

Research *at* Penn





Research at Penn

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Penn's Research Enterprise

Research is what Penn does. As one of the top research universities in the world, Penn is not only generating important new knowledge in the fields of medicine, technology, business, science, and beyond, but also applying this knowledge to improve the lives of individuals and communities at home and around the globe.

In its 17th year, the annual Research at Penn brochure highlights some of the groundbreaking research from the past year across the University's 12 schools.

Doctors of medicine are utilizing personalized cell therapy to give lifesaving treatment to individuals with lymphoma, and developing vaccines for ovarian cancer. An international team of geneticists is showcasing the various skin colors of Africa. A historian and civil rights activist offers lessons learned from past protest movements. A marketing researcher is investigating how to predict personality traits through Facebook likes. A history of art professor is examining the narrative of the Benjamin Franklin Parkway. A historic preservationist is helping to save petrified stumps in Colorado. A cyclist and engineer is creating a new metric for bike lane safety.

With annual research funding of almost \$1 billion, Penn research is aimed at expanding the frontiers of human achievement and understanding, with the ultimate goal of improving the world.

To keep up with all the University's research news, visit Penn's research website: www.upenn.edu/researchdir.

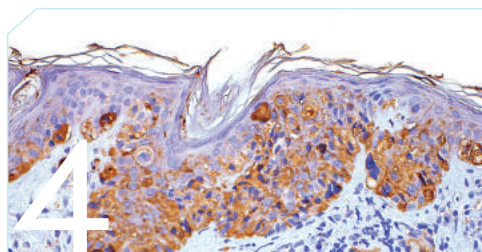


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What's Inside



Women who have previously been pregnant fare best against skin cancer.



Helicopter parenting may handicap puppies in guide dog training.



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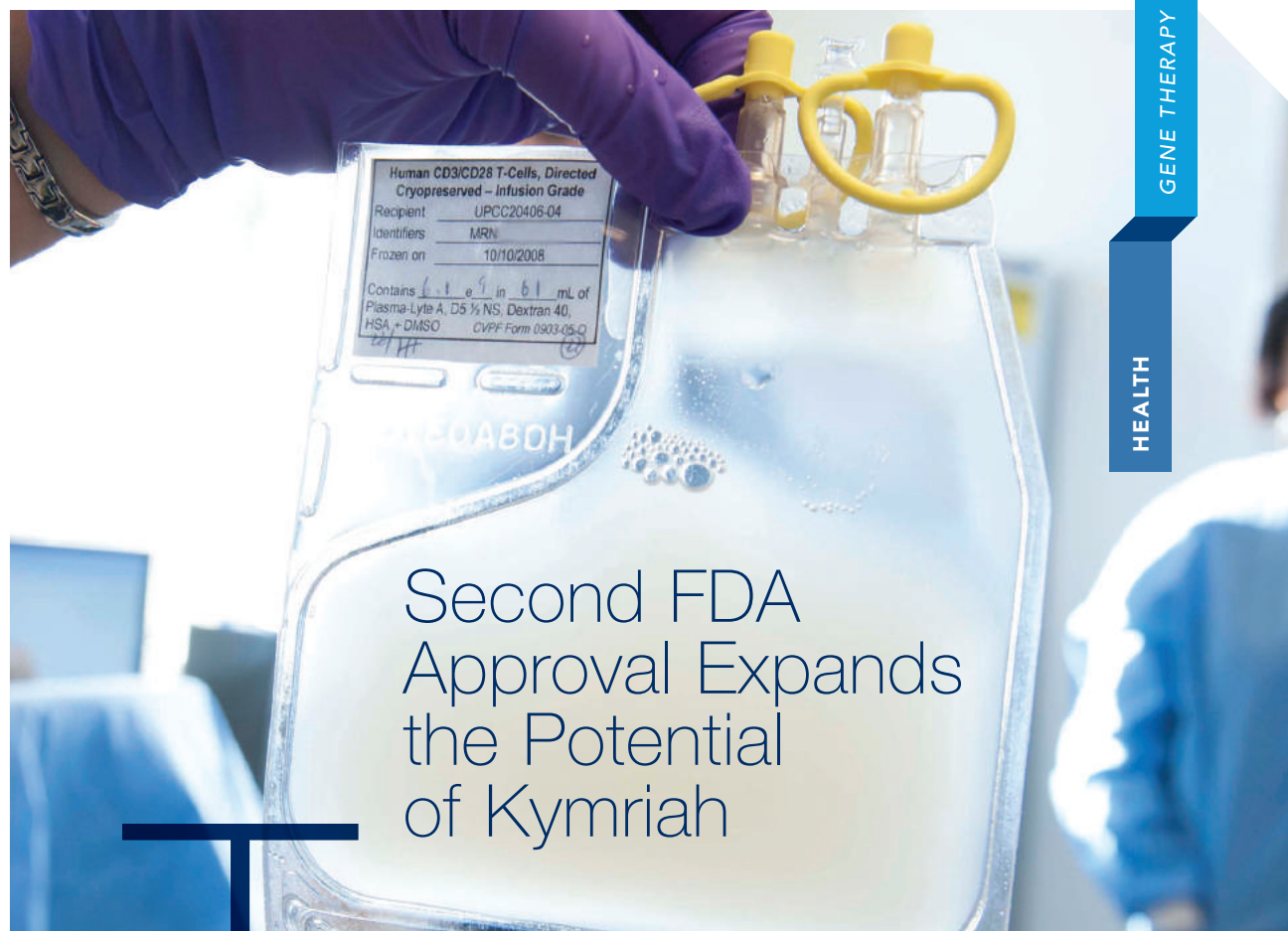
Start from Scratch with a New Criminal Justice System

One expert says the system operates in an anti-democratic manner and targets certain groups for unjust treatment.

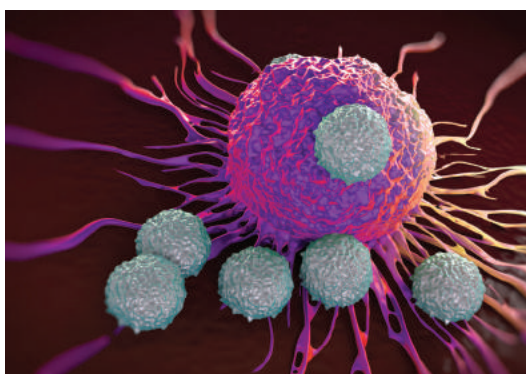
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Based on firsthand experiences and historical research, a professor outlines the power of resistance.



Second FDA Approval Expands the Potential of Kymriah



In personalized cell therapy, T cells are transformed into targeted cancer-killers.

hough roughly two-thirds of patients with diffuse large B-cell lymphoma (DLBCL) respond well to standard chemotherapy treatment, the remaining one-third do not. Of that third, half are not candidates for high-dose chemotherapy with a stem cell transplant, the best current second-line therapy.

That leaves many patients in a desperate state. “I can’t overstate how sick some of these patients were,” says Stephen Schuster, director of the Lymphoma Program at Penn’s Abramson Cancer Center and the Robert and Margarita Louis-Dreyfus Professor in Chronic Lymphocytic Leukemia and Lymphoma Clinical Care and Research.

Beginning about five years ago, Schuster and others at Penn initiated clinical trials using chimeric antigen receptor modified T cells (CAR-T cells) to test another approach to beating

lymphoma in these challenging cases. The new strategy entailed a personalized cell therapy, whereby a patient’s own T cells are collected, transformed into targeted cancer-killers, and reinfused into the patient in order to expand, then attack and eradicate cancer cells. These genetically reprogrammed T cells were astonishingly effective.

“To take this previously untreatable group of patients and bring many of them back to life—it’s a high,” Schuster says. “There’s no feeling like it.”

On May 1, 2018, the U.S. Food and Drug Administration issued an approval for the CAR-T cell therapy Kymriah, developed and tested by Penn scientists, in collaboration with Novartis, for the treatment of adult patients with relapsed or refractory DLBCL who have failed two or more lines of systemic therapy. The approval further expands the use of this product, which

was initially approved by the FDA in August 2017 for use in pediatric and young adult patients with relapsed or refractory B-cell precursor acute lymphoblastic leukemia (ALL).

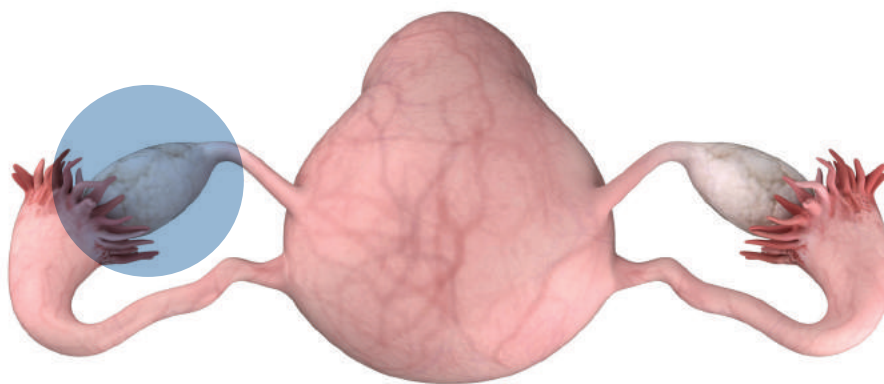
The initial approval of Kymriah for ALL was a breakthrough as the first gene therapy approved in the U.S.; this second indication significantly expands the patient population that stands to benefit from the technology. Roughly 27,000 people are diagnosed each year with DLBCL, the most common form of non-Hodgkin lymphoma, and of those, an estimated 6,500 may be eligible for treatment with Kymriah. FDA approval was also indicated for patients with high-grade B-cell lymphoma and DLBCL arising from follicular lymphoma.

“This is clearly a game-changer for the field,” Schuster says. “It’s going to impact a lot of patients.”

The technology behind Kymriah originated at Penn from the innovative work led by Penn Medicine’s Carl June in developing the CAR-T platform for reprogramming T cells. An initial cohort of patients was treated with the CAR-T cell therapy at Penn, with a long-term, follow-up reported last year in the *New England Journal of Medicine*. Using nearly the identical protocol, Schuster then worked with Novartis to lead an international, multicenter trial called JULIET. More than half of those treated responded to the therapy, with 40 percent achieving a complete, long-lasting response.

“The international trial included 27 centers in 10 countries on four continents and we hit the nail on the head,” Schuster says. “There was luck here, combined with great science by Carl June and others, and we were able to move quickly from the trial at Penn to the global trial. It was very gratifying to see the same great results coming in from all these different investigators from around the world.”

HEALTH / ONCOLOGY



OVARIAN CANCER VACCINE SHOWS PROMISE

Janos L. Tanyi, an assistant professor of obstetrics and gynecology at the Perelman School of Medicine, has spent nearly 10 years at Penn chipping away at groundbreaking research, developing methods that fight against ovarian cancer.

One of several studies he’s led, published in *Science Translational Medicine*, was all about personalizing a vaccine for each individual ovarian cancer patient. The pilot trial, conducted at the Perelman School of Medicine and the Abramson Cancer Center, yielded promising results—findings that Tanyi says “warrant further testing in larger clinical trials.”

“There are many questions still open,” Tanyi says, “but we’ve definitely seen a survival advantage.”

Tanyi, alongside his colleagues at Penn and the Lausanne Branch of the Ludwig Institute for Cancer Research, made each patient’s personalized vaccine by sifting through their own peripheral blood mononuclear cells for suitable precursor cells, and then growing these, in the lab, into a large population of dendritic cells, which are essential for an effective T cell immune response.

The researchers then exposed the dendritic cells to specially prepared extracts of the patient’s tumor, activated the cells with interferon gamma, and injected them into the patient’s lymph nodes, in order to prime a T cell response.

“Here we have a vaccination that was able to create T cells which were specific to the unique mutation of the patient’s cancer cells,” says Tanyi, noting that the T cells proved to be highly tumor-specific, sparing healthy cells.

This strategy was tested on advanced ovarian cancer patients who received a dose of tumor-exposed dendritic cells every three weeks, sometimes for more than six months. Half of the patients who were evaluated showed large increases in the numbers of T cells specifically reactive to tumor material, indicating a good response to the vaccination.

Funding for the study was provided by the National Institutes of Health, the Marcus Foundation, the Ovarian Cancer Immunotherapy Initiative, the Ludwig Institute for Cancer Research, and the OvaCure Foundation.

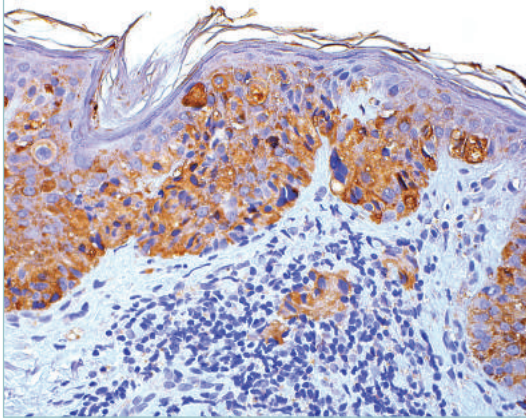
This individualization of treatment, Tanyi notes, is something that, in the future, “will hopefully be routine.”

“I see what direction we can go in,” he adds.

For now, Tanyi says, he hopes to bring this study “up to the front line”—meaning to patients with earlier stages of ovarian cancer, and with stronger immune systems. Also, he and his team will work to enhance the effectiveness of the vaccine by combining it with other drugs that deactivate tumor anti-immune defenses.

“I want to see the difference it makes,” he says. “I really believe it will have a much better survival outcome.”

Studying Pregnancy Hormones to Fight Melanoma



Women who develop melanoma and other cancers generally do better than men, says Todd Ridky, an assistant professor of dermatology at the Perelman School of Medicine. Women don't get as much cancer, he says, and when they do, they tend to respond better to treatment.

One group of women fares best against skin cancer—those who have previously been pregnant—and Ridky's team may have discovered why.

Protection likely comes from the extended estrogen surge that accompanies pregnancy. This finding led Ridky and graduate student Chris Natale to identify a possible new cancer target and chemical compound potentially useful against many common cancers. They published their work in the open-access journal *eLife*.

Specifically, Ridky's team found that activating a prevalent cellular protein called GPER (for G protein-coupled estrogen receptor) inhibited melanoma, and that the compounds that did this also increased the efficacy of an immune therapy called anti-PD-1,

commonly used to treat melanoma and other cancers.

In mouse models of therapy-resistant melanoma, combining the GPER activator with the immunotherapy dramatically extended survival compared to anti-PD-1 alone, completely eliminating tumors in 50 percent of the mice. Immunotherapy alone did not eliminate any tumors.

Inspiration for the research came from clinical observation of dermatology patients, which led Ridky and colleagues to connect pregnancy, birth control pill use, and specific sex hormones to darkening of skin pigmentation in cells known as melanocytes.

"Pregnancy results in changes to hundreds of different circulating factors, but birth control pills have only two ingredients, progesterin and estrogen," Ridky says. "We hypothesized that the same trigger caused hyperpigmentation in both."

They eventually determined that estrogen induces melanoma cells to make more pigment and slows down their ability to proliferate and divide. In addition, GPER mediated the estrogen effects in melanocytes.

'Training' Toughens Up the Immune System

George Hajishengallis of Penn Dental Medicine (left) is the co-lead author of a study that shows how the innate immune system can be trained to "remember" past threats.

Vaccines typically respond to specific threats, like a certain strain of the flu. But what if a more general vaccine existed, which could fortify the immune system against threats of various sorts, from infection to chemotherapy?

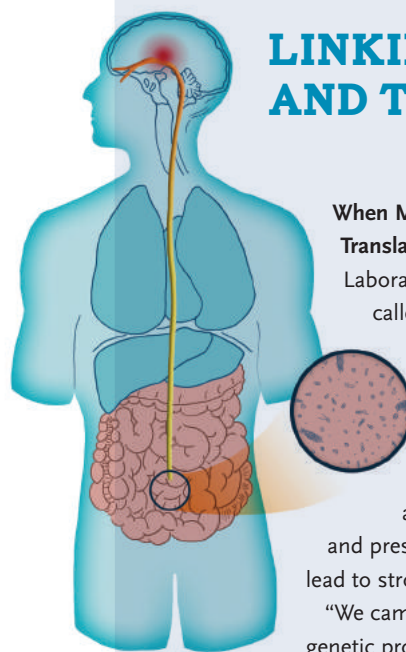
Penn researchers collaborated with an international team to show how the innate immune system, which responds more generally to dangers detected in the body, can be trained to "remember" past threats and respond more robustly to future challenges.

The scientists show that this innate immune training, mediated, for instance, by the molecule β -glucan, takes place at the level of the bone marrow. The findings, published in the journal *Cell*, point to a strategy by which one could prime the immune system prior to entering a situation where the risk of contracting an infection was high, or prior to receiving chemotherapy, to avoid a depletion of the immune system's neutrophils, some of the first cells to travel to points of infection.

"Taking β -glucan prior to chemotherapy would be a very good application," says George Hajishengallis, the Thomas W. Evans Centennial Professor in the School of Dental Medicine's Department of Microbiology and co-lead author of the study. "And in the case of infections, β -glucan would prime your innate immune system so it would be poised to respond much faster and stronger to an infection."

Until relatively recently, the dogma in immunology was that the adaptive immune system possesses a memory, which is why vaccines are effective even years later, while the innate immune system does

LINKING BRAIN DISEASE AND THE GUT MICROBIOME



“We then extended these findings to cancerous melanocytes and as a result, have a new, exciting cancer target and potential new anti-cancer drug,” he says. “In normal physiology, estrogen binds to GPER but also to the traditional nuclear estrogen receptor. Here, we were able to use a small molecule, a lab-made compound, that only binds to GPER.”

This receptor activation drastically slowed the ability of melanoma cells to multiply and made them more visible to the immune system and susceptible to immunotherapy. It’s a new approach to fighting cancer, initiating something instead of blocking it, and it shows great potential.

The team is now working with a Penn Center for Innovation sponsored start-up, Linnaeus Therapeutics Inc., to obtain FDA approval for the first in-human trial with the GPER-activating compound, which was initially developed by a University of New Mexico collaborator. The goal is a human clinical trial within 12 to 18 months of that approval.

not. Yet recent studies have shown that training the innate immune system with stimuli such as β -glucan, a sugar molecule found in fungus, can elicit more robust innate immune responses.

Initial investigations suggested that this effect was mediated by changes to mature myeloid cells—the category of immune cells that encompasses neutrophils, monocytes, macrophages, and others. But because these cells survive only a day or two and the training effect can last months, Hajishengallis and colleagues knew there had to be some other mechanism at work.

Their hypothesis was that the changes had to somehow affect the bone marrow, the site of hematopoietic stem cells, or HSCs, and specifically those that serve as myeloid cell precursors. To test this prediction, they gave mice a single injection of β -glucan and found that within a day, their HSCs expanded.

“But it was not a random expansion,” Hajishengallis says. “There was a bias toward myelopoiesis,” that is, the generation of myeloid precursor cells.

The researchers found that mice challenged with β -glucan produced more myeloid cells and suffered less evidence of DNA damage in their HSCs compared to a control group. β -glucan also had a beneficial impact after chemotherapy, preserving white blood cells and prolonging survival.

In future work, the researchers plan to study innate immune system training in the context of aging and in a variety of disease conditions.

When Mark Kahn’s lab moved into the Smilow Center for Translational Research in 2016, something strange happened:

Laboratory mice that would typically develop a brain disease called cerebral cavernous malformations (CCM) stopped getting sick—first in a few litters, then progressively more and more.

That unforeseen twist led Kahn, a professor of cardiovascular medicine at the Perelman School of Medicine, to rethink some of what he knew about this ailment, which occurs either sporadically or is inherited, and presents as clusters of blood vessels in the brain that can lead to stroke and seizure.

“We came to the conclusion that the change was not likely a genetic problem,” he says, “but more likely reflected an unexpected environmental influence.”

However, his team, spearheaded by M.D./Ph.D. student Alan Tang, still had to determine how factors outside the body might be affecting vascular structures deep in the brain.

The animal model provided another clue. Rarely, a single individual mouse would develop CCM coupled with a large abdominal abscess. “These abscesses were typically composed of gram-negative bacteria, which is what you would expect in the abdomen,” Kahn says. “But that also suggested that gram-negative bacteria might be able to stimulate this disease—which was an interesting idea.”

Subsequent work confirmed that gut bacteria could, in fact, trigger CCM, but only if the bacteria entered the bloodstream, allowing them to travel to the brain. Knowing this, the researchers attempted to block the disease by inactivating TLR4, a receptor that responds to gram-negative bacteria. Removing the receptor, they showed, could prevent CCM altogether.

“Humans don’t typically have bacterial abscesses,” Kahn explains, “so the question then arose, this is a nice detective story, but is it relevant for the human disease?”

The findings were some of the first substantiated links between the gut microbiome and brain disease.

Turns out it is. Working with researchers at the University of California, San Francisco and the University of New Mexico, Kahn and Tang tried to sort out why the brain disease progressed differently in patients who all shared the exact same genetic mutation. After genetic analysis, TLR4 was the only significant pathway identified, the same one the Penn team had previously pinpointed in mice.

This confirmed that gram-negative bacteria were the key stimulus and that the more bacteria that escaped into the blood, the more severe the disease became. The researchers also showed that antibiotic treatments or a sterile environment could prevent the disease completely.

The findings, which they published in *Nature*, were some of the first substantiated links between the gut microbiome and brain disease.

Next steps for this team include better understanding the gut barrier as it relates to CCM and collecting thousands of human microbiome samples of people with the disease to determine what places patients at risk.

Injectable Gel Helps Regenerate Heart Muscle After Attack

When someone has a heart attack, oxygen and blood cannot reach certain regions of the heart. Many of the contracting cells, called cardiomyocytes, die off, which reduces the heart's ability to beat normally. The cardiomyocytes that survive can become much less effective.

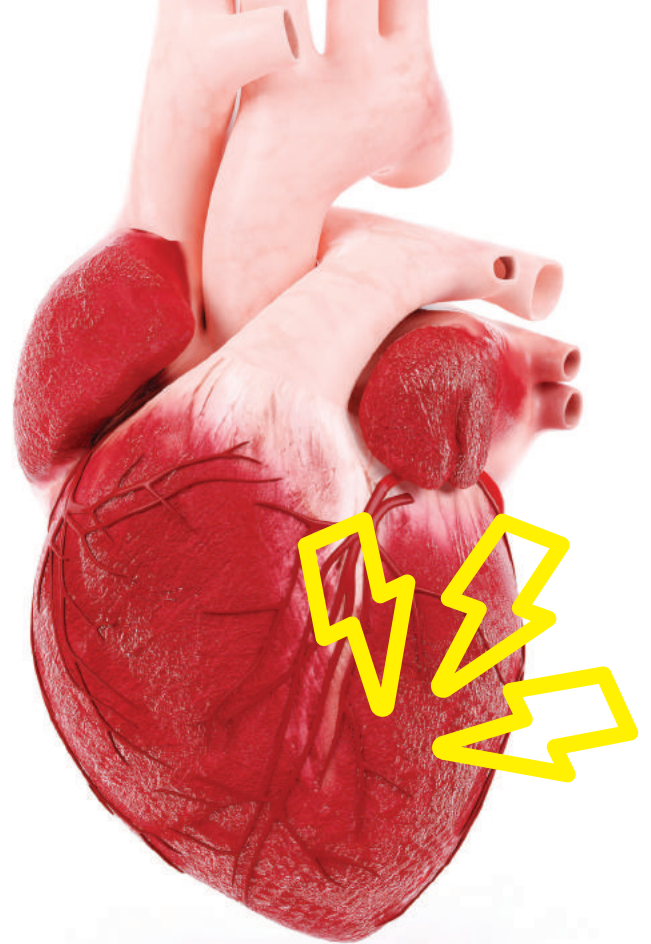
Short gene sequences called microRNAs (miRNA) can help reverse the process by targeting specific pathways that aid in cell regeneration. However, getting the right miRNA dose to the right place is challenging; the heart needs to make new cells and those cells need to replicate, but if cell replication happens elsewhere, it can be damaging.

Jason Burdick of the School of Engineering and Applied Science and Edward Morrisey of the Perelman School of Medicine had an idea for a new approach: an injectable

“In contrast to other tissues, the heart doesn’t have a natural way to regenerate itself, so that’s what we were aiming to do, essentially turning on these cells so they could proliferate.”

gel that could slowly and consistently deliver microRNAs to the heart muscle to produce just the right amount of cardiomyocytes. The results, which they published in *Nature Biomedical Engineering*, show promise for limiting long-term damage following a heart attack.

“In contrast to other tissues, the heart doesn’t have a natural way to regenerate itself,” says Burdick, a professor of bioengineering. “So that’s what we were aiming to do, essentially turning on these cells so they could proliferate.”



First, Burdick and Morrisey needed the right material, so they designed a hydrogel that is shear-thinning, meaning its bonds can be intentionally broken under certain stress—like when pushed out of a syringe—but it also self-heals, meaning once that stressor is gone, the bonds form again and the material goes from liquid back to solid, allowing the hydrogel to stay in one place.

They then tested the gel on three mouse models, one with normal healthy mice, plus two others that experienced an induced heart attack and the intervention. In the first group, cardiomyocyte proliferation biomarkers increased within a few days. Group two, engineered to have individual cardiomyocytes that randomly express one of four fluorescent proteins, showed an expansion of clusters of cells over time, meaning proliferation occurred. Group three recovered better than control mice, pumping more blood with each beat and showing fewer signs of an enlarged heart, a common heart attack byproduct.

“If you use the gel for a while, the cardiac muscle will grow back, but the stimulus eventually needs to go away,” says Morrisey, a professor of medicine and scientific director of the Penn Institute for Regenerative Medicine. “It’s a matter of finding that window to promote the regeneration so the muscle cells grow back, but then removing the stimulus, because continued proliferation of cardiomyocytes could cause heart failure.”

The researchers are now working on pilot studies using larger animals to demonstrate efficacy in a pre-clinical model that better mimics what happens during and after a human heart attack.

ADDRESSING OPIOID MISUSE BEFORE, DURING, AND AFTER SURGERY

Every day, more than 115 people in the U.S. die from opioid overdoses, an epidemic that's tragically risen throughout the years, due in large part to doctors' prescribing practices.

Now, as studies show a decline in prescriptions for opioid painkillers, there are, unsurprisingly, more people in treatment. But what happens when this particularly vulnerable population in recovery needs surgery, and, ultimately, pain relief?

Peggy Compton, the van Ameringen Chair in Psychiatric and Mental Health Nursing at the School of Nursing, touches on this subject in an article in *Pain Medicine* with her colleague Joseph Myers, an anesthesiologist at MedStar Georgetown University Hospital. The duo present an innovative set of interventions—termed the ComfortCare Perioperative Recovery Program—for doctors and their teams to screen for opioid use disorder preoperatively, and create a patient-centered care plan to reduce or eliminate the use of opioids during the surgical experience.

“We have to be sure we aren't re-exposing patients in recovery thoughtlessly to opioids,” says Compton. “We need to be more mindful.”

Compton, who's been studying the overlap between addiction, pain, and opioids for years, insists that there is no need to rely on opioids for pain relief—before, during, or after surgery—as much as we have in the past.

“It's time for new ways of doing things in the perioperative environment, and we argue for unseating opioids as the hammer with which to hit all nails of discomfort,” says Compton, noting other pain-relief options such as bupivacaine liposome injectable suspension, nerve blocks, and IV

Tylenol. “We don't have to run to opioids for everything.”

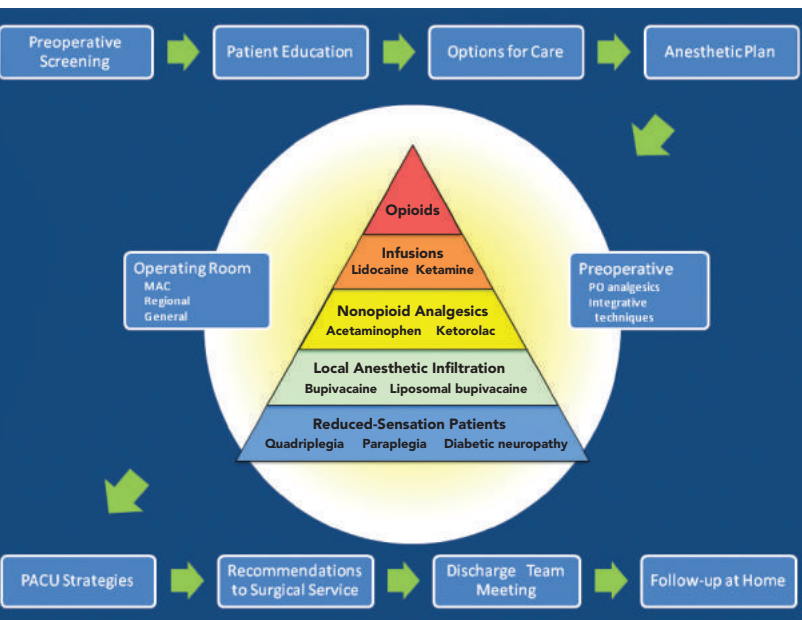
Arguably the most important component to the program, Compton and Myers write, takes place prior to admission, as patients are screened for a history of substance use disorder. For patients who wish to remain abstinent from drug use, the ComfortCare program would be presented in this manner: “We offer ComfortCare to those who have had difficulty stopping the use of opioids

or are currently in recovery from opioid addiction. Would you like more information about the program?”

If a patient shows interest, he or she is given a folder describing the program. It's up to the patient to self-identify, and other than providing the educational brochure, no other action is taken that might stigmatize the patient.

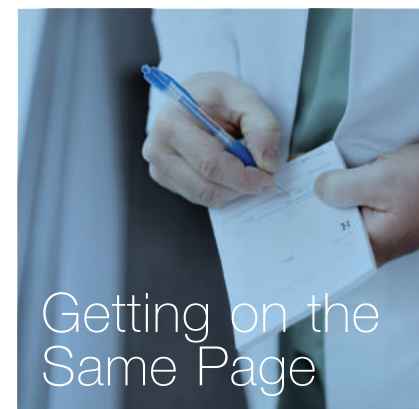
“Effective perioperative pain management is a priority for all patients, including those with a history of substance use disorder,” says Compton. “But relapse must be assessed as a potential opioid-related side effect in these recovering patients, and relapse prevention strategies must be integrated into the care plan.”

Compton and Myers are currently testing their model at Georgetown.



The ComfortCare Perioperative Recovery Program allows doctors and their team to screen for opioid use disorder before surgery.

BRIEF PAIN MANAGEMENT



Getting on the Same Page

For cancer patients, whether they are undergoing treatment or not, persistent and recurrent pain is common. That's why, for many years, prescription opioids have been used to manage the overwhelming discomfort.

In an effort to address the opioid epidemic, clinical guidelines are being published by various agencies, hoping to improve the way these drugs are prescribed, and cut back on the ever-growing number of people misusing them. One issue Salimah Meghani of the School of Nursing and Neha Vapiwala of the Perelman School of Medicine have found, though, is that too often these recommendations are inconsistent with the long-standing and current national cancer pain guidelines—causing confusion among clinicians who care for patients with cancer.

For instance, the Centers for Disease Control and Prevention's new guidelines recommend avoiding prescribing long-acting opioids, especially concurrently with immediate-release opioids. But the National Comprehensive Cancer Network guidelines indicate co-prescription of long- and short-acting opioids, the latter to manage pain flares that are common among cancer patients.

To encourage organizations to collaborate and resolve these inconsistencies, Meghani and Vapiwala bring the matter to light in their *JAMA Oncology* article: “Bridging the Critical Divide in Pain Management Guidelines From the CDC, NCCN, and ASCO for Cancer Survivors.”

NEW HOPE FOR TRIPLE-NEGATIVE BREAST CANCERS

As part of a breast cancer diagnosis, doctors analyze the tumor to determine which therapies might best attack the malignancy. But for patients whose cancer is triple-negative—that is, lacking receptors for estrogen, progesterone, and HER2—the options for treatment dwindle. In the absence of targeted therapies, triple-negative breast cancers, or TNBC, also tend to be more aggressive than other cancer subtypes.

While it is known that defects in mitochondria, the cells' energy generators, are associated with the initiation of breast cancers, it had been unclear whether alterations in mitochondrial DNA or mitochondrial function contribute to TNBC metastasis or to the cancer's notorious resistance to chemotherapy.

New findings from a study led by a Penn team have made inroads into a strategy to identify TNBC tumors at risk for metastasis, and eventually target these cancers with drugs. The work pinpointed patterns associated with aggressive triple-negative breast cancers that open up the possibility for more accurate risk assessment and personalized treatment.

The study appeared in the journal *BBA: Molecular Basis of Disease* and was supported in part by the Breast Cancer Alliance.

"Currently, there is no molecular diagnostic to identify which TNBC patients might be poor responders to available chemotherapies," says lead author Manti Guha, a research assistant professor at the School of Veterinary Medicine. "By identifying unique mitochondrial defects and alterations in metabolic gene expression in the most aggressive subset of tumors, this study provides new molecular biomarkers that could identify the aggressive subset of TNBCs and, more importantly, offer these patients promising options for treatment."

In an earlier report, Guha and colleagues had shown that, by experimentally inducing mitochondrial dysfunction, breast cancer cells can be reprogrammed toward metastasis.

The researchers made use of tissue samples from patients with different breast cancer subtypes, defined cancer lines, and previously collected genomic data representing 825 breast cancer patients. They found that patients who had more advanced disease were more likely to have the lowest number of copies of mitochondrial DNA (mtDNA). They also found clear patterns in mtDNA copy numbers between breast cancer subtypes, with triple-negative cancers having the most reduced copy numbers. Additional screening revealed an imbalance in a particular sequence of mtDNA that was prevalent in triple-negative tumors, but not in other breast tumor subtypes.

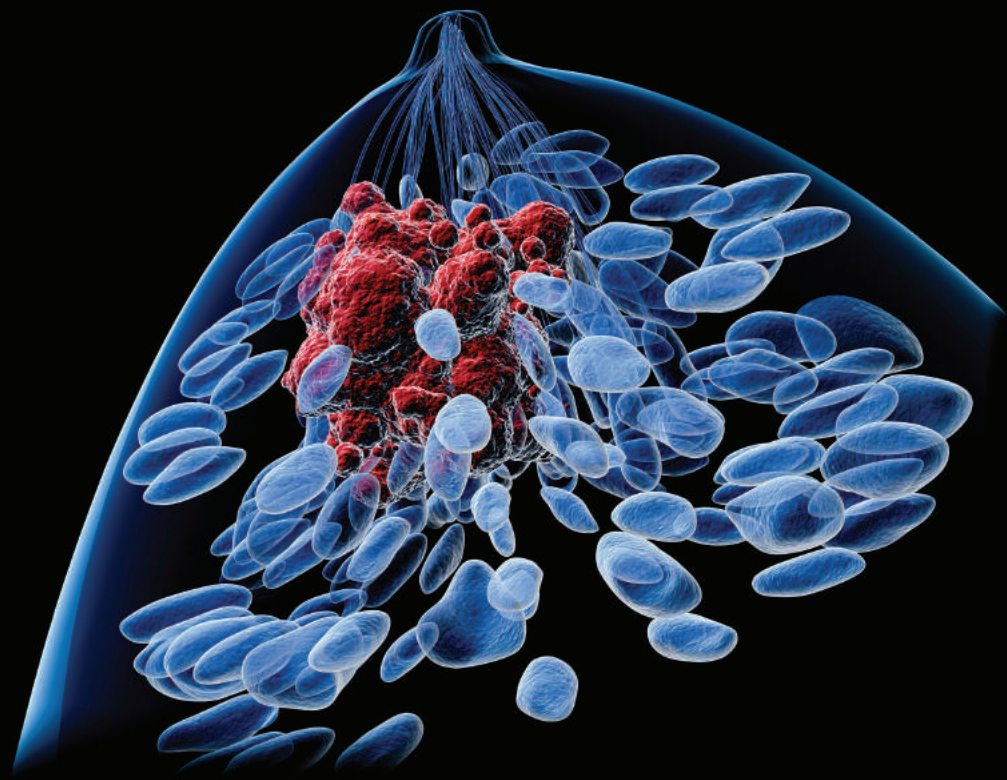
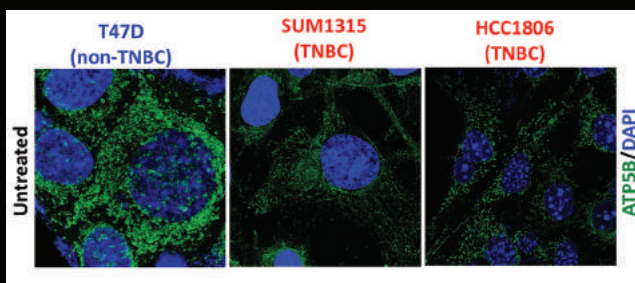
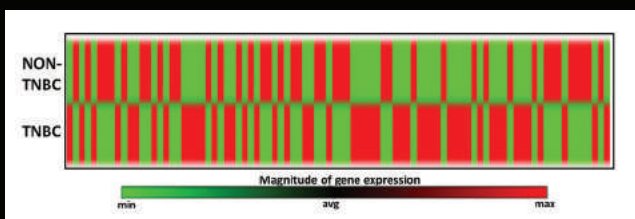
Examining breast cancer cell lines, the researchers also identified differences in oxygen consumption between triple-negative and other cancer subtypes, indicating impaired cellular respiration, a measure of mitochondrial function in those cells.

In a broad screen of 84 genes related to mitochondrial function and cellular metabolism, the researchers found clear patterns that differentiated triple-negative tumors from other breast tumor subtypes. These genes could serve as potential therapeutic targets for intervention, or as biomarkers to identify breast tumors that are more likely to metastasize.

To build on these findings, Guha and colleagues are investigating whether FDA-approved therapies—or those currently in clinical trials—that target metabolic pathways could prove particularly effective against triple-negative breast cancer.

BELOW, TOP: A heat map showing differences in the expression of mitochondrial and metabolism genes between TNBC and non-TNBC tumors.

BELOW, BOTTOM: The research implicated mitochondrial function in the aggressive nature of triple-negative breast cancers. Fluorescent green dye lights up a mitochondrial protein in tumor tissue. Triple-negative cancer samples contain noticeably reduced expression of this protein.





How Binge Eating Affects People Trying to Lose Weight

Binge eating means feeling out of control while consuming an objectively large amount of food. When such episodes occur weekly for at least three months, a person may have binge eating disorder. So how do these episodes affect people with Type 2 diabetes and obesity who are actively working to lose weight?

According to findings published in the journal *Obesity* by Penn researchers, the episodes present a significant obstacle: Those who continue to binge eat while trying to lose weight drop about half as much as those who don't or those who do and subsequently stop.

"Continued binge eating can act as a barrier to success," says Ariana Chao, an assistant professor in the School of Nursing.

Chao studies how addictive-like eating behaviors influence weight management. To better understand the role of binge eating in weight loss, she and colleagues from the Perelman School of Medicine and elsewhere assessed data from a study called Action for Health in Diabetes, or Look AHEAD. This

multi-center randomized controlled trial included more than 5,000 participants ages 45 to 76 with body mass indexes above 25 (or 27 for those using insulin) and Type 2 diabetes.

Look AHEAD's original aim was to compare the effects on cardiovascular morbidity and mortality of two treatments: An intensive lifestyle intervention that included dietary recommendations, physical activity, and behavior modifications; and diabetes support and education that encouraged participants to attend three sessions per year on physical activity, social support, or eating.

In addition, Look AHEAD annually assessed binge eating. Via a questionnaire, participants noted any instances in the past six months during which they consumed excess food and felt a lack of control over that eating.

Chao and her team, which included Thomas Wadden, director emeritus of the University's Center for Weight and Eating Disorders, analyzed the impact of binge eating on weight loss. The researchers found that at four years,

participants in the intensive lifestyle intervention group who reported no or reduced binge eating lost 4.6 percent of initial body weight compared to 1.9 percent for those who continued to binge eat.

"Previously, it was unclear whether people who binge eat need to be treated for that behavior before attempting behavioral weight loss," Chao says. "Our findings suggest that people who continue to binge eat after starting a behavioral weight-loss program do need additional treatments."

Though this study, primarily funded by the National Institutes of Health, looked at a particular population subset, two-thirds of U.S. adults are overweight or obese, so it's important for clinicians to screen for these behaviors, Wadden says.

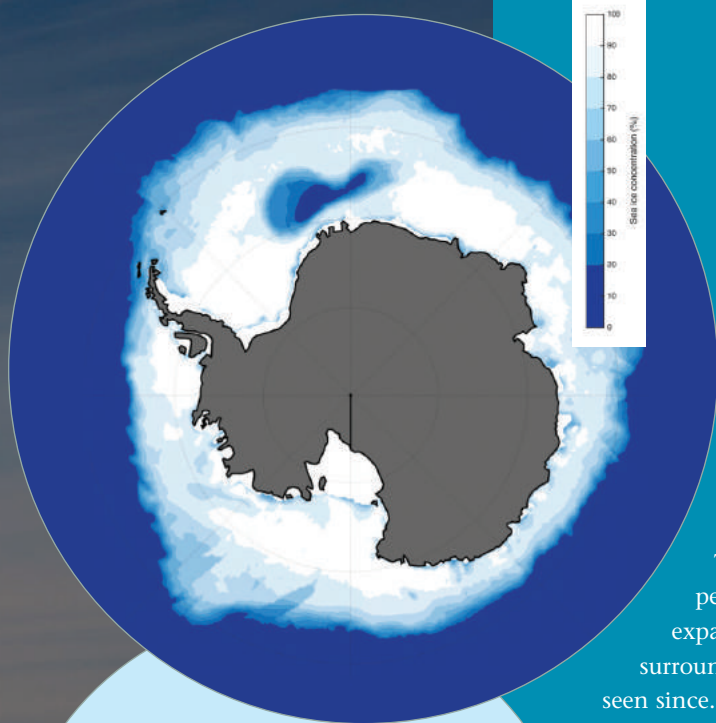
"Individuals with a history of binge eating shouldn't be excluded or discouraged from engaging in behavioral weight loss," he says. "But binge eating should be monitored regularly."



The Climatic Impact of Sea-Ice Openings

CLIMATE SCIENCE

NATURAL SCIENCE



In 1974, satellites captured a puzzling phenomenon: A 250,000-square-kilometer opening in the winter sea ice in the Weddell Sea, south of South America.

The opening, known as a polynya, persisted over three winters. Such expansive ice-free areas in the ocean surrounding Antarctica have not been seen since. However, in a fascinating twist, in September and October 2017, a smaller polynya, on the order of 80,000 square kilometers, was observed.

In a new analysis of climate models, published in the *Journal of Climate*, researchers found that such polynyas can occur as a result of climate oscillations, with important global effects. Heat escaping from the ocean through these openings in the ice influences sea and atmospheric temperatures, wind patterns, and even rainfall in the tropics.

Though part of a natural pattern of climate variability, the ripple effects of polynyas have implications for how the Earth's climate will respond to future anthropogenic warming. "This small, isolated opening in the sea ice in the Southern Ocean can have significant, large-scale climate implications," says Irina Marinov, an assistant professor in Penn's Department of Earth and Environmental Science in the School of Arts and Sciences.

Supported by the National Science Foundation, Marinov co-authored the work with Anna Cabre, a former postdoc in Marinov's lab and now an oceanographer with the Institute of Marine Sciences in Barcelona, and Anand Gnanadesikan, a professor at Johns Hopkins University.

Typically, the Southern Ocean is covered in ice during the Southern Hemisphere's winter. Polynyas occur when warm subsurface waters of

North Atlantic and equatorial origin mix locally with cold surface waters, a process known as open-ocean convection.

Marinov and colleagues used powerful models that simulate past and future climate to project the effects of polynyas.

In their model, polynyas and accompanying open-ocean convection occur roughly every 75 years. When they arise, the researchers observed, they act as a release valve for the ocean's heat. Not only does the immediate area warm, but so does the overall sea-surface and atmospheric temperatures of the entire Southern Hemisphere and, to a lesser extent, the Northern Hemisphere, as well.

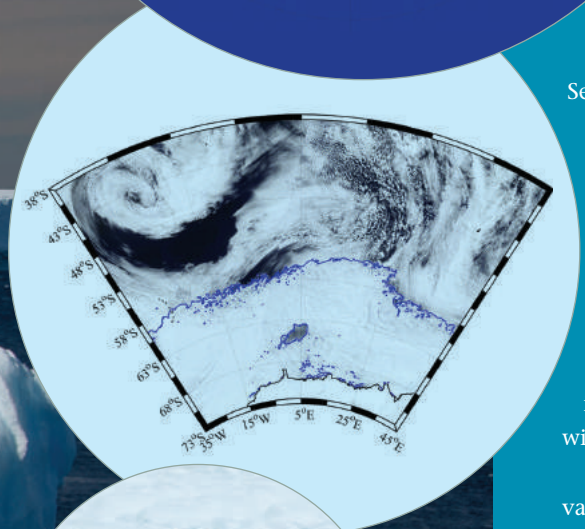
Variations in north-south temperature gradients lead to other changes, for example, a shift in the Intertropical Convergence Zone, the equatorial belt where trade winds converge, resulting in the most intense precipitation on the planet. When a polynya occurs, this rain belt moves south a few degrees and stays there for 20 to 30 years before shifting back.

"This affects water resources in, for example, Indonesia, South America, and sub-Saharan Africa," says Marinov.

The work raises many new questions, such as the implications of observed climate warming and enhanced precipitation on polynyas' decreasing frequency in the real world.

"This investigation into polynyas and Southern Ocean convection turned out to be a very important and interesting story for the global climate," says Marinov, "that we think a lot of people will be studying in the next decade."

With the help of a Penn University Research Foundation grant and new NSF funding, Marinov and her group are now looking at the response of global ocean currents and the North Atlantic to Antarctic polynyas.



TOP TO BOTTOM:

Data on sea ice concentration averaged over three September months, from 1974 to 1976, shows the vast open water of the Weddell polynya.

A satellite image of the Weddell Sea from Sept. 25, 2017, shows a smaller polynya that persisted through October.

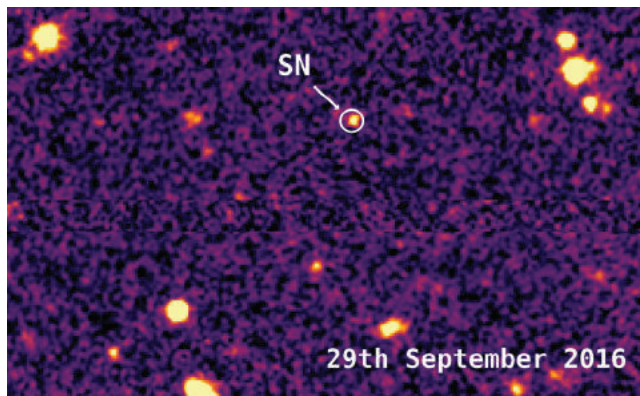
Irina Marinov, a climate researcher in the Department of Earth and Environmental Science, stands on Weddell Sea ice in Antarctica.

Long, Long Ago From a Blast Far, Far Away

ASTRONOMY

NATURAL SCIENCE

When a star explodes at the end of its life cycle, a supernova forms.



An international team of astronomers, including researchers from Penn, confirmed the discovery of the most distant supernova ever detected. This huge cosmic explosion took place 10.5 billion years ago when the universe was only a quarter of its current age.

The exploding star, named DES16C2nm, was detected by the Dark Energy Survey (DES), an international collaboration to map several hundred million galaxies and thousands of supernova explosions in order to learn more about dark energy, the mysterious force believed to accelerate the universe's expansion.

As detailed in a study published in *The Astrophysical Journal*, light from the event has taken 10.5 billion years to reach Earth, making it the oldest supernova ever discovered and studied. The universe itself is thought to be 13.8 billion years old.

Chris D'Andrea, a postdoctoral fellow, and Masao Sako, an associate professor in the Department of Physics & Astronomy in

the School of Arts and Sciences, collaborated on the work with Mathew Smith of the University of Southampton. Researchers at the University of Portsmouth also contributed to the work, which was supported in part by funding from the U.S. Department of Energy and the National Science Foundation.

A supernova is the explosion of a massive star at the end of its life cycle. DES16C2nm is classified as a super luminous supernova, the brightest and rarest class of exploding stars, first discovered a decade ago. They are thought to be caused by material falling onto the densest object in the universe, a rapidly rotating neutron star newly formed in the explosion of a massive star. This violent explosion, Sako says, is brighter than even the brightest galaxies.

According to Smith, the ultraviolet light from these supernovae "informs us of the amount of metal produced in the explosion and the temperature of the explosion itself, both of which are key to understanding what causes and drives these cosmic explosions."

D'Andrea and other researchers will continue to hunt for these rare supernovae in the future with more powerful surveys, such as the Large Synoptic Survey Telescope and the Wide-Field Infrared Space Telescope.

HELICOPTER MOMS RAISE LESS SUCCESSFUL GUIDE DOGS



NATURAL SCIENCE / PSYCHOLOGY

A multi-disciplinary team has revealed the perils of being a helicopter parent—for dogs.

According to their research, doting mothers seem to handicap their puppies, reducing their chances of successfully completing a training program to become guide dogs.

“It’s remarkable,” says Emily Bray, who led the work and earned her Ph.D. from Penn, working with a trio of faculty members, including the late biology professor Dorothy Cheney and

psychology professor Robert Seyfarth from the School of Arts and Sciences, and veterinary behavior and welfare expert James Serpell from the School of Veterinary Medicine. “These puppies were with their mom for only five weeks and it’s having an effect on their success two years later. It seems that puppies need to learn how to deal with small challenges at this early age and, if they don’t, it hurts them later.”

The study was done at The Seeing Eye, an organization in Morristown, N.J., that breeds, raises, and trains dogs to



guide blind people. The work, which was published in *Proceedings of the National Academy of Sciences*, was supported by the National Science Foundation.

To gather information about the puppies’ early-life experiences, Bray and a team of undergraduate research assistants logged long hours at The Seeing Eye’s breeding facility, taking video and closely observing 23 mothers and their 98 puppies for their first five weeks of life.

“We wanted to know if we could differentiate the moms based on how they interacted with their puppies,” Bray says.

Analyzing these interactions, the researchers saw that some mothers stood out as being particularly attentive and others less so. Checking back in with the puppies a couple of years later, the researchers found that those with mothers that were more attentive were less likely to graduate from The Seeing Eye’s training program to become guide dogs. In particular, those dogs whose mothers nursed more often lying down, as opposed to sitting or standing up, were less likely to succeed.

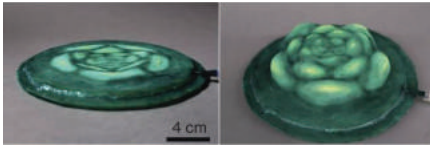
“If a mother is lying on her stomach, the puppies basically have free access to milk, but if the mother is standing up, then the puppies have to work to get it,” Seyfarth says. “A hypothesis might be that you have to provide your offspring with minor obstacles that they can overcome for them to succeed later in life because, as we know, life as an adult involves obstacles.”

The work underscores the connection between maternal behavior and the behavior of offspring later in life, but further research is needed to determine exactly why the attentive mothers were more likely to have puppies that were released from the program.

“It’s hard to know whether the puppies are less able to deal with problems down the line because of the way that they’ve been coddled, or if they’ve somehow picked up on their mother’s anxiety,” says Serpell, “or if they’ve inherited some genetic component that’s affecting their behavior.”

In particular, those dogs whose mothers nursed more often lying down, as opposed to sitting or standing up, were less likely to succeed.

OCTOPUS CAMOUFLAGE INSPIRES ROBOTS



ABOVE: Researchers are attempting to mimic bumps on cephalopods' skin called papillae, which can change shape thanks to underlying muscles.

BELOW: Drawing inspiration from the octopus and other cephalopods, Penn researchers have developed a new technology that can transform a 2-D surface into a 3-D shape.

In a blink of an eye, an octopus can transform from a colorful creature to a drab pile of rocks and plant life.

This camouflage relies on specialized pigment organs, but what makes the octopus unique among animals is its ability to change the texture of its skin, which further enhances camouflage. Previously flat stretches can bulge out in patterns that complete the illusion.

James Pikul, an assistant professor of mechanical engineering and applied mechanics in the School of Engineering and Applied

Science, is taking inspiration from these and other cephalopods to develop a deeper understanding of the physics that allow 2-D surfaces to transform into 3-D shapes.

In a paper published in *Science*, Pikul and co-authors outlined a method for achieving this transformation that they have dubbed CCOARSE, or Circumferentially Constrained and Radially Stretched Elastomer.

Consisting of a stretchy silicone layer imbued with an inflexible fiber mesh in precise locations, the material can be inflated like a balloon into a predetermined 3-D shape.

Pikul helped develop CCOARSE with colleagues at Cornell University, where he conducted work as a postdoctoral researcher under Itai Cohen, a professor of physics, and Rob Shepherd, an assistant professor in the Sibley School of Mechanical and Aerospace Engineering. The three are now patenting the technology.

Their inspiration came from cephalopods' papillae, bumps that extend from the skin as the result of erector muscles below. With funding from the Army Research Office, the researchers developed CCOARSE to act as synthetic tissue groupings that mimic the papillae's shape-changing behavior, producing bumps and bulges in varying shapes and sizes. A simple algorithm determines where fibers must be placed in the silicone sheet to achieve the desired final form.

Given the complexity of cephalopods' camouflage system, Pikul envisions even finer-grained control over CCOARSE's ultimate shape as being possible.

"Cephalopods have different subsets of papillae and activate them in different combinations depending on what surface texture they want to mimic," Pikul says. "We could

begin thinking about CCOARSE like pixels on a display. Each individual shape change would be relatively simple, but combined, you could achieve complex results."

Eventual applications could include disappearing computer displays, virtual reality interfaces that give users touch feedback, and medical devices such as balloon catheters that take complex shapes when inflated.

"We're even thinking about more fun ways to use this technology," Pikul says, "like in architecture and fashion."



A smartphone's glass screen is made of atoms jammed together with no discernible order, which is why dropping one often results in it shattering. Unlike metals and other crystalline materials, glass and many other disordered solids cannot withstand significant deformation before failing and breaking, and, because of their lack of crystalline order, it is difficult to predict which atoms might change during failure.

To find a link between seemingly disparate disordered materials, an interdisciplinary team of Penn researchers from the School of Arts and Sciences and the School of Engineering and Applied Science studied various disordered solids. Understanding materials failure on a fundamental level could pave the way for designing more shatter-resistant glasses or even predicting geological phenomena like landslides.

"To understand how a system chooses its rearrangement scenario, we must make connections with the underlying microscopic structure," says Douglas Durian, a professor of physics and astronomy. "For crystals, it's easy; rearrangements are at topological defects such as dislocations. For disordered solids, it's a very hard 40-year-old problem that we're now cracking. What and where are structural defects in something that's disordered?"

The researchers employed a technique developed by Andrea Liu, the Hepburn Professor of Physics, and



Making Shatter-Resistant Glass

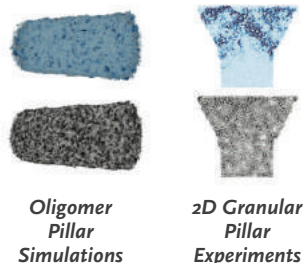
other collaborators from Penn, as well as Harvard University. Using machine learning, they collected hundreds of quantities that characterize the arrangements of particles in each system, quantities that individually might not be expected to reveal much. Importantly, they found the combination of these quantities that correlates strongly with the dynamics.

In a paper published in *Science*, the Penn researchers revealed commonalities among these materials and systems, defining a counterpart to the “defects” implicated in crystalline materials failure. This so-called “softness” predicts the location of defects, which are the collection of particles most likely to change when the material fails.

The systems the researchers studied were rearranging due to random thermal fluctuations or to different kinds of applied stress such as squeezing or stretching. If the researchers can understand why various systems behave differently beyond the point of yield, they may be able to control softness and how it evolves under stress. This could lead to tougher coatings and materials, such as more durable glass screens for phones.

The paper is the culmination of years of research funded by the National Science Foundation and conducted at Penn’s Materials Research Science & Engineering Center, hosted by the Laboratory for Research on the Structure of Matter.

Penn researchers have discovered how to predict defects in glass and other disordered materials, which could pave the way for shatter-resistant phone screens, and even landslide prevention.



LRSM Awarded \$22.6M National Science Foundation Grant

Penn’s Laboratory for Research on the Structure of Matter (LRSM) was awarded a six-year, \$22.6 million center grant from the National Science Foundation (NSF) to support the lab’s work on cutting-edge materials. The lab’s new activities will engage faculty from nine departments and across three schools at Penn.

The LRSM, founded in 1961, was among the nation’s first three academic institutes for interdisciplinary materials research. It has hosted an NSF Materials Research Science and Engineering Center (MRSEC) since 1996. The latest LRSM MRSEC, the largest of only eight awarded nationwide, provides crucial support for the lab’s education and outreach missions, its shared experimental facilities, as well as its research aims in new areas.

“LRSM research projects identify and innovatively tackle big problems at the frontier of materials science,” says Arjun Yodh, the James M. Skinner Professor of Science in the Department of Physics & Astronomy and director of the LRSM. “These problems are generally multi-faceted and are too difficult for individuals or small teams to solve.”

Thanks to the grant, Yodh says, three interdisciplinary projects are underway. One group will develop strategies to enhance toughness in glassy materials. A second group will learn to harness the structural, chemical, and mechanical complexity inherent in fibrous networks, and a third group will make assemblies of nanocrystals on hard (fabricated) and in soft (reconfigurable) materials to impart novel optical and magnetic response.

To Motivate Lasting Behavior Change, Sometimes



HEALTH / BEHAVIORAL SCIENCE

When Penn professors Katherine Milkman and Angela Duckworth embarked on the “Behavior Change for Good” initiative (BCFG) in the fall of 2017, their goal was to understand how to make behavior change stick across multiple domains, using both proven and new strategies grounded in psychology and behavioral economics.

The researchers are seeing promising early results from one of their first major efforts, a 28-day digital program conducted in partnership with national gym chain 24 Hour Fitness to help build lasting gym habits. Designed by 47 leading behavioral scientists from a range of specialties and institutions, including Penn, “StepUp” houses 20 interventions as part of a massive experiment aimed at identifying what works best for enduringly changing behavior.

“With just partial returns—and of course, all of this could change—but as of now, we’re seeing that roughly two-thirds of the interventions we’re trying are improving behavior in a significant way,” says Milkman, a professor in the Department of Operations, Information, and Decisions at the Wharton School. “Only 5 percent would be working if those positive results were noise. When it’s a fraction like two-thirds, you feel pretty good.”

Behavior Change for Good is one of a growing number of programs across Penn turning to behavioral economics and technology to design more effective interventions. The three-year-old Penn Medicine Nudge Unit, the first of its kind in the world embedded within a health system, develops and tests approaches to steer medical decision-making based around the patient’s long-term wishes. It launched with support from the decade-old Center for Health Incentives & Behavioral Economics (CHIBE), which conducts public-health research with behaviorally informed solutions on subjects from medication adherence to smoking cessation.

In a CHIBE-backed study published in the *New England Journal of Medicine*, for example, Scott Halpern, an associate professor of medicine, epidemiology, and medical ethics and health at the

Perelman School of Medicine, found that free tools aimed at helping people quit smoking worked three times better when coupled with a monetary reward than when offered alone.

More than 6,000 participants were randomly assigned to one of four intervention groups or the control, which provided resources and regular text messages. Interventions included free e-cigarettes, free cessation tools like a nicotine patch or gum, those aids plus a no-strings-attached \$600 reward for not smoking, or the tools and the money, but the \$600 sat in an account, depleting each time the participant missed a milestone. Quit rates for the two groups with financial incentives remained the highest six months out.

“It costs employers anywhere from \$3,000 to \$6,000 more per year to employ a smoker over a non-smoker,” says Kevin Volpp, the senior author on that paper and director of CHIBE. “One of the key virtues of incentive programs is that they only cost money if people succeed in changing their behavior.”

Another Penn study, led by Nudge Unit Director Mitesh Patel, used a gamification platform to get participants to up their physical activity. Families enrolled together, and during a 12-week period, each participant was given points that could be lost if they didn’t meet daily step goals counted by a fitness tracker. Every day, one family member was randomly selected as the group’s representative; if that person failed to take enough steps, everyone in the family received a notification that they lost points.

Family members in the intervention ended up walking, on average, an extra mile each day and meeting their fitness goals 27 percent more than families in the control setup, according to Patel, an

All It Takes Is a Nudge

assistant professor of medicine and health care management at Penn Medicine. What's more, after six months, much of the effect had endured.

Step counters are by no means the only technological tools available to researchers and clinicians. Patel names a few additional items, such as electronic scales that regularly sync to personal devices; other wearables; and pill and water bottles linked to personal health care data. He also mentions one that, above all, likely makes such techniques scalable.

"Seventy percent of adults have a smartphone and go everywhere with it. We're already carrying the technology," he says. "We can leverage that by better understanding the predictable irrationality of people, like the fact that they tend to think about the immediate-term instead of the long-term, the reward of eating something today as opposed to preventing a heart attack down the line."

The same is true of financial incentives, which offer immediate payoff. Psychology has also shown that people are more motivated by the threat of loss than they are by potential gains, that they excel with reinforcement that's variable rather than constant, and that their social networks inform and influence them.

"We're leveraging the psychology of how humans behave—in their favor," Patel says.

Researchers have only just scratched the surface in a field that's growing all the time. In 2016, when Penn's Nudge Unit began, it was the only one of its kind; in September 2018, Patel's group hosted a symposium for 20 health systems interested in forming their own nudge units. And as preliminary results from the Behavior Change for Good initiative show, the potential for this science is enormous.

"There are billions of people in the world, pretty much all of whom have challenges related to unachieved goals. Many factors get in our way, but behavior is a struggle for everyone," Milkman says. "We're basically crowdsourcing the challenge of behavior change. We think the way you solve this big problem is to get the best minds in the world working on it in collaboration."





GENETICS

SOCIAL SCIENCE

The Varying Skin Colors of Africa

An international team led by geneticists Sarah Tishkoff and Nicholas Crawford has identified new genetic variants associated with skin pigmentation. While most skin color genes have been discovered through studies of European populations, the new study, published in *Science*, incorporated samples from diverse African groups.

The findings help explain the vast range of skin color on the African continent, shed light on human evolution, and elucidate the genetic risk factors for conditions such as skin cancer.

“We have identified new genetic variants that contribute to the genetic basis of one of the most strikingly

variable traits in modern humans,” says Tishkoff, a Penn Integrates Knowledge Professor and the David and Lyn Silfen University Professor in Genetics and Biology, with

appointments in the Perelman School of Medicine and School of Arts and Sciences. “When people think of skin color in Africa, most would think of darker skin, but we show that within Africa there is a huge amount of varia-

tion, ranging from skin as light as some Asians to the darkest skin on a global level and everything in between.”

The study was conducted with support primarily from the National Institutes of Health and the National Science Foundation.

Tishkoff and colleagues measured the light reflectance of the skin—a stand-in for melanin content—of more than 2,000 Africans from ethnically and genetically diverse populations. They found the darkest skin in Nilo-Saharan pastoralist populations in eastern Africa, and the lightest skin in San hunter-gatherer populations in southern Africa.

Using genetic information from nearly 1,600 people, the researchers found four key areas of the genome where variation closely correlated with skin color differences.

The region with the strongest associations was in and around the *SLC24A5* gene, one variant of which is known to play a role in light skin color in European and some southern Asian populations. This variant was common in populations in Ethiopia and Tanzania that were known to have ancestry from Southeast Asia and the Middle East, suggesting it was carried into Africa from those regions.

Another region, which contains the *MFS12* gene, had the second-strongest association to skin pigmentation.

The work underscores the diversity of African populations and the lack of support for biological notions of race.



This gene is expressed at low levels in depigmented skin in individuals with vitiligo, a condition where the skin loses pigment in some areas.

“I still remember the ‘aha! moment’ when we saw this gene was associated with vitiligo,” says Crawford, a postdoctoral researcher. “That’s when we knew we’d found something new and exciting.”

Additional associations with skin color were found in the *OCA2* and *HERC2* genes, which have been linked with skin, eye, and hair color variation in Europeans, though the mutations identified are novel. Another region included genes that play a role in ultraviolet light response and melanoma risk.

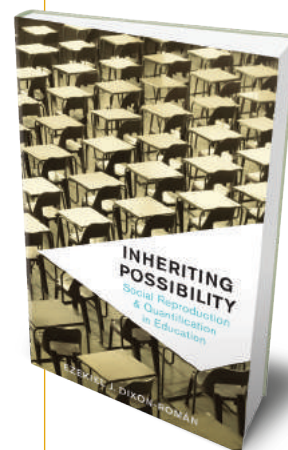
“Africans don’t get melanoma very often,” Tishkoff says. “The variants near these genes are highest in populations who live in areas of the highest ultraviolet light intensity, so it makes sense that they may be playing a role in UV protection.”

Tishkoff notes that the work underscores the diversity of African populations and the lack of support for biological notions of race.

“We show that skin color is extremely variable on the African continent and that it is still evolving,” Tishkoff says. “There’s no such thing as an African race.”

Researchers measured the light reflectance of the skin of more than 2,000 Africans from diverse populations to identify the genetic underpinnings of some of the continent’s great diversity.

BRIEF SOCIAL POLICY



Rethinking the Philosophy of Science

In “Inheriting Possibility,” Ezekiel Dixon-Román, an associate professor at the School of Social Policy & Practice, interrogates the philosophy of science’s age-old assumed division between nature and culture. He argues nature has always engaged in cultural processes, questioning how social science has come to know and construct knowledge about the world. This premise, he argues, has profound implications on theories of how power and inequality are reproduced, as well as how we have produced knowledge about the world via quantification. Through this book, he offers a cultural theoretical rethinking of both social reproduction and quantification in education. Using multiple forms of data, Dixon-Román provides examples with SAT scores and parenting practices, illuminating the multigenerational, sociocultural, and socio-historical forces forming and shaping both.

His goal? Rethink August Comte’s long-running positivist philosophy and the scientific method in a way that emphasizes a relational, dynamic, and entangled world that is always in process.

The contribution to the philosophy of science aims to prompt new discussion about quantification in social science in an age of information in which data is ubiquitous, and to marry the objective with the subjective.

TO STOP COLLECTIVE BLAME OF MUSLIMS, CALL OUT CHRISTIAN TERRORISTS

People collectively blame all Muslims for a crime committed by one; the same doesn't happen with a white male like Charleston shooter Dylann Roof.

SOCIAL SCIENCE / COMMUNICATION

The month after an ISIS-claimed terrorist attack in Paris, hate crimes against Muslims in the United States more than tripled, from 13 to 45. Following the October 2017 Las Vegas shooting by a white male, the same focused anger toward white men never materialized.

Emile Bruneau, director of the Peace and Conflict Neuroscience Lab at the Annenberg School for Communication, wanted to understand why such collective blame—holding a group responsible for an individual's actions—applies to some populations but not others.

“Should we close the mosque where a terrorist prays? Legally and traditionally, we reject this,” Bruneau says. “You can't hold the mosque responsible, just like you can't hold a town responsible if someone there is a white supremacist who commits murder.”

“She notes that blaming all Muslims for the attacks in Paris is like blaming all Christians for the Westboro Baptist Church or the KKK,” Bruneau says. Directly calling out the double standard, he adds, probably made people realize their hypocrisy.

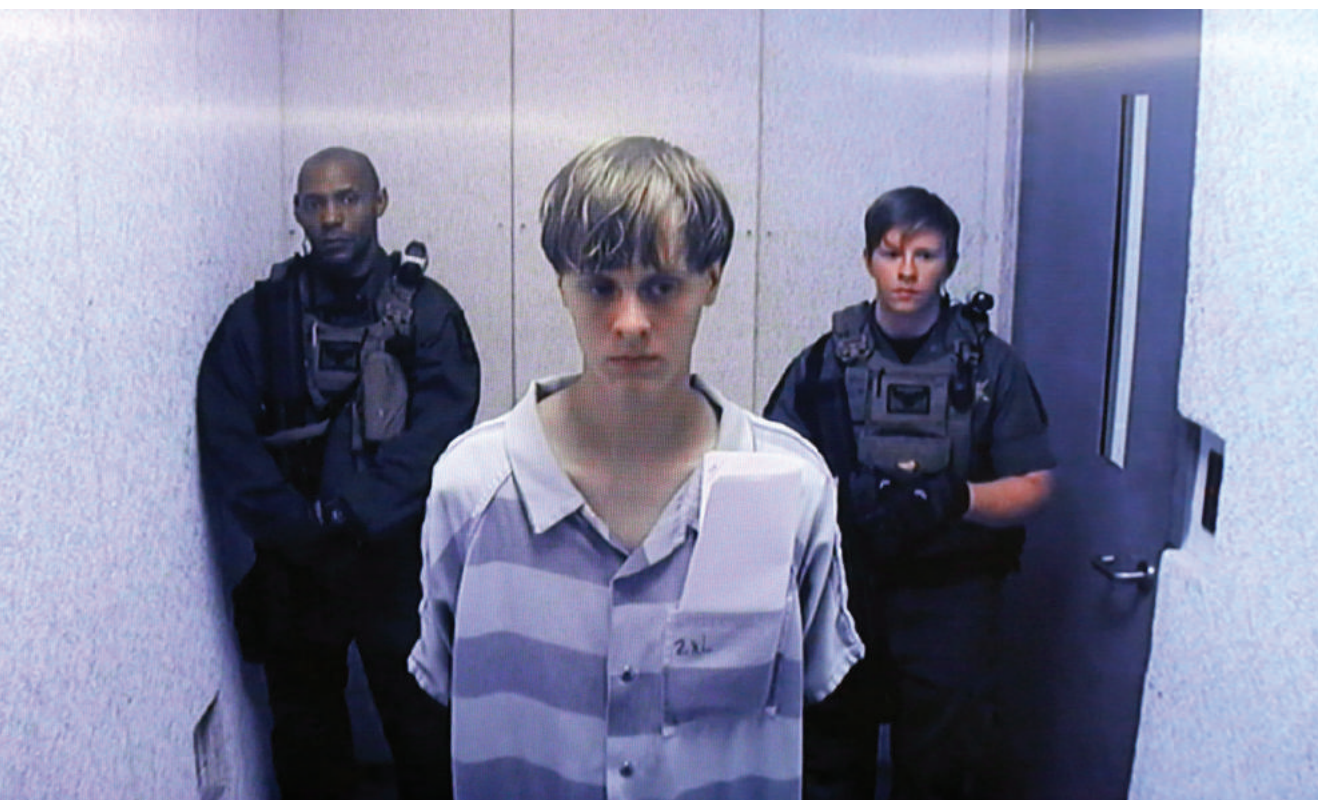
Next, Bruneau and colleagues randomly assigned 1,000 individuals to watch one of the same eight videos, this time to forecast which might best prevent viewers from blaming all Muslims for an act committed by one. Overall participants failed at the task, predicting that the one that actually had the most influence would have no influence at all.

Finally, half of 600 additional participants read short biographies of white male terrorists like Charleston shooter Dylann Roof, then reported how personally responsible they felt for the terrorist's actions. The last iteration presented a Muslim terrorist, then asked participants how responsible all Muslims were for this individual's actions. (The other half completed only the final exercise.)

The difference between those who had completed the exercise and those who hadn't was stark: On a scale of 0 to 100, with 100 being “completely responsible,” people in the latter group placed Muslim blame between 35 and 40. For those in the former, that number dropped to 10.

Bruneau thinks this is because humans don't like feeling hypocritical.

“If you put hypocrisy in someone's face, if you use it as a weapon rather than a tool, you'll probably get a reaction,” he says. “But if you can gently point to it, they're more likely to change.”



Looking specifically at collective blame toward Muslims, Bruneau and colleagues built a three-step experiment.

In the first step, 2,000 participants watched one of eight videos depicting Muslims. A short documentary, for example, highlighted the relationship between a Muslim cleric and his wife. The idea was to determine which video would most effectively reduce collective culpability, and the winner was a Muslim woman speaking on Al Jazeera.

A New Metric for Bike Lane Safety

Longtime cyclist Megan Ryerson is studying cyclists in real environments to measure bike lane safety.

Megan Ryerson, an assistant professor of city and regional planning and electrical and systems engineering, is tapping into a new way to measure bike lane safety—not by collecting data in a lab, but by studying real cyclists, in real environments.

Motivated by years of biking Philadelphia's congested streets, Ryerson, alongside an interdisciplinary group of design and engineering students, launched a pilot study in October 2017 that applied high-tech glasses to measure the experiences of student cyclists traversing one of the city's protected bike lanes. The pilot used camera-enabled devices to document participants' visual fixations, pupil dilation, head movement, and gaze velocity.

"Cyclists—and I'm a cyclist—know protected bike lanes feel safer, but we lack ways to measure this safety," muses Ryerson. "The only safety metric we as planners have is crashes. Imagine being able to analyze intersections or roadways, for example, by how much stress and uncertainty they create for cyclists and to correlate that with crashes. This type of data allows a much more nuanced approach to understanding our urban infrastructure."

Ryerson and her students are currently defining, coding, and estimating a wide array of brand-new safety metrics enabled by her research approach. Ryerson has been focused on cyclist workload, and found that cyclists on urban roads without protected bike lanes often did a ground check—scanning for potholes and trash—or looked quickly over their right or left

shoulder at, for example, a close passing vehicle, called a "shoulder check." High workload could cause a cyclist to miss seeing a street sign or not notice a vehicle quickly changing lanes. That documented mismatch between experience and design has implications for future urban planning and engineering.

Since the pilot, Ryerson has received grants through the Penn Medicine Strategic Plan 2.0 as well as through her involvement with Penn's Transportation Research Center, Mobility21, to improve the quality of the eye-tracking glasses and continue the pilot studies with more students and study more sites around Philadelphia. Ryerson is doing this all while consulting with Philadelphia's Vision Zero Task Force—an initiative to eliminate all traffic-related deaths by 2030. The idea: make intersections safer and, thus, transform neighborhoods into environments that are safer and more comfortable to encourage healthier habits.

Transportation infrastructure is, by design, a public health intervention.

"Reducing the number of crashes is a critical public health goal. And designing infrastructure that will lead to fewer crashes will encourage

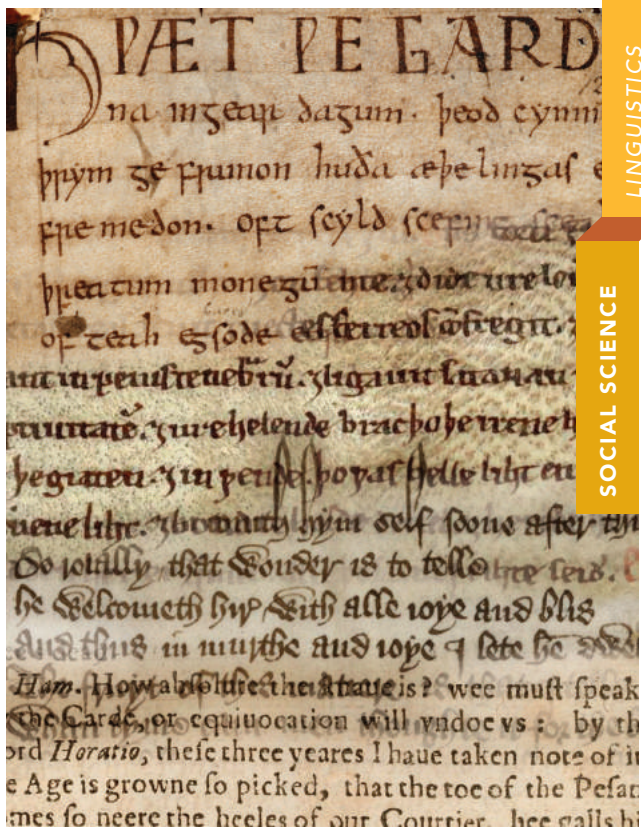
"Cyclists—and I'm a cyclist—know protected bike lanes feel safer, but we lack ways to measure this safety."

more people to walk and bike, and promote healthier and more active lifestyles for people of all ages," Ryerson says. "That can have significant health impacts, improve quality of life, and provide people expanded access to opportunities."

BELOW, TOP: The intersection of S. 43rd and Chestnut streets pre- and post-installation of a protected bike lane.

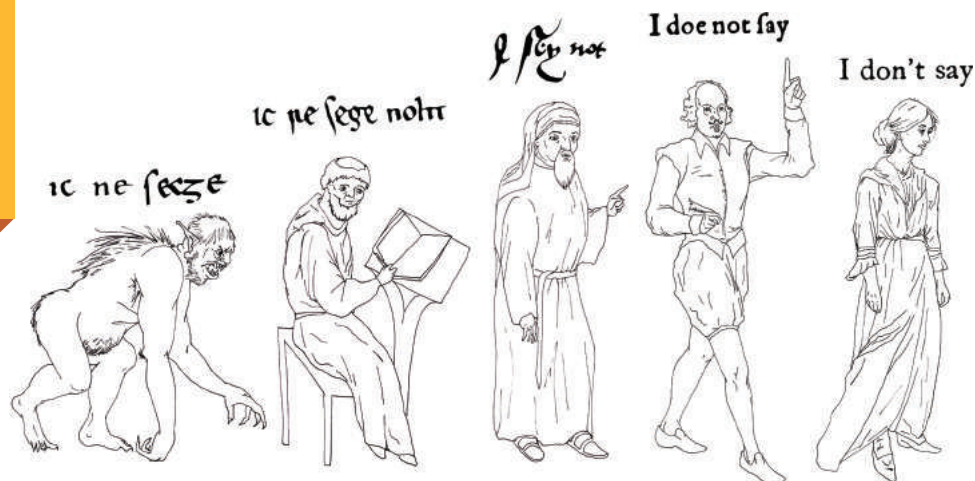
BELOW, BOTTOM: A wayfinding sign installed at Chestnut and 33rd streets. The study preliminarily determined that many cyclists, while riding, tend to look down and not up, indicating signs like this one may go unnoticed.





LINGUISTICS

SOCIAL SCIENCE



Luck Plays a Role In How Language Evolves

Read a few lines of Chaucer or Shakespeare and you'll get a sense of how the English language has changed during the past millennium. At Penn,

linguists and evolutionary biologists joined forces to determine whether such linguistic changes occur by random chance or by a selective force. Their findings were published in *Nature*.

"Linguists usually assume that when a change occurs in a language, there must have been a directional force that caused it," says Joshua Plotkin, a professor of biology and senior author on the paper. "Whereas we propose that languages can also change through random chance alone."

According to Robin Clark, a co-author and professor of linguistics in the School of Arts and Sciences, Leonard Bloomfield, one of the great early American linguists, once said that you can never see a language change, that the

change is invisible. "But now, because of the availability of these large corpora of texts, we can actually see it, in microscopic detail, and begin to understand the details of how change happened," Clark says.

The researchers chose three well-characterized English language changes to evaluate for signs of selection, using substantial collections of annotated texts dating from the 12th to the 21st centuries. One change is the regularization of past-tense verbs. Using a corpus of more than 100,000 texts ranging from 1810 to 2009 that have been parsed and digitized, the team searched for verbs where both regular and irregular past-tense forms were present, for example, "dived" and "dove" or "wed" and "wedded," finding 36 examples. For six of these verbs, the team found evidence of selection. In four of these cases, selection favored the irregular past tense form.

A swimmer 200 years ago might have "dived," for example; today we would say they "dove." The shift toward using this irregular

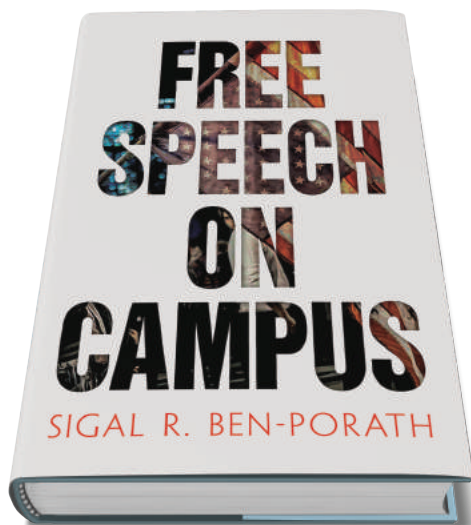
form coincided with the invention of cars and increasing use of the rhyming irregular verb "drive"/"drove."

Most verbs, however, showed no evidence of selection. The researchers found that, when rarely used verbs changed, the replacement was more likely to be due to chance. But when more common verbs switched forms, selection was more likely to be a factor driving the replacement.

The authors, whose work was funded in part by the David & Lucile Packard Foundation, the U.S. Defense Advances Research Projects Agency, and the U.S. Army Research Office, also observed a role of random chance in a form of grammatical change, and in an example of verbal negation.

As the authors see it, it's only natural that social-science fields like linguistics increasingly exchange knowledge and techniques with fields like statistics and biology.

"By looking at the analogies between social science and biology, this work is pushing toward a unification between the two fields," says Clark. "I think both sides stand to gain."



SPEAKING FREELY ON COLLEGE CAMPUSES

Freedom of speech is a hallmark of American democracy. The authors of the Bill of Rights deemed it so essential to self-

rule that it is the second right mentioned, after freedom of religion.

Devotion to open-minded dialogue on college campuses has been embraced, by and large, by students and faculty for generations, but students with diverging ideological leanings frequently differ on how free freedom of speech actually is. Certain groups believe the right is almost absolute, and purposely push boundaries to test its limits. Other organizations seek to limit debate on topics such as race, sexuality, war, and international politics that they believe lie outside the bounds of reasonable discussion.

In her book “Free Speech on Campus,” Sigal Ben-Porath, a professor in the Graduate School of Education and an associated faculty member in the Departments of Political Science and Philosophy in the School of Arts and Sciences, examines the current state of the arguments about free speech on university campuses, using real-world examples to explore the contexts in which conflicts and tensions erupt, and offering both theoretical and practical solutions.

Ben-Porath says her interest in writing the book grew out of her work chairing Penn’s Committee on Open Expression, which drew her attention to the complications regarding free speech, especially in the current environment.

“There is a lot of tension around this right now, and I think campuses should be ready, they should be prepared,” she says. “The first step to being prepared is to talk about it more, not less.”

Commentators and critics point to instances in which conservative speakers have been heckled or prevented from speaking as proof that students are too fragile for open ideological debate, and are attempting to stifle free speech. The most vocal critics accuse universities of being too elitist, lacking ideological diversity, and prioritizing progressive and liberal views.

Surveys have shown waning support for some aspects of speech or First Amendment protections on college campuses, but Ben-Porath says students objecting to some forms of speech in fact support free speech, but object to free speech being used to harm, denigrate, or silence another human being.

“This is not being a snowflake; this is being an activist,” she says. “What they are expressing is not oversensitivity or that they can’t handle the truth. They are expressing a commitment to the values that we are teaching them and we are not always practicing, like equal dignity to all persons, and ensuring that all members of campus can participate in the conversation. That doesn’t show fragility, in my view. It actually shows a commitment to democratic values, and we need to listen to that.” She suggests ways to incorporate both inclusion and freedom into everyday campus work.



Abolishing the Criminal Justice System and Remaking It Anew

American criminal law is supposed to be democratic: applied in a neutral, apolitical way, equally across the board, with the full inclusion and participation of all citizens.

But it isn’t.

Dorothy Roberts, a Penn Integrates Knowledge Professor and the George A. Weiss University Professor, with appointments in Penn Law School and the School of Arts and Sciences, says the U.S. criminal justice system operates in an anti-democratic manner and targets certain groups for unjust treatment. She says various aspects of American criminal law exclude African Americans from full participation.

“Three central aspects of the U.S. criminal justice system—mass incarceration, capital punishment, and police terror—all continue to this day and all can find their roots in slavery,” she says. “We have seen over the decades since emancipation that these institutions and practices have been perpetuated through lynching, through the disproportionate rates of imprisoning and executing black people, and through anti-black police violence.”

Reforms have been proposed to make criminal law more democratic, but Roberts says the anti-democratic function is so deeply engrained

CONTINUED ON PAGE 24

in U.S. criminal justice that the system cannot be reformed.

“You would really have to dismantle the entire system to create a truly democratic one,” she says.

In an article published in the *Northwestern Law Review*, Roberts, encapsulating 30 years of her writing and research on racism and criminal justice, lays out her argument that an abolitionist approach is needed to undo the anti-democratic aspects of criminal law and reconstitute the government’s approach to social harms without those aspects.

Roberts, who is also the Raymond Pace and Sadie Tanner Mossell Alexander Professor of Civil Rights, is proposing abolition, which she sees as a vision for action rather than the immediate destruction of the criminal justice system.

“By abolishing, I mean dismantling and eliminating the anti-democratic foundation of the criminal justice system,” she says. “It’s not just a matter of extending the way it operates now to be more inclusive or making it more efficient or fairer.”

She says breaking apart the criminal justice system would take a number of steps over a period of time, led by a movement of people who see abolition as the goal.

Roberts says racism and white supremacy have structured criminal law in a way to disenfranchise large numbers of black people, and to reinforce racist stereotypes about black criminality that have been a barrier to black people’s full participation in U.S. democracy.

“It’s important to look at how criminal justice has actually functioned with respect to black Americans and other marginalized groups who have been the subject of government subordination through the criminal law,” she says. “It’s not just the way that criminal law is applied, it’s also that the very definition of law-breaking itself is biased against black people.”



A hot topic in the news, and a likely talking point for the 2020 election, universal basic income payments are something loana Marinescu, a labor economist, couldn't help but explore.

Research she's completed with Damon Jones of the University of Chicago dives—for the first time—into the labor market impacts of the Alaska Permanent Fund, which has, since 1982, allotted a yearly cash dividend to all Alaskan residents.

The fund, now worth nearly \$65 billion, is a diversified portfolio of invested oil reserve royalties, and, in recent years, has put forth an annual payment of about \$2,000 per person of any age in Alaska—as long as they've lived in the state for one year.

“Policies like this and other social protection systems intend to help people achieve greater income security in the face of less stable employment,” says Marinescu, an assistant professor at the School of Social Policy & Practice. “I wanted to see if there were any unintended consequences of this particular program.”

One often-used argument against universal basic income payments is based on simple economic theory, Marinescu says. “It’s the idea that if people get money for nothing, they might think, ‘What’s the point in working?’”

But when it comes to the Alaska Permanent

Fund, Marinescu and Jones’ research suggests this theory is far off. The dividend, in fact, showed no effect on employment, and increased part-time work.

“This cash is going back into the economy, and people are spending money on local goods and services such as restaurants,” says Marinescu. “The cash stimulates the local economy, which then needs more workers.”

To Marinescu, the Alaska Permanent Fund is an ideal model to study. In existence for more than 30 years, it allows researchers to “see what happens in the long run,” she says. Also, it’s a truly universal example, whereas other studies that look at similar programs only showcase a few individuals that receive cash.

Marinescu and Jones used a data-driven approach to conduct their study, comparing the evolution of the labor market outcomes in Alaska after the introduction of the dividend payments to a set of control states, such as Wyoming and Nevada, which are “almost identical to Alaska in terms of their level of employment, share of college graduates, share of different industries,” says Marinescu.

“It’s important to understand the costs and benefits of a policy like this,” says Marinescu, especially now, she adds, as new carbon taxes may lead to a no-strings-attached dividend payment in some U.S. states.

“I wanted to see if there were any unintended consequences of this particular program.”

How do you emerge from a behavior rut? Research from Penn and elsewhere has shown that such a change reflects what's happening in a brain region called the posterior cingulate cortex. Neurons there ramp up firing rates, peaking just before exploratory behavior.

"The circuits in our brain that allow us to focus on a particular task, especially one that leads to reward, are well known," says Michael Platt, the James S. Riepe University Professor. What's less established, he says, is which trigger causes people to break from routine, particularly when there's risk involved.

Two experiments led to some important findings, which the researchers published in *Neuron*. Platt and colleagues looked at rhesus macaque foraging behavior. These non-human primates could choose to harvest a juice reward that depleted over time but was guaranteed and immediate, or move to a new "patch," using more time and energy but potentially resulting in a larger payoff.



DISCOVERING WHICH BRAIN REGION MOTIVATES BEHAVIOR CHANGE

"Imagine you're picking berries in a tree," Platt says. "At first it's easy, but after a while you have to climb farther and farther out on weaker branches to get the berries, most of which probably aren't ripe. At some point it makes sense to go to the next tree."

The second experiment mimics a traveling salesman who moves from door to door. Not every stop is successful, but an ideal pattern emerges, one the salesman follows until repeated failure makes a change necessary. Monkeys in the traveling-salesman experiment could visit six locations, two of which randomly contained rewards.

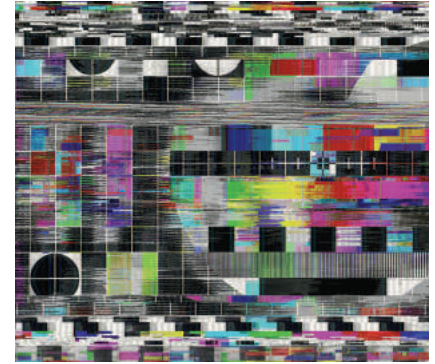
"The optimal solution is a routine where you visit all of them in a circle. That's what monkeys do in the wild," Platt says. "Occasionally, these animals break off to explore, kind of like what people do in a grocery store when they realize they forgot to pick up milk. Suddenly, monkeys here would go out of order, and we didn't know why."

While watching the macaques, the researchers simultaneously recorded neural activity in the posterior cingulate cortex. They saw that neural activity there built up until it peaked—and that's when animals changed course. The findings provide correlational evidence that this spike leads to divergent thinking and action.

"If you stimulate activity in the area, then you become more exploratory," Platt says. "Similarly, if you suppress activity, you become hyper-focused on one option, maybe never making a change."

The work, funded by the National Institutes of Health and the Duke Institute for Brain Sciences, has possible business applications; techniques that directly or even indirectly activate the posterior cingulate cortex potentially provoke more creativity.

BRIEF COMMUNICATION



Creating a Safer, Freer, and More Empowered Media

The Center for Media at Risk, led by Barbie Zelizer, the Raymond Williams Professor of Communications at the Annenberg School for Communication, looks at the various ways in which media practitioners are unable to do their jobs because of political interference.

"That runs the gamut from the effect of circumstances of creeping authoritarianism to straight totalitarian rule," Zelizer says. "It's not just one place geographically or just one platform, as in only journalism. Rather, it is the entire media environment that is at risk."

The Center is hoping to create a forum that will allow media practitioners and scholars to speak to each other and strategize about how to identify when media practitioners are put at risk, and what can be done to resist it.

Zelizer says media practitioners and university scholars have suffered a loss of public confidence in the past few years. She says the Center provides an opportunity for both populations to converse and re-conceptualize what they're doing.

"My hope is that by coming together, we will think forward in ways that will help keep the media and media practitioners safer, and freer, and more empowered than they are today," she says.

Innovative Interpretation of Homer's 'Odyssey'

When Emily Wilson was 8 years old, she was cast as the goddess Athena in a shortened version of Homer's "Odyssey"—her elementary school play.

"Of course I didn't know," says Wilson, "I didn't know I would then get to publish a translation of the 'Odyssey.'"

A professor of classical studies in the School of Arts and Sciences, Wilson became, in November 2017, the first woman to publish an English translation of the "Odyssey," a nearly 3,000-year-old poem. Wilson worked five years to bring the ancient epic to fresh life.

The original is composed in dactylic hexameter verse; Wilson created a new and coherent piece in the native Anglophone meter, iambic pentameter, that's as enchanting and suspenseful as the Greek original.

"Homer's music is quite different from mine," Wilson says, "but my translation sings to its own regular and distinctive beat."

The translation is also the same number of lines as the original poem.

"I chose to write within this difficult constraint because any translation without such limitations will tend to be

longer than the original," Wilson writes in the Translator's Note of her book, "and I wanted a narrative pace that could match its stride to Homer's nimble gallop."

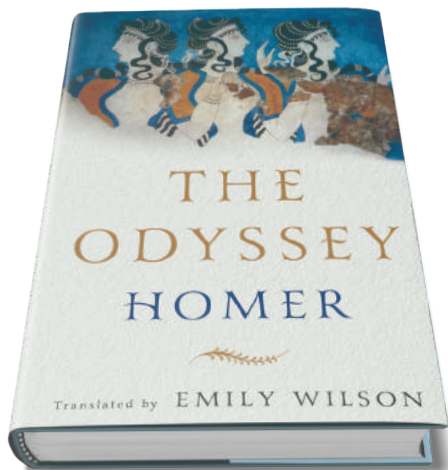
Wilson was interested in many characters within the story, not just Odysseus, and she wanted to make sure that a reader "can feel inside the characters in the poem." She hoped, she says, "to convey the ways that each character in the poem has her or his own distinctive point of view."

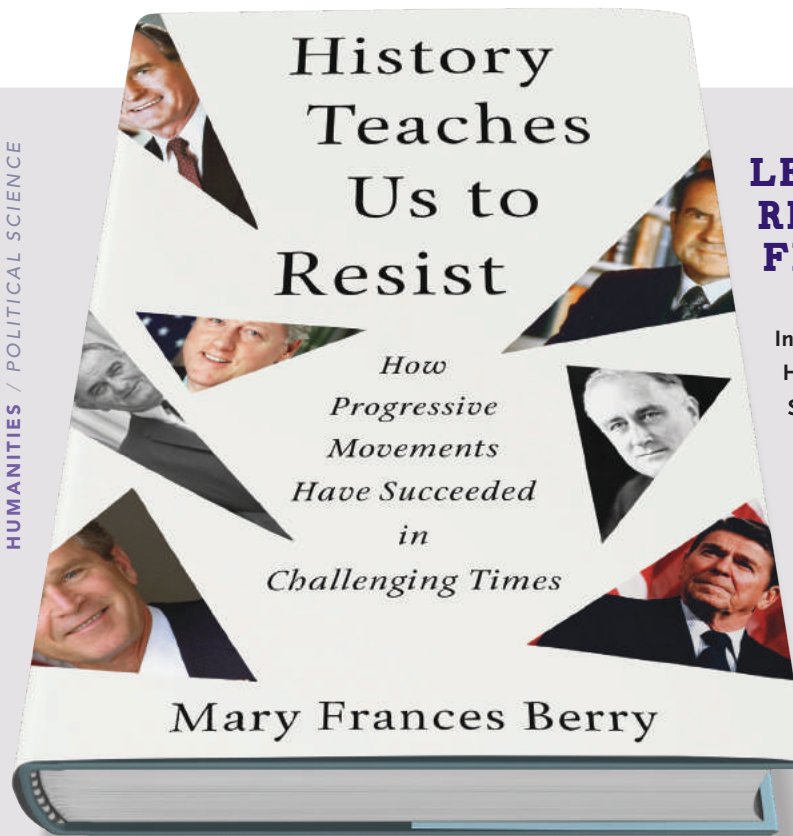
Wilson says she never would have agreed to do the translation unless she felt she would be able to "really do something different" from the 60-plus translations in English that were already out there, while also "engaging responsibly with the original."

Wilson was in college at Oxford when she first read the entire "Odyssey" in Greek, a language she began studying, along with Latin, in high school. While preparing her translation, she'd read the original repeatedly, read it out loud, handwrite a draft, rewrite it, read her English out loud, rewrite it, send it to her editor, Pete Simon at W.W. Norton, and then rewrite again.

It's Wilson's hope that her translation is readable and fluent, but also that its literary artifice is clearly apparent, to a new generation of scholars, students, and general readers alike.

"A lot of people know about the 'Odyssey.' It's often a poem that a lot of people are forced to read in high school," says Wilson. "I hope my translation is able to speak to people of all ages and backgrounds, even those who aren't brilliant academics."





LESSONS ON RESISTANCE FROM HISTORY

In her book “History Teaches Us to Resist: How Progressive Movements Have Succeeded in Challenging Times,” Mary Frances Berry, a professor of history and Africana studies in the School of Arts and Sciences, shares her memories of being a protestor, provides an in-depth analysis of protest strategies, and highlights lessons learned from a lengthy history of fighting against injustice.

Based on firsthand experiences and historical research, Berry—an author, civil rights activist, and former chair of the U.S. Commission on Civil Rights—outlines the power of resistance and the ways in which protest is a key ingredient in politics.

Berry says she was inspired to write the book “after seeing such mourning after the 2016 presidential election, and seeing so many people frustrated.” Her editor persuaded her to share her research and expertise, including taking part in protests against the Vietnam War, the Free South Africa movement, and efforts to keep President Reagan from, she says, “turning back the clock” on civil rights.

The tome illustrates that even in perilous times, progressive movements can flourish. Berry details how resistance has neutralized “outrageous proposals, even in challenging times,” and discusses the role that technology has played in connecting people from all walks of life and in mobilizing nationwide movements.

The most important takeaway from “History Teaches Us to Resist,” Berry says, is for activists to study past movements, whether they succeeded or failed.

“Activists who were involved have lessons to teach,” she says. “Find creative and imaginative ways to disrupt because if the media doesn’t cover you, you can’t grow your movement.”

Berry says the book’s lessons on protests throughout history can be used to further advance social justice today by remembering that those in power always think the movement will go away in time. She says it is important to be persistent and keep goals simple, as exemplified in slogans such as “End the Draft,” “End the War,” “Freedom Yes, Apartheid No,” and “Don’t Turn Back the Clock on Civil Rights.”

“To make change, we must keep it simple. Be persistent and willing to sacrifice and stand by principle,” Berry says. “One march by itself is insufficient. Large, repeated marches targeted on the same subject can succeed. Resistance works to raise consciousness about issues even when change does not immediately follow.”

Examining the Worldwide Language of Sustainability

During a trip to Berlin in 2010, Professor of Germanic Languages and Literatures Simon Richter came upon the term *Nachhaltigkeit*. Translated, it means “sustainability.” But its cultural implications, he found, went beyond that: The word signaled a connection to the country’s high regard for the forest, spurred by the Enlightenment and derived from Hans Carl von Carlowitz’s 1713 book on forestry.

His next curiosity: How many other countries have their own unique interpretation of a word that, ostensibly, means the same thing everywhere?

“‘Sustainability’ is a word that’s on the tip of everybody’s tongue, but depending on where you are and what language you use, it may look differ-



ent,” Richter says. “And there may be resources there in the word itself, in the cultural concept and culture itself, that allow a country or government—or citizens—to pursue or achieve sustainability more vigorously than others.”

Richter marinated his musings for several years before eventually running a summer program for students with the College of Liberal

and Professional Studies and Penn Summer Abroad that further opened his eyes to international interpretations of relatively new and now-common words like “sustainability” and “resilience,” looking specifically at the Netherlands, Germany, and Indonesia.

From there, he examined the language of the 1987 United Nations environmental report, “Our Common Future,” that necessitated translation of the terms.

“That’s interesting because in many cases there isn’t a term at hand,” Richter says. “Or, it’s not obvious what the term will be. We went with ‘sustainability,’ but the French went with ‘durability’ and the Dutch did the same. Other languages, there was no obvious word, so they made one up.”

He ultimately launched the “Language of Sustainability” project with three undergraduate students, mapping various meanings of the word and its variations around the world. They carefully drafted a questionnaire that targets those with a background in environmental policy, soliciting answers about how cultures worldwide discuss sustainability.

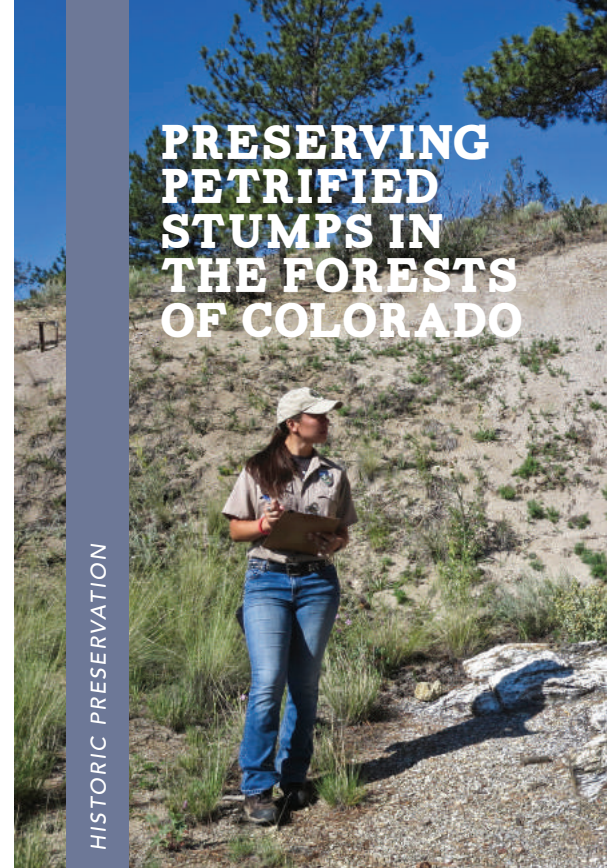
So far, for the ongoing project, they’ve collected responses that cover 50 languages. They’ve learned that in Chinese, for example, the word used for sustainability is entirely new and, because of that, appears to be more attractive to young people—but slightly off-putting to older Chinese speakers.

“I think it’s eye-opening for students to realize that sustainability, resilience, this is not a universal language and also not an abstract language,” Richter says. “These are concepts and practices that are alive, culturally, and distinct and embedded in all sorts of social and political processes.”

Awareness, he says, can lead to some important reflection.

“By becoming informed about how resilience and sustainability operate in another culture, you become more aware of your own, and in becoming more aware, you can call those assumptions into question,” he says. “And out of that, openings appear where strategic interventions may result in more and better changes.”

PRESERVING PETRIFIED STUMPS IN THE FORESTS OF COLORADO



HISTORIC PRESERVATION

HUMANITIES

When concerned paleontologists from Colorado’s Florissant Fossil Beds sent out a distress signal through the Cooperative Ecosystem Studies Units Network—a national consortium of partners of which Penn is a member and resource—Professor Frank Matero, chair of the graduate program in historic preservation at the School of Design, answered the call.

The problem at hand? Their petrified tree stumps were deteriorating.

The unusual forest of stump fossils— one of only a few in the world, others being in faraway places like Thailand and Greece—is a result of redwood trees being buried after a long-ago volcanic eruption, after which the treetops deteriorated but their stumps were preserved by a blanket of ash. Over time, the stumps fossilized into dazzling objects that transformed the site into a tourist attraction.

Today, though, the stumps suffer from years of weathering and human intervention. “They used dynamite to expose them, and later built shelters for protection that only made things worse,” says Matero. “The shelters collected and diverted the water into great circular pools around the fossil stumps, and in the winter, they’d freeze and cause the stumps to delaminate into fragments great and small. The site managers realized they had a problem.”



What captured his attention about the project, Matero says, is the unusual hybrid material of the stumps: anatomically wood, he says, but mineralogically stone. It was a “bizarre problem” that he’d never seen in buildings, but recognized could have larger implications for preserving deteriorated stone monuments and buildings.

The solution, Matero theorized, was to both redesign the shelters and stabilize the detached fragments of the stumps using special reversible ceramic pins originally developed by NASA as a high-tech conservation solution. In collaboration with graduate student Evan Oxland, whose thesis focused on the pinning research, Matero has been researching new reversible techniques for mechanical repair of stone and other brittle materials for more than a decade.

“While the problem at hand happens to be a rare collection of fossilized tree stumps in Colorado, the truth of the matter is this research will benefit a great number of historical monuments and sites—no doubt about it,” Matero says. “I’ll probably never work on a petrified forest again,” he says, noting how odd the project may seem, “but the point is to see the relevance of the solution beyond the immediate problem. Such is the nature of research.”

The History of the Benjamin Franklin Parkway

Philadelphia is a city that imagined the post-industrial before industry had even begun to sputter.

So says David Brownlee, a history of art professor in the School of Arts and Sciences, in “Building the City Beautiful,” a history of the Benjamin Franklin Parkway and celebration of its forward-thinking design. First published in 1989, in tandem with a Philadelphia Museum of Art exhibition of the same name, Brownlee updated and reissued the book to celebrate the centennial of the Parkway, for which demolitions and the paving of the roadway from City Hall to Fairmount Park were complete in October 1918.

“Quite remarkably, in the 20th century, we were the city that really led the way in imagining what a city might be in the post-industrial era,” Brownlee says, explaining that the early demolition of factories in favor of cultural institutions was nearly unheard of at the time. “We talk about ‘post-industrial’ now, but this was post-industrial then. The idea of manufacturing right there in the center of the city was already obsolete.”

Brownlee draws on unpublished sources from the Architectural Archives of the University of Pennsylvania, the Athenaeum of Philadelphia, the Free Library archives, and many other sources to tell the story of the Parkway’s development between 1871 and 1929, including the designs of the Philadelphia Museum of Art and Free Library of Philadelphia. The story is, he says, indicative of the “giganticism” of Philadelphia, at the time known as the “Workshop of the World.”

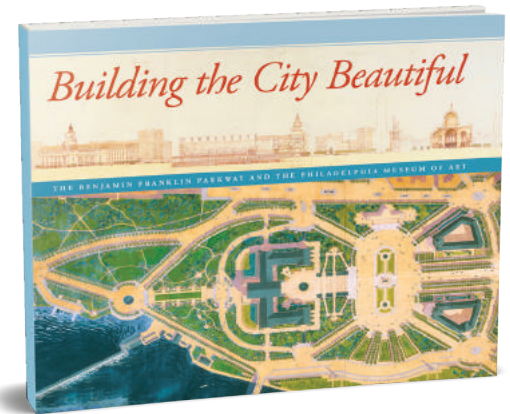
“What I try to do in the book is help people understand how this great urban boulevard, lined with classical buildings built in the first third of the 20th century, was an authentically *modern* thing,” he adds, “embodying the same ideology, goals, and in many respects artistic values of what we think of as conventional ‘modern’ architecture.”

New research adds 20 pages of material about the making of cultural institutions like the Barnes Foundation, could-have-been scenarios like an original plan to make the Parkway zigzag, and fleshed-out accounts of the making of the Philadelphia Museum of Art and the Free Library—specifically, the role of Julian Abele in both.

Abele was the first African-American architecture alumnus of Penn who went on to become a high-flying architect at the Horace Trumbauer firm, which had a hand in designing both the Art Museum and the Free Library. Though historians have long suspected Abele’s involvement, Brownlee fills in the details, concluding with confidence that he did, in fact, design the Free Library and that, while not the lead designer, he oversaw both preliminary studies and the making of construction drawings for the Philadelphia Museum of Art.

Ultimately, Brownlee says, that story and others significantly open doors for continued research about Philadelphia power players of the time—Anthony Drexel, Peter Widener, Mayor Rudolph Blankenburg, and Eli Kirk Price—who still lack definitive biographies.

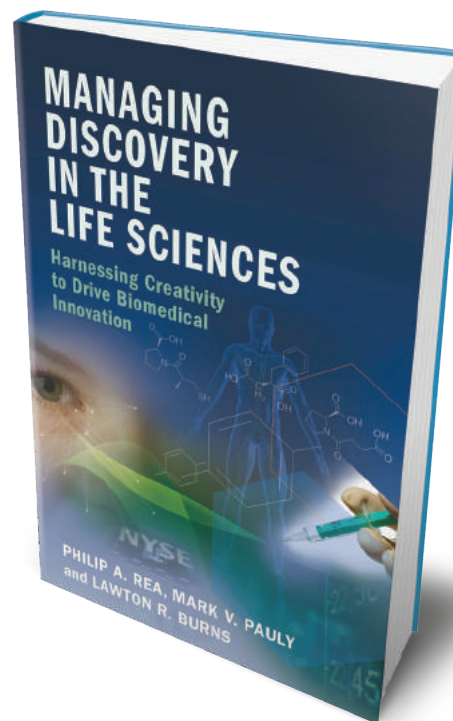
“I think the challenge now is to continue to explore some of these really big stories—untold in Philadelphia,” he says. “I’ve focused on the architectural part of it, but some of the fascinating big players of client and civic life still need modern studies.”



As familiar as medical devices like the catheter or drugs like cholesterol-lowering statins may be, what's largely unexplored is how they came to be in the first place.

Three Penn professors—a biochemist, an economist, and a sociologist—set out to find answers.

“If you really want to understand the business at play in drug development, whether a statin or Gleevec, you name the therapeutic, you need to understand the individual steps in its genesis—in concepts and principles—that give rise to the fabric out of which innovations can arise,” says Philip Rea, a biochemist



How Biomedical Innovations Are Discovered—and Managed

in the School of Arts and Sciences. “If you don’t have that background, it’s hard to see how something happened and why it happened the way it did.”

And how, then, those success stories can be learned from.

The genesis of “Managing Discovery in the Life Sciences: Harnessing Creativity to Drive Biomedical Innovation,” a 526-page book published by Cambridge University Press, is inherently interdisciplinary. It originates from Rea’s connections with the Wharton School’s economist Mark Pauly and sociologist Lawton (“Rob”) Burns, all key players in Penn’s Roy and Diana Vagelos Program in Life Sciences and Management.

For their book, they examined how 11 notable biomedical innovations came to be, looking as much at process as outcome. Leaning heavily on the theme of serendipity—finding answers to questions not yet posed—the book acknowledges the unknowable trajectory of biomedical innovation.

“The mission of the book is to use concrete examples, actual drugs that in practically all cases have proved to be very effective and undoubtedly improved quality of life and saved lives, to understand the amalgam of science and business strategy in carrying them forward,” Rea says.

The case studies, which tackle, among others, the competing hepatitis C therapies of the early 2010s and the run-up to Carl June’s CAR-T cell therapy breakthrough, highlight a creativity that begs for careful management—but also freedom.

“The sciences and arts are similar that way,” notes Rea. “It’s process, as much as anything else. How often does an artist have a clear conception of what they’re going to do from the onset other than in the doing?”

The professors’ findings, then, are twofold: Economically, costs of research and development for new drugs are rising because investors are willing to put forth funds for long-shot drugs that take time to gestate; and scientists work best when given a long leash to experiment.

“I think you need people in leadership positions who have sufficient understanding of the science to on one hand know, or have suspicion, as to what might seem like a fairly cranky idea that is worth giving a bit of time just to see where it goes,” Rea says. “It’s like a new musical artist. When you get the demo, it’s maybe very rough, with lots of inadequacies, but there’s something about it. Something that a lot of people would like to ‘hear’—would benefit from.”





NAVIGATING WORKPLACE FRIENDSHIPS WITH CARE

At work, friendships are everywhere.

“They are very prevalent,” says Nancy Rothbard, “and they do affect our ability to work effectively together—both in positive and negative ways.”

For years, Rothbard, the David Pottruck Professor and chair of the Management Department in the Wharton School, has centered her research around how people navigate the boundaries of their personal and professional lives. In the paper, “Friends Without Benefits: Understanding the Dark Sides of Workplace Friendship,” published in *The Academy of Management Review*, Rothbard and doctoral student Julianna Pillemer unravel a theoretical framework for managing the complicated phenomenon.

“We had a sense going into this work that it was more complex than people might think,” says Rothbard. “But as we were delving in, I was surprised by the depth of those complexities, and how many complexities there are—how many pitfalls there can be, and the type of social skill it might take to navigate this.”

Rothbard and Pillemer highlight how four defining features of friendship—informality, voluntariness, communal norms, and socio-emotional goals—are at odds with four fundamental elements of organizational life—formal roles, involuntary constraints, exchange norms, and instru-

mental goals. These tensions, the researchers contend, can negatively affect individual, group, and organizational outcomes.

“On an individual level, some tensions could lead you to become distracted,” says Rothbard, “or on a group level, if you’re in a group with friends, you might not want to raise a divergent opinion, and you might not prepare as much for the task at hand, thinking, ‘They’re going to forgive me,’ leading to worse group decision-making.”

It’s not that we shouldn’t have friends at work, Rothbard notes, but it is something that should be “navigated with care,” especially in light of technological shifts, social media, in particular, which are changing the way employees connect.

“It’s very easy to mess up, to fall into one of these traps and have it negatively impact working relationships, and working relationships are critical,” Rothbard says. “The way we interact with people at work is the secret sauce—that’s the ingredient that’s key to a successful organization.”

Rothbard and Pillemer’s paper is one of the first that looks at friendship in the workplace in such a systematic way, highlighting the downsides in addition to acknowledging their importance.

“Being thoughtful about how relationships play out in the workplace is serious,” says Rothbard. “It’s important to nurture them, but also set boundaries on them.”



Budget Tool Keeps Legislators Honest

The Penn Wharton Budget Model, founded in 2015 as a transparent, independent modeling group for legislators to use while they’re writing bills, made a splash when it projected in December 2017 that a 10-year outlook of the Tax Cuts and Jobs Act would cost \$500 billion more than what the government estimated.

Four months later, in April 2018, official Congressional scorers would update their cost estimate by \$430 billion. Findings further suggest that half of the effectiveness of the then-bill’s corporate tax cut would be undone in 10 years.

Uniquely, the team got granular with projections, evaluating impacts of the tax changes by industry—looking at, among others, agriculture, the arts, educational services, finance, manufacturing, and retail trade, again finding that, in many cases, short-term benefits would peter out as years went on.

The group continues to press forward in new areas, including estimates related to public infrastructure, universal basic income, trade, Social Security, and Medicare reform.

PERSONALITY TRAITS AND FACEBOOK LIKES

You can predict a lot about an individual's personality traits through his or her Facebook likes.

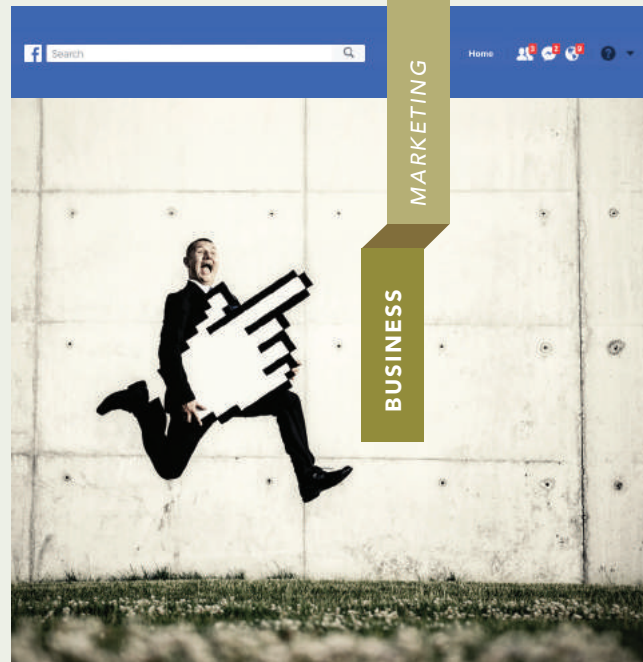
Using data from approximately 20,000 users of the myPersonality app, Gideon Nave, an assistant professor of marketing at the Wharton School, and colleagues were able to predict the personalities of Facebook users through their likes and musical preferences.

The myPersonality app ran on Facebook between 2007 and 2012. The app allowed users to participate in psychological research by filling out a personality questionnaire. Users could also voluntarily submit their Facebook profile information, such as profile pictures, status updates, and likes. Alongside the personality questionnaire was a listening questionnaire that asked people how much they liked 25 unreleased, 15-second excerpts of music.

Nave and Juri Minxha of the California Institute of Technology; Michal Kosinski of Stanford University; and David M. Greenberg, Jason Rentfrow, and David Stillwell of the University of Cambridge set out to see if they could predict people's personalities from either their ratings of the musical pieces in the questionnaire, or from liking music artists on Facebook.

The researchers found that in both cases, they were able to find patterns that reliably linked people's personalities to the music they like. Nave and colleagues published their findings in *Psychological Science*.

To measure personality, the researchers used a model called the Big 5 personality traits: Openness to experience, conscientiousness,



extroversion, agreeableness, and emotional stability/neuroticism.

Nave says the predictability was most notable for openness to experience and extroversion, but all traits were predictable. He says music that is mostly predictive of openness was music that the average person would define as sophisticated. Conversely, a person who likes unsophisticated music is probably low on openness.

“Once you know one’s musical taste, you have some signal,” he says. “Of course, it’s not going to be perfectly predictive of who you are, but it gets some approximation that correlates with your actual personality.”

Nave says the researchers were “quite surprised” to discover that you can predict personality based only on how much people rate liking 15 seconds of never-before-heard music. He says the findings could be of great benefit to marketers.

“The music industry is a big industry, so knowing to match people with the music [is important],” he says. “Once they know what you listen to and what music you like, it tells them something about you and your needs—and marketing is about the needs of the customer. Once they better know the needs of the customer, they can give better service to the customer.”

The researchers were “quite surprised” to discover that you can predict personality based only on how much people rate liking 15 seconds of never-before-heard music.

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