evidence currently exists.

Continued >

“There’s no evidence you can offer that would discredit a conspiracy theory. Any evidence you offer simply confirms the power of the conspirators to control your reality.”

—KATHLEEN HALL JAMIESON

“In other words, we have no reason to believe they’re true.” Jamieson says. “But in people’s minds, they believe that that reality exists, and that belief has real consequences.”

As an example, she mentions “Pizzagate” and Edgar Maddison Welch, who, in 2016, armed himself and entered Comet Ping Pong in Washington, D.C., intending to stop the child abuse he “knew” to be happening in the pizza parlor’s basement by high-level Democrats—including Hillary Clinton.

“Even after he found no children, no abuse, he did not give up the conspiracy theory,” Jamieson says. “That tells us something very important: There’s no evidence you can offer that would discredit a conspiracy theory. Any evidence you offer simply confirms the power of the conspirators to control your reality.”

For both health and political beliefs, conservative media play a large role in the spread of conspiracy theories, Albarracín says.

“First, they are heightening anxiety in the population, which fuels conspiracy beliefs,” she says. “Secondly, they are directly injecting the content. So, if your media diet is mainly Fox News, then you’re more likely to also experience anxiety in the moment because of what’s being presented to you. The combination of the conspiracy stories and the content is powerful.”

The researchers didn’t see these same effects with liberal or mainstream media, or from social media. They say that points to a responsibility on the part of conservative outlets to change what they highlight and how. Jamieson says groups like the APPC’s Factcheck.org also must debunk false ideas early.

“Once people have moved into full-blown conspiracy thinking, it’s hard to get them out,” she says.

These theories can have real consequences for both individuals and society, made clear by an event like the January 2021 United States Capitol insurrection. Jamieson says preventing such outcomes in the future requires better grasping how conspiracy theories stick.

“Providing that kind of understanding is a key contribution of this book,” she says.

LAW

THE CORRELATION BETWEEN COMMUTING TIME AND EVICTION BY DEFAULT

In the first controlled study of eviction rates across time in a large urban center, [David Hoffman](#), a professor of law and deputy dean at the [University of Pennsylvania Carey Law School](#), and colleague Anton Strezhnev of the University of Chicago, found that Philadelphia tenants who live farther away from the city's courthouse and rely on mass public transit are less likely to show up, leading to eviction by default.

The study, which is outlined in the paper “Longer Trips to Court Cause Evictions” published in the *Proceedings of the National Academy of Sciences*, reviewed nearly 235,000 evictions filed against approximately 300,000 Philadelphians from 2005 through 2021. Using datasets obtained through the non-profit Philadelphia Legal Assistance, the Pew Charitable Trusts, and elsewhere, Hoffman and Strezhnev found that 40% of tenants in eviction proceedings during that time lost due to default.

“Eviction is at the center of a set of social ills that are often difficult to understand and disentangle,” Hoffman says. “Our goal is to offer a previously unidentified but plausible cause of evictions: commuting time to court. When the court system requires defendants to show up by a particular time—in this case, 8:45 a.m.—or default their rights with near certainty, our research shows that longer mass transit commutes result in significantly higher likelihoods of being evicted.”

According to Hoffman and Strezhnev's calculations, for every 10 minutes in additional commuting time, tenants are between 0.65 and 1.4 percentage points more likely to default. A one-hour increase in commuting time has a 3.9 to 8.6% average effect on the probability of tenant default. If all tenants were able to get to their hearing in 10 minutes or less, Philadelphia would have eliminated approximately 4,000 to 9,000 such defaults over that period.

In contrast, when tenants were offered Zoom or virtual hearings during the COVID-19 pandemic, the commuting time effect disappeared.

“Even when we compare across buildings that are all roughly the same distance from the courthouse, we find that there is still a lot of variation in commuting time because of how Philadelphia's public transit network is laid out, and that this residual commuting time is strongly correlated with default,” Strezhnev adds. “Our finding persists even after accounting for a lot of other factors that might be associated with both commuting time and default. We are quite confident that the relationship we've discovered is causal and not spurious.”



A New Metric for Designing Safer Streets

Current federal regulations for installing pedestrian and bicyclist-friendly infrastructure at an unsafe crossing, such as a crosswalk with a traffic signal, require either a minimum of 90 to 100 pedestrians crossing this location every hour, or at least five pedestrians struck by a driver at that location in one year.

A study led by [Megan Ryerson](#) and other researchers from the [Stuart Weitzman School of Design](#) and the [School of Engineering and Applied Science](#) has found that individual-based biometrics can provide a more proactive approach for designing safer roadways for cyclists and pedestrians.

“Part of the challenge is that transportation systems are designed and refined using metrics like crash or fatality data instead of data on human behavior to help understand what makes an area unsafe or what specific interventions would be the most impactful,” says Ryerson. “This reactive approach also fails to capture where people might want to cross but don’t because they consider it too dangerous and that, if it were safe, more people would utilize.”

The team developed an approach to evaluate cognitive workload—a measure of a person’s ability to perceive and process information—in cyclists and looked at how different infrastructure designs elicit changes in cognitive workload and stress in urban cyclists. Riders wore eye-tracking glasses equipped with inward- and outward-facing cameras and a gyroscope capable of collecting eye- and head-movement data.

One of the main findings was the ability to correlate locations with disproportionately high numbers of crashes with a consistent biometric response that indicates increased cognitive workload, wherein a heightened workload means threat of a crash is heightened. However, there is a caveat: A higher cognitive workload doesn’t necessarily mean that they will crash, but it does mean that a person is less able to effectively process new information, like a pedestrian or a driver entering a bike lane. Additionally, the researchers found that stressful areas were consistent between expert cyclists and inexperienced, less confident cyclists.

Ryerson says the research shows that it’s possible to be more proactive about safety and that city planners could use individual-level data to identify areas where a traffic intervention might be useful—before anyone is hit by a car.



Using eye-tracking data from cyclists navigating through Center City, researchers from the lab of Megan Ryerson describe how biometric data can be used to find potentially challenging and dangerous areas of urban infrastructure.



A pair of eye-tracking glasses being set up in the field.

Offspring of Nicotine Users More Likely to Also Use Nicotine



Heath D. Schmidt, a neuroscientist in the [School of Nursing](#) and the [Perelman School of Medicine](#), set out wanting to know why there is increased prevalence of smoking in the children of fathers who smoke. In the United States in 2021, about one in every 50 high school students reported smoking a cigarette in the past month, according to the National Youth Tobacco Survey. For the same timeframe, that number jumped to one in nine for e-cigarettes. Most smokers form this habit before age 25. Previous research has offered some explanation, including a link between parents who smoke and the addiction risk of their children. Schmidt wanted to better understand this connection.

Using a novel rat animal model, Schmidt and his collaborators found that males who voluntarily self-administered nicotine for 60 days produced offspring more likely to also self-administer nicotine—whether female or male. The research highlights which populations are most vulnerable to nicotine use in society.

Q: Has previous research shown a link between parents who smoke or use tobacco products and an increased risk of a nicotine use disorder in their children?

A: There are data that do indicate that both the sons and daughters of parents who smoke will go on to develop a nicotine use disorder. There's also some evidence that the offspring of parents who smoke might develop cognitive impairments as well. But we don't yet know why.

We have some guesses. Children who grew up in households where smoking is a regular part of their daily lives see it. It's a behavior that they may model. However, it's not clear whether that's due to a direct impact of nicotine itself on the developing brain. The real benefit of an animal model is that we can isolate the effects of the drug itself on offspring development and physiology.

Continued >

“Children who grew up in households where smoking is a regular part of their daily lives see it. It’s a behavior that they may model. However, it’s not clear whether that’s due to a direct impact of nicotine itself on the developing brain. The real benefit of an animal model is that we can isolate the effects of the drug itself on offspring development and physiology.”

—HEATH D. SCHMIDT

Q: What was the main finding of your research here?

A: The major findings were that both the male and female offspring of the fathers that consumed the nicotine had enhanced nicotine-taking. That fits with the human data and suggests that the offspring of fathers who smoke tobacco products are more susceptible to developing a nicotine-use disorder.

We also saw sex-dependent effects where the male, but not female, offspring developed cognitive deficits, as well as anxiety-like behavior. Cognitive deficits like these are mediated by the hippocampus, an area of the brain that regulates learning and memory, so we decided to look at genes to determine which were involved. One stood out, *Satb2*.

Q: What is *Satb2*?

A: It’s a gene that plays a role in neurodevelopment, but not much is known about its role in the adult brain. Two recent studies showed that *Satb2* plays a role in the synaptic plasticity in the hippocampus, as well as learning and memory in the adult brain. We thought that fit perfectly with what we were hypothesizing.

Q: What did you find when you dug deeper into *Satb2*?

A: We saw that these male offspring with cognitive deficits had decreased levels of *Satb2* in the hippocampus. That really supported the hypothesis that decreases in *Satb2* underlie these cognitive deficits. The obvious next step was to try to reverse that decrease, so we developed a virus that would over-express *Satb2* in the hippocampus.

With elevated levels of *Satb2* in the hippocampus, we found that we could prevent or reverse the cognitive deficits in the nicotine-sired male offspring. That was really encouraging. We also found that enhanced *Satb2* expression normalized nicotine taking. So, *Satb2* seems to play a critical role in the heritable effects of paternal nicotine taking.

NEUROSCIENCE

MAPPING VISUAL LANDSCAPES IN THE BRAIN

The brain has a lot to process in the visual world around us. Children running, birds flying, vehicles whizzing by, all against a shifting, dynamic background. It is a miracle we can recognize objects at all.

A study published in *Nature Communications* by [Vijay Balasubramanian](#) of the [School of Arts & Sciences](#) and former Penn researcher [Eugenio Piasini](#) examined brain pathways allowing animals to apprehend objects. The researchers hypothesized that deep brain neurons respond to more abstract elements of scenes, independent of transient shifts in appearance. For example, neurons in the human inferior temporal cortex, deep in the visual pathway, register objects even as they position on the retina (a part of the central nervous system). Think of how you recognize a moving face: This is the brain, processing images to recognize the face while accounting for changing position.

“If you look at a more abstract thing, like a particular tree, its identity always stays the same,” explains Balasubramanian, director of Penn’s Computational Neuroscience Initiative. “So, it can look different because you view it from different sides, but it’s the same thing—the same tree. We expect that in deeper, more cognitive brain regions, there are circuits registering the concept of an object rather than the detail of its appearance.”

Think again of the tree: As the fall of sunlight on its branches shifts, neural responses in the brain must register both its “thing-ness,” he says, and changes in appearance.

That invariance—the brain’s ability to detect when, say, a dog running in the park is the same dog sitting at its owner’s feet—is the key to these findings based on experiments performed at a lab in Italy. The researchers analyzed activity in multiple cortical areas in rodents viewing dynamic scenes. Applying state-of-the-art techniques, they found that deeper brain regions processed information more slowly, representing the world in more stable, or “invariant,” ways (e.g., registering the same tree despite changing appearance). By contrast, earlier parts of the pathway registered more variant information,



like changing object orientation. In this way, the brain retains information about both the abstraction of objects and their varying appearance.

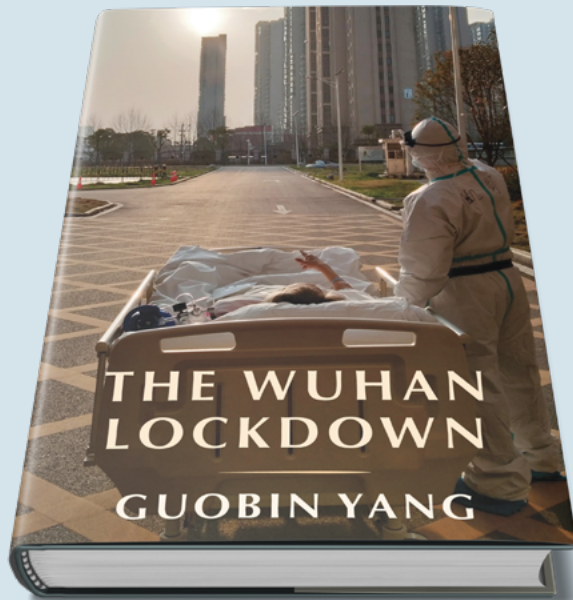
The process goes like this. The image first enters the neural network of the retina that extracts “visual features,” Balasubramanian explains, like bright and dark spots. Next, that information goes through the optic nerve to the visual cortex, where complex features like shape fragments and textures are assembled. It then splits into a dorsal branch going up the back of the head where motion is processed, and a ventral branch to the inferior temporal cortex, where visual objects are mapped. So, the brain is like a factory, where different installations cooperate to construct the whole from the parts.

The study also suggests that object identity—the perception of a thing like a tree—is among the slowest changing element of senses the brain processes. This knowledge may be useful for machine learning, Balasubramanian adds, noting that engineers draw inspiration from the brain.

The researchers studied these questions in animals whose brain states had different degrees of awareness. A surprise was that brain signaling in the anesthetized state acted more like signaling in the wakeful, conscious state than when rodents were just “zoning out” in inactive or meditative states. This counterintuitive finding is interesting for continued research into modes of awareness and how the brain achieves them.

Future research will also assess how these newly understood concepts may apply to processing sound to extract auditory “objects,” such as specific words or a person’s voice.

A Snapshot of Life in China During Lockdown



In February 2022, [Guobin Yang](#) of the [Annenberg School for Communication](#) published “The Wuhan Lockdown” through Columbia University Press. The book is a portrait of ordinary people in Wuhan, China, at the time of lockdown in 2020 through analysis of online “lockdown diaries.” Here, Yang discusses his research.

Q: At what point did you know you wanted to write about the Wuhan lockdown? Why?

A: Almost as soon as the lockdown in Wuhan started. Wuhan was put under lockdown on Jan. 23, 2020. Within a few days, lockdown diaries exploded on Chinese social media. Some of them went viral. The strong personal feelings recorded in these diaries struck a chord. Having used diaries in my previous research, I immediately saw the significance of these materials and started collecting them.

Q: How did you go about researching this book? It must have been a Herculean task to sort through 6,000 diaries.

A: I liked reading the diaries because they offered unusual insights into people’s visceral experiences, insights you won’t easily get through after-the-fact interviews. As we went into our own COVID lockdown in Philadelphia, reading diaries from Wuhan also became a source of information. I learned practical lessons about how to navigate my lockdown routines.

In terms of researching this book, I have to thank Chinese social media platforms. Diarists shared their lockdown diaries on popular platforms such as WeChat and Weibo. I followed as many diarists as I could find and read and downloaded their postings every day. I also read and selectively downloaded reader comments. Popular diary postings received thousands of comments. Readers not only interacted with the diarists, but also among themselves. Readers shared their own lockdown experiences. Reading both the diary postings and reader

comments gave me a clear sense of how people managed daily life, how they navigated personal and emotional anxieties and fears, and how they responded to government policies.

Q: What were some common threads between physicians, government officials, patients, etc., in how they were reacting to this event?

A: People’s reactions changed over time and public sentiments came in waves. Initially, there was lots of fear, anxiety, loneliness, anger, despair. Very quickly, you could see a strong social solidarity emerging from the concerted efforts among citizens and government agencies to fight the virus, such as when even online fandom communities mobilized to raise funds and donations for Wuhan. There were also lots of online protest activities, not against lockdown or quarantine policies, but about problems that arose in the implementation of some of these policies.

Q: What surprised you in your research?

A: I was surprised by the mobilizing power of the lockdown diaries. The daily posting of those diaries and public responses to them essentially created a social rhythm. Like rituals of everyday life, they provided order and regularity in times of uncertainty and crises.

Q: What did you learn about the early days of the lockdown/pandemic that you didn’t know going in, and how do you think this period of the lockdown will be remembered as time goes on?

A: I learned that ordinary people could really do extraordinary things. And almost everything that Wuhan residents did in their 76-day lockdown was extraordinary. How the Wuhan lockdown will be remembered is another matter. It will be remembered differently by different people. There will be official, ‘master’ narratives, and there will be memories by the common people. There will be lots of traumatic memories.

SOCIAL JUSTICE

ADDRESSING SOCIAL INEQUITIES THROUGH RESEARCH

With social justice as the core of its mission, all endeavors of the [School of Social Policy & Practice](#) (SP2) are “inevitably pointed at addressing social inequities and oppression,” says Dean [Sara Bachman](#).

Indeed, faculty at SP2 address homelessness, substance use, the carceral system, guaranteed income and universal basic income, the foster care system, data-driven social policy, and the impact of philanthropy.

[Desmond Patton](#), SP2’s first Penn Integrates Knowledge Professor, with joint appointments in SP2 and the [Annenberg School for Communication](#), conducts pioneering research to examine connections between young people, gang violence, and social media. He is founding director of SAFELab, which works to better understand violence involving youth of color. His new Penn Center on Inclusive Innovation and Technology focuses on community-informed, value-driven research and praxis.

Longtime Professor [Dennis Culhane](#), a nationally recognized expert on homelessness, co-founded the grant-funded organization Actionable Intelligence for Social Policy (AISP) with [John Fantuzzo](#) of the [Graduate School of Education](#).

AISP’s toolkit for centering racial equity throughout the data lifecycle, released in 2020, was requested by organizations across the country and became the basis for AISP’s Equity in Practice Learning Community, now in its second year.

Faculty member [Ioana Marinescu](#) studies issues of economic security, including income-support policies, wage exploitation, and antitrust policy. On a three-year project funded by the Alfred P. Sloan Foundation, Marinescu and graduate student Hyeri Choi are studying factors affecting underemployed workers.

With student field placements and internships at more than 200 agencies and organizations in Philadelphia and beyond, SP2 is committed to sustaining and growing community partnerships. “We have this incredible opportunity to draw on all of that energy, that enthusiasm for the mission to move forward as social change agents in new ways,” Bachman says.

“We have this incredible opportunity to draw on all of that energy, that enthusiasm for the mission to move forward as social change agents in new ways.”

—SARA BACHMAN



How does the media's portrayal of tobacco and e-cigarette use affect whether young adults decide to smoke? Two [Annenberg School for Communication](#) studies aimed to answer that question.

One, in the *Journal of Communication*, found that negative media coverage of these behaviors mattered in reducing intent to smoke. A second, shared in *Communication Research*, found that media's effects on views about the prevalence and acceptance of tobacco and e-cigarette use changed for young people depending on the viewing medium.

"This project measured media coverage of these issues in a very intensive way," says [Robert Hornik](#), the Wilbur Schramm Professor Emeritus of Communication and Health Policy.

The research evolved under the federal Tobacco Centers of Regulatory Science grant program. In 2013, Hornik received nearly \$3.5 million to study how communication about tobacco products was changing in a shifting media environment, part of a Center grant of more than \$19 million. In the past decade his team has published a dozen papers on this work.

"These latest studies are obviously about tobacco, but they're also about media effects," says Leeann Siegel, a postdoctoral fellow at the National Cancer Institute who ran one of the studies as a Penn doctoral student. "This project has taken a lot of energy over a lot of years and these papers offer crucial outcomes."

For the first, the team—which included [Laura Gibson](#), now a research assistant professor in the [Perelman School of Medicine](#)—monitored the daily media landscape from May 2014 to June 2017, seeking tobacco-related content from 50 major U.S. newspapers, eight broadcast outlets, the Associated Press wire, 100-plus websites, Twitter, and YouTube. Simultaneously, they surveyed 13- to 25-year-olds weekly, asking questions about smoking-related behavior.

The researchers then analyzed the datasets side by side. Across all platforms but YouTube they found a significant association between weekly anti-tobacco messaging and lower intentions to smoke among the U.S. youth and young adult population. The same wasn't true for positive coverage of tobacco products, which didn't move the needle either way.

In the second study, the researchers analyzed how media depictions of tobacco use normalized such behavior. They found that the more it appeared in long-form texts, the more likely young people were to report the behavior as normative. Social media, however, went the opposite way.

Hornik and Siegel say the work has broad implications in terms of norm perceptions and media influence on tobacco-related behaviors. It also supports the idea that in order to examine media effects, it's useful to accumulate coverage across media sources and over time to complement sample surveys.

Media Depictions of Tobacco and Their Effect on Young Adults



CRIMINOLOGY

THE LONG REACH OF THE CRIMINAL JUSTICE SYSTEM IN BLACK AND LATINX COMMUNITIES



Interactions with the U.S. criminal justice system can have lasting and unexpected consequences. Research from the Department of Criminology and the Department of Sociology in the [School of Arts & Sciences](#) looked at several facets of this, including who is at greatest risk to encounter the criminal justice system, what role diversions programs might play, and what happens when a city increases its police force numbers.

Sociologist [Courtney Boen](#), an assistant professor and Axilrod Faculty Fellow, conducted the work on inequalities in risk of system contact with colleagues from Princeton and Washington University in St. Louis. In the journal *Demographic Research*, they showed that Black boys and young men face the greatest risk of early interactions with the criminal legal system, particularly those whose parents have a high school education or less.

Specifically, the team found that by age 26, 6 in 10 Black men in this category had been arrested, 4 in 10 had experienced probation, and 4 in 10 had been incarcerated. Latinx men and Black women also faced significant risk; 1 in 4 was arrested by age 26.

“The reach of the criminal legal system in the lives of these young people, and by consequence, their families and communities, is staggering,” Boen says.

Diversion programs have the potential to help, according to work from criminology postdoctoral fellow [Viet Nguyen](#), in collaboration with criminologist Aurélie Ouss and the Philadelphia District Attorney’s Office (DAO).

When a person with no criminal history is charged with a non-violent, misdemeanor offense, the prosecutor can get the case dismissed or pursue a conviction. Diversion programs offer a middle ground that keeps the person from formally entering the criminal justice system. For example, those who complete Philadelphia’s Accelerated Misdemeanor Program can get their case record expunged by doing community service and paying court fees.

Continued >

Diversion programs offer a middle ground that keeps the person from formally entering the criminal justice system.

There's fear, however, that such programs might expand the number of people interacting with the criminal justice system, drawing in cases that would otherwise have been dismissed. Nguyen wanted to understand whether this fear had merit.

In a white paper published in conjunction with the DAO, he found that diversion programs can produce a net-narrowing effect. Rather than growing the number of people who interact with the criminal justice system long term, these programs reduce the overall scope by increasing expungement rates and lowering reconviction rates.

"It can change a young person's trajectory," Nguyen says. "That's a nuanced part of diversion programs that people don't often talk about."

Criminal justice policies and practices aren't just important at the individual level. Associate Professor of Criminology [Aaron Chalfin](#) and colleagues from the University of Oregon, the University of California, Los Angeles, and Barnard College, wanted to understand whether increasing a city's police force affected crime rates.

They analyzed 242 cities across the U.S. during the 38-year period from 1981 to 2018, factoring in federal grants to departments earmarked for hiring more officers. For three categories—index crimes, quality-of-life crimes, and other—the team tracked total arrests as a whole and broken down by race.

Using an economic model, they showed that adding 10 to 17 more officers prevented one homicide annually, but that low-level arrests increased; with each extra officer, an additional 22 arrests for crimes like drug possession took place. They shared what they learned in *American Economic Review: Insights*, the journal of the American Economic Association.

Chalfin says the findings provide concrete evidence that redirecting funds from the police to other measures has real consequences.

"The research suggests that money spent on police is effective at reducing crime and violence," he says. However, he adds, "when it comes to reducing violence, it's crucial to have a portfolio of strategies."

PHOTO CREDITS

COSMOLOGY / COVER + PAGES 8–9

Ningfeng Zhu

IMMUNOTHERAPY / PAGE 1

Perelman School of Medicine

INFECTIOUS DISEASE / PAGE 2

Robert Woeger on Unsplash

EARTH & ENVIRONMENTAL SCIENCE / PAGE 4–5

Map: Jonas Toupal

Photo: Alex Schein

PHYSICS / PAGE 7

Arnold Mathijssen

MANAGEMENT / PAGE 10

Desola Lanre-Ologun on Unsplash

REGENERATIVE MEDICINE / PAGE 13

University of Dundee School of Medicine 2015

Illustration by Annie Campbell

PUBLIC HEALTH / PAGE 14

Eric Sucar

REPRODUCTIVE BIOLOGY / PAGE 16

Bottom: Eoin Whelan/PLOS Biology/CC-BY 4.0

www.creativecommons.org/licenses/by/4.0

CULTURAL HERITAGE / PAGES 17–18

Page 17 + Back Cover: Sarah Lerner

Page 18 Top: Kwesi Daniels

Page 18 Bottom: Randy Mason

ART HISTORY / PAGE 20

Anastasis Agathos

ART HISTORY / PAGE 21

School of Arts & Sciences

NURSING / PAGE 22

School of Nursing

ENERGY POLICY / PAGE 26–27

Mine Photo: Courtesy of Peter Psarras

Lab Photo: Scott Spitzer

DERMATOLOGY / PAGE 28

Kang Ko

VETERINARY MEDICINE / PAGE 29

Luiza Sayfullina on Unsplash

ADDICTION STUDIES / PAGE 30

Josh Olalde on Unsplash

EDUCATION / PAGE 33

Illustration by Nadia Hafid

LIFE SCIENCES / PAGES 35–36

Longfellow Real Estate Partners

PUBLIC HEALTH / PAGE 37

City of Philadelphia

ASTRONOMY / PAGE 37

Dark Energy Survey/DOE/FNAL/DECam/CTIO/

NOIRLab/NSF/AURA/P. Bernardinelli & G. Bernstein

(Penn)/DESI Legacy Imaging Surveys

DENTAL MEDICINE / PAGE 40

Courtesy of the researchers

ENVIRONMENTAL HEALTH / PAGE 41

Johnny McClung on Unsplash

FINE ARTS / PAGE 42

Top: David Heald

Bottom: Eric Sucar

GEOLOGY / PAGE 45

Nakul Deshpande

LAW / PAGE 48

ActionVance on Unsplash

CITY PLANNING / PAGE 49

Thomas Orgren

NEUROSCIENCE / PAGE 52

Ricardo Gomez Angel on Unsplash

COMMUNICATIONS / PAGE 55

John Caroro on Unsplash

Research *at* Penn

*Advances in Knowledge
from the University
of Pennsylvania*

Year 2023 | Volume 21

upenn.edu/researchdir