# Research at Penn

*Advances in Knowledge from the University of Pennsylvania*

Volume 11 | Year 2013

Penn


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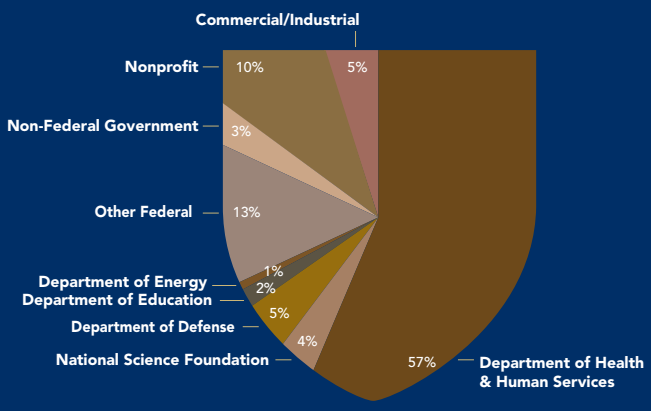
# Penn's Research Enterprise

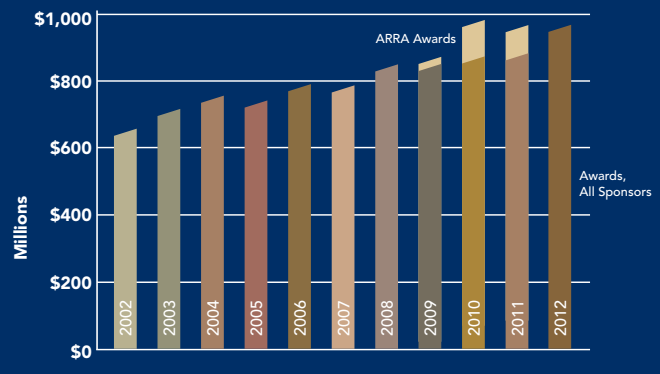
**PENN IS A WORLD-CLASS TEACHING AND RESEARCH INSTITUTION PROUDLY FURTHERING THE LEGACY OF ITS FOUNDER, BENJAMIN FRANKLIN, WHO BELIEVED IN THE UNCEASING IMPORTANCE OF INTELLECTUAL INNOVATION.**

Sponsored research support is integrally important to Penn's research enterprise. The University received more than $874 million in total research awards in the 2012 fiscal year and is consistently ranked as one of the largest recipients of funding from the National Institutes of Health. Federal support accounts for approximately 82 percent of sponsored program dollars, while the remaining 18 percent comes from a combination of foundations, state and local governments, associations, and private industry. In all, the University received more than 3,500 awards in the 2012 fiscal year.

## Research Awards by Sponsor




## Total Awards



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***Vincent Price,*** *Provost* ***Steven J. Fluharty,*** *Senior Vice Provost for Research*

To move knowledge forward, research must extend beyond the traditional silos of academic thought. At Penn's 12 schools, exploration reaches across campus, across disciplines, and across the globe with the goal of addressing the world's most complex issues. In Penn's classrooms and in the field, researchers and students are engaged in groundbreaking, multi-disciplinary inquiry.

This brochure highlights some of the eminent research at Penn that has occurred in the past year. From a discovery that could lead to effective treatment of male-pattern baldness, to a quick on-the-spot test to detect concussions in athletes, and the discovery that babies as young as six months understand the meaning of far more words than previously believed, scientists at Penn have focused on interdisciplinary innovation.

Historians and preservationists have teamed up to study and refurbish the Lazaretto quarantine station that once housed victims of yellow fever. A law professor asks whether people should be protected from revealing too much private information about themselves, whether they want protection or not. And in business, a management expert asks why good people can't get jobs.

At 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 of the University's research news, visit Penn's research website, **www.upenn.edu/researchatpenn.**

The University of Pennsylvania, in Philadelphia, is one of America's premier research and teaching universities. As a member of the Ivy League, Penn has a proud history of academic excellence with 12 schools that offer undergraduate, graduate, and professional degrees to more than 24,000 students.

# what's inside



Penn

# Just ONE Brain Injury Can

Each year, nearly 2 million Americans suffer a traumatic brain injury (TBI) caused by falls, car crashes, other accidents, and in some cases, assaults.

While many injuries can easily heal, brain injuries are much more dangerous. In fact, TBI is the No. 1 environmental risk factor for developing Alzheimer's disease.

Repeated concussive or mild head injuries, such as those suffered by boxers and football players, can lead to chronic traumatic encephalopathy, a progressive degenerative disease of the brain.

In a study co-authored with a colleague at the University of Glasgow, Douglas Smith, professor of neurosurgery and director of the Center for Brain Injury and Repair at the Perelman School of Medicine, found that even a single, moderate-to-severe TBI can have lasting damage on the brain.

In their research, funded by the National Institutes of Health, Smith and his colleague examined post-mortem brains from 39 long-term survivors of a single TBI and compared them with uninjured, age-matched controls.

When the brain experiences trauma, its axons—the electrical pathways that allow one part of the brain to communicate with another—can be damaged.

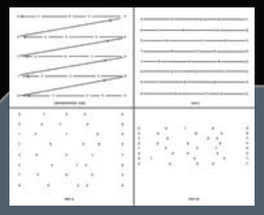
In addition to this axonal damage, TBI survivors showed an accumulation of neurofibrillary tau tangles and amyloid-beta plaque pathology far beyond what was found in the controls. Specifically, years after a single TBI, about one-third of cases showed these pathologies, similar in appearance to the tangles and plaques found after repetitive TBI and in neurodegenerative diseases such as Alzheimer's.

"If you lose an axon, it's gone forever," Smith says. "You will lose that connection in another part of your brain. Moreover, this is an injury that can keep on taking, potentially triggering long-term pathological processes."

Even young patients can be impaired forever. "With just a concussion, about 15 percent of patients have persisting cognitive dysfunction over time and we think, in large part, that's related to the axon injury," Smith says.

The study findings, published in *Brain Pathology,* may provide a pathological link with the epidemiological observation of an increased risk of developing Alzheimer's disease after traumatic brain injury. Smith says it is important to identify pathological features in brain injury that might explain clinical manifestations.

# Have Lasting Effects



## *A Better Way to Detect Concussions*

A simple sideline test can accurately detect concussions in athletes, according to a study by researchers at Penn's Perelman School of Medicine. Current sideline examinations can leave a substantial amount of brain function untested following a concussion. Penn researchers showed that their new test enhances current methods, enabling doctors to reliably identify athletes with head trauma. The study was published in *Neurology*.

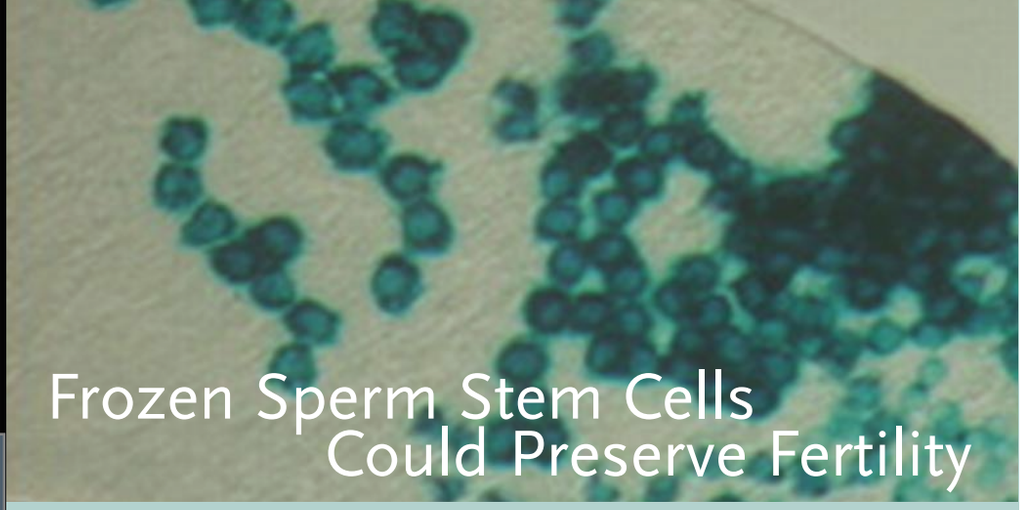
The one-minute examination, called the King-Devick test, captures changes in eye movement, attention, language, and other symptoms of impaired brain function.

Athletes are asked to read single-digit numbers displayed on index cards. An increase in the time needed to complete the test suggests a concussion has occurred, particularly if the delay is five seconds greater than the individual's baseline test time.

"This rapid screening test provides an effective way to detect early signs of concussion, which can improve outcomes and hopefully prevent repetitive concussions," says senior author Laura Balcer, a professor of neurology, ophthalmology, and epidemiology at the Perelman School of Medicine. "If validated in future studies, this test has the potential to become a standard sideline test for athletes."

The study was funded by a grant from the National Eye Institute.

"This is a very exciting area, to find a relationship between traumatic brain injury and Alzheimer's disease. For example, we are also finding that brain trauma can physically break important structures inside of axons called microtubules. Since microtubules transport protein down axons, this may explain why protein accumulation is a common feature of axonal injury in brain trauma," he says. "New treatments that are emerging for Alzheimer's disease include microtubule stabilizers, which may also be effective for treating traumatic brain injury by stopping the progression of certain pathological changes."



# Frozen Sperm Stem Cells Could Preserve Fertility

HEALTH | VETERINARY MEDICINE

**GREATER NUMBERS OF PEOPLE ARE REACHING ADULTHOOD** after being treated for cancer as children. But this good news carries an unfortunate toll: About one-third of boys who survive cancer have severely reduced fertility. Adult men can freeze their sperm before undergoing treatment, but prepubescent boys don't have this option. Chemotherapy destroys their spermatogonial stem cells before they begin producing sperm.

Now, a research project 14 years in the making is opening the door for an innovative way to preserve the fertility of boys undergoing treatment for childhood cancers.

The project is the brainchild of Ralph Brinster, professor of reproductive physiology at Penn's School of Veterinary Medicine. The recipient of a 2011 National Medal of Science for a lifetime of research on the genetics of the cells that give rise to sperm and eggs, Brinster says the research grew from a collection of animal spermatogonial stem cells languishing in a lab freezer.

With some of the samples sitting frozen for as long as 14 years, Brinster realized these cells could serve as a proof-of-concept for a human therapy. Prior to chemotherapy, Brinster explains, boys could have their spermatogonial stem cells extracted and frozen, then implanted after they reached puberty.

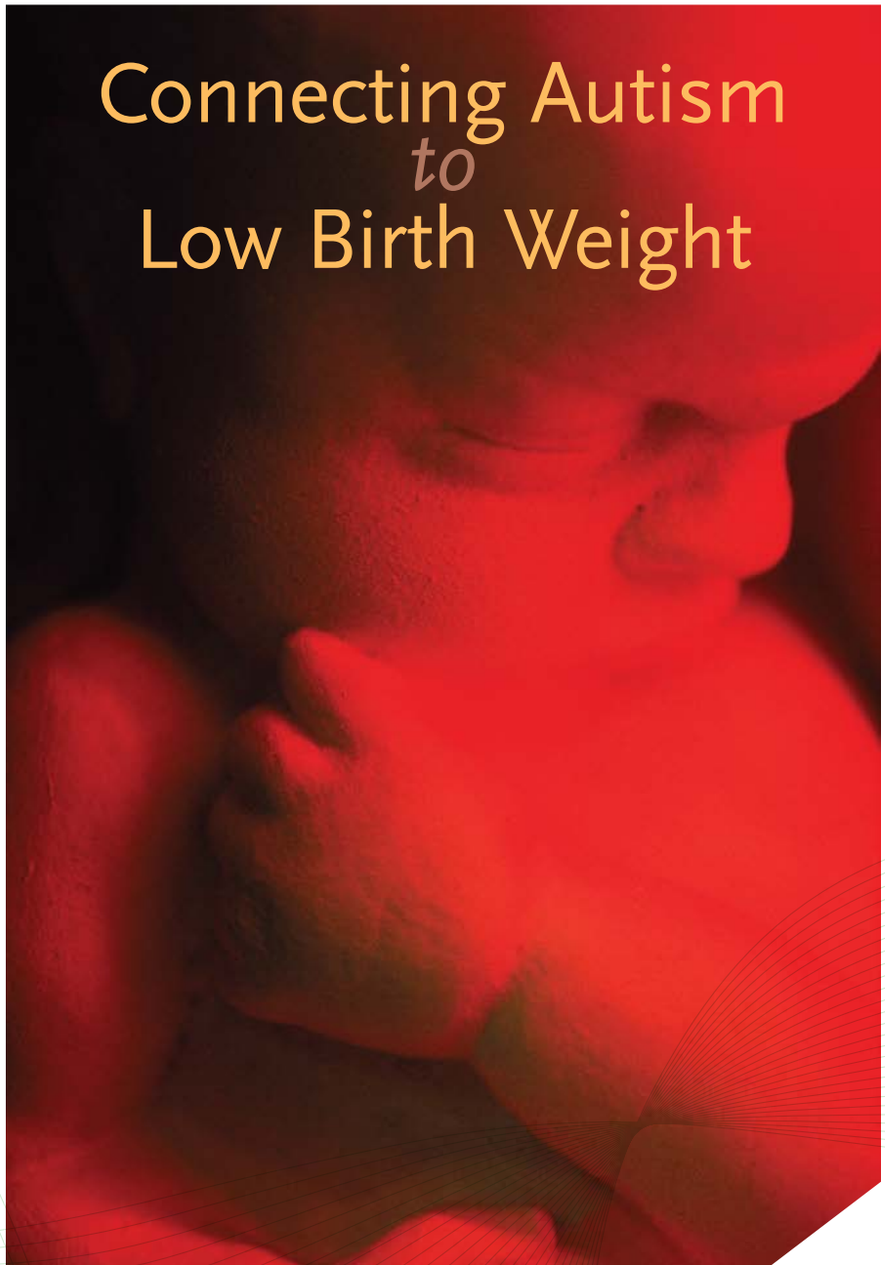
In a paper published in the journal *Human Reproduction*, Brinster and his colleagues demonstrated the effectiveness of this potential treatment. Their experiment showed that not only were spermatogonial stem cells able to survive extended periods of freezing, but also that mice who had them implanted in their testes were able to reproduce both in vitro and in vivo.

> ***"Here we had cells frozen for more than a decade that implanted in the right place and made sperm, and that sperm made offspring without apparent genetic defects."***

"Human and animal spermatogonial stem cells have been successfully frozen for short periods of time, but this is completely different," Brinster says. "Here we had cells frozen for more than a decade that implanted in the right place and made sperm, and that sperm made offspring without apparent genetic defects."

The research was supported by the National Institutes of Health and the Robert J. Kleberg Jr. and Helen C. Kleberg Foundation.

# Connecting Autism *to* Low Birth Weight



**LOW-BIRTH-WEIGHT BABIES—INFANTS BORN WEIGHING BETWEEN ONE AND FIVE POUNDS—CAN FACE A HOST OF LONG-TERM HEALTH AND DEVELOPMENTAL ISSUES,** including illness, infection, and, according to a study from the Penn School of Nursing, an increased risk of autism.

For 25 years, Penn Nursing Professor Jennifer Pinto-Martin has been involved in a longitudinal study examining a cohort of babies born at a low birth weight to assess their susceptibility to long-term disorders.

Pinto-Martin, also director of the Center for Autism and Developmental Disabilities Research and Epidemiology, says medical professionals knew very little in the 1980s about the long-term consequences of premature birth. To determine the lasting effects of low birth weight, the cohort was assessed at ages 2, 6, 9, 16, and 21.

Of the 1,105 babies in the study, about 800 survived and were tracked by Pinto-Martin and colleagues.

*"We thought that it would maybe be double what we see in the general population. The fact that it was five times as much was quite shocking."*

With funding from the National Institutes of Health, they performed a diagnostic assessment of the low-birth-weight cohort for autism.

When the cohort reached age 16, the teenagers were evaluated and screened for autism. Pinto-Martin says 18 percent screened positive.

At age 21, the cohort was given a full-scale diagnostic assessment comparing those who screened positive and those who screened negative to determine the overall diagnostic prevalence of autism. Pinto-Martin says they found a prevalence five times that of the general population.

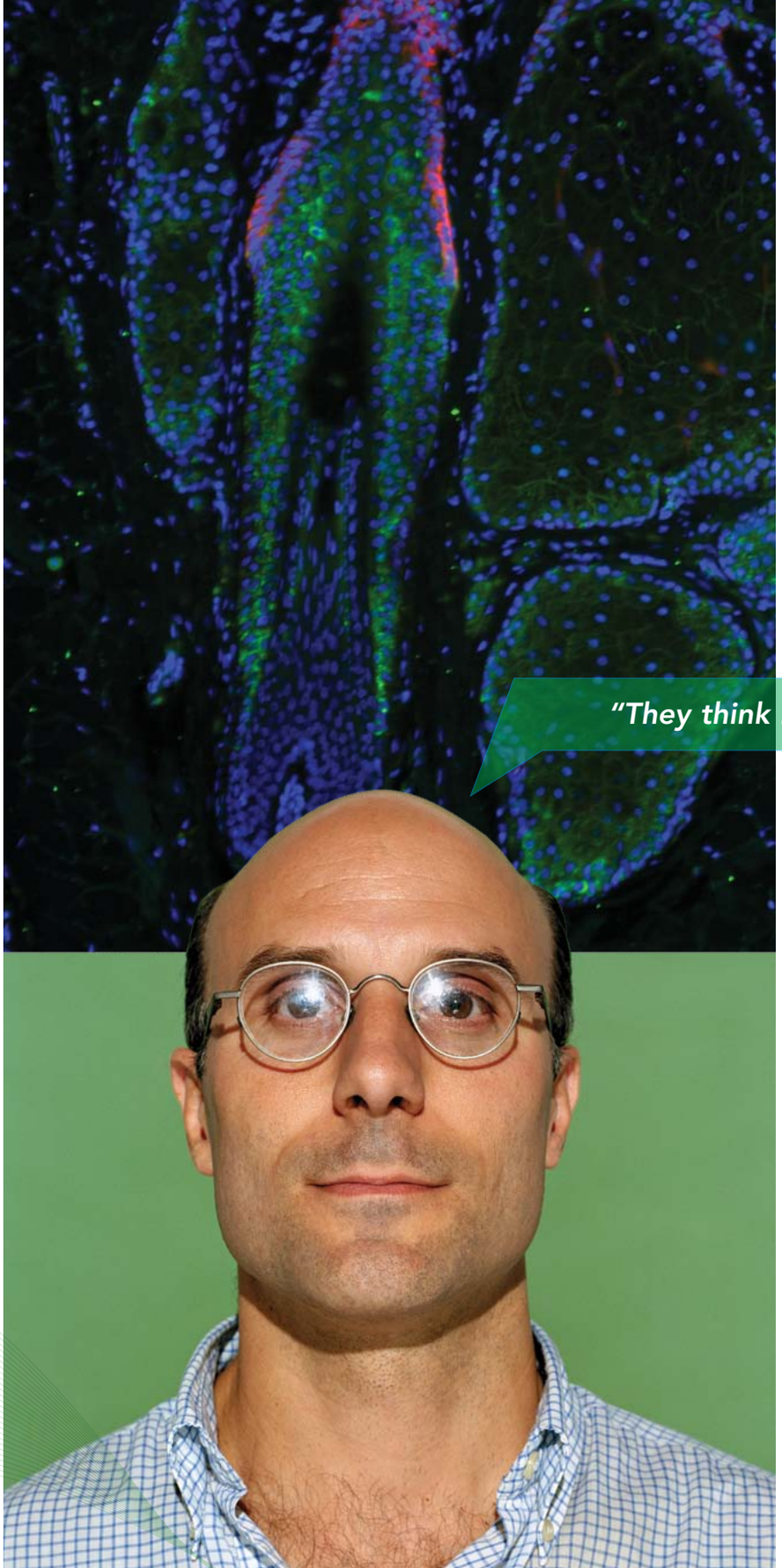
"Even though we knew that there were more [instances of autism] in this cohort, we were surprised by the magnitude of it," she says. "We thought that it would maybe be double what we see in the general population. The fact that it was five times as much was quite shocking."

Pinto-Martin and her team were among the first researchers to link low birth weight and prematurity to an increased risk for autism, and the first to use validated, gold-standard, interactive diagnostic instruments.

The study was published in *Pediatrics.*

**HEALTH | FAST FACT**

*Only about* **10-15%** *of cases of autism have an identified primary genetic cause.*



*HEALTH | DERMATOLOGY*

**IT MAY NOT BE LIFE THREATENING, BUT IT'S A CONDITION THAT CAUSES GRIEF FOR MILLIONS OF MEN AND WOMEN: HAIR LOSS.**

Half of all men develop some degree of baldness by the age of 50, and 80 percent are balding by the time they reach 70. Two drugs are currently available to treat male-pattern baldness: Rogaine and Propecia. Why do we need another?

# A Target to Halt Baldness

"The problem is those products don't work very well," says George Cotsarelis, chairman and professor in the Department of Dermatology at Penn's Perelman School of Medicine.

To try to find a better approach, Cotsarelis and colleagues from Gillette Corporation and the University of Texas examined gene expression in the scalp tissue of five men with male-pattern baldness. An enzyme called prostaglandin D2 synthase turned up at much higher levels in balding scalps compared with portions of the men's scalps that still had hair. The researchers also found that the lipid produced by the enzyme, prostaglandin D2 (PGD2), was present in elevated levels in bald scalps.

*"They think regrowing hair will be simple, like planting grass seed."*

When the team applied PGD2 topically to mice, it slowed down the animals' hair growth. In addition, mice that were genetically modified to overproduce PGD2 in their skin had smaller hair follicles and larger oil glands than normal—just what is seen in human balding scalps.

Publishing their findings in *Science Translational Medicine*, the researchers confirmed that PGD2 inhibits hair growth by signaling through a receptor called GPR44 (also called DP2). A drug that blocks this signaling activity could stop balding in its tracks. "We've had a lot of interest from several different drug companies to do just that," says Cotsarelis.

Though he isn't yet certain whether such a drug will stop baldness from progressing, or reverse it, Cotsarelis does believe it will offer another weapon in the arsenal against baldness in men, and likely in women, too.

"Many people don't realize how complex baldness is," says Cotsarelis. "They think regrowing hair will be simple, like planting grass seed. But I'm hopeful that understanding how prostaglandins play a role will offer a new kind of treatment."

Funding for the study came from the National Institutes of Health, the Skin Disease Research Center, the Pennsylvania Department of Health, Penn Medicine's Edwin and Fannie Gray Hall Center for Human Appearance, the American Skin Association, and the Dermatology Foundation.

HEALTH | NEUROSCIENCE

# Stress Across the Generations

**A BABY HAS A HIGHER RISK OF DEVELOPING SCHIZOPHRENIA OR AUTISM IF THE MOTHER WAS STRESSED WHILE PREGNANT,** and individuals with these disorders tend to be more sensitive to stress than other people.

The disorders also manifest differently in males and females. On average, males display symptoms of schizophrenia earlier in life, and more boys than girls are diagnosed with autism.

How maternal stress triggers these conditions, and why boys appear more vulnerable are questions that Tracy L. Bale, an associate professor of neuroscience with appointments in Penn's School of Veterinary Medicine and Perelman School of Medicine, is investigating. Her research suggests the answers may lie in the different ways male and female brains develop.

In a study funded by the National Institute of Mental Health, Bale built on earlier work showing that exposing a pregnant mouse to stresses, such as wet bedding or unusual noise, caused male offspring to have a heightened response to stress. She wondered if this effect could be passed on to the grandsons of the stressed mothers.

The focus on the male offspring was strategic; male mice don't participate in pup-rearing, thus eliminating confounding effects of nurture versus nature.

Bale found that, indeed, the grandsons of the stressed females showed the same pattern of increased stress sensitivity. In addition, these males had patterns of gene expression in their brains akin to those of normal females. Their performance on tests of cognitive ability and reactions to stress also matched closely with that of females.

When a pregnant mouse is stressed, Bale believes, it sets off a chain reaction that "reprograms" a son's brain to be more like a female brain, possibly by interrupting testosterone signaling during a critical window of development.

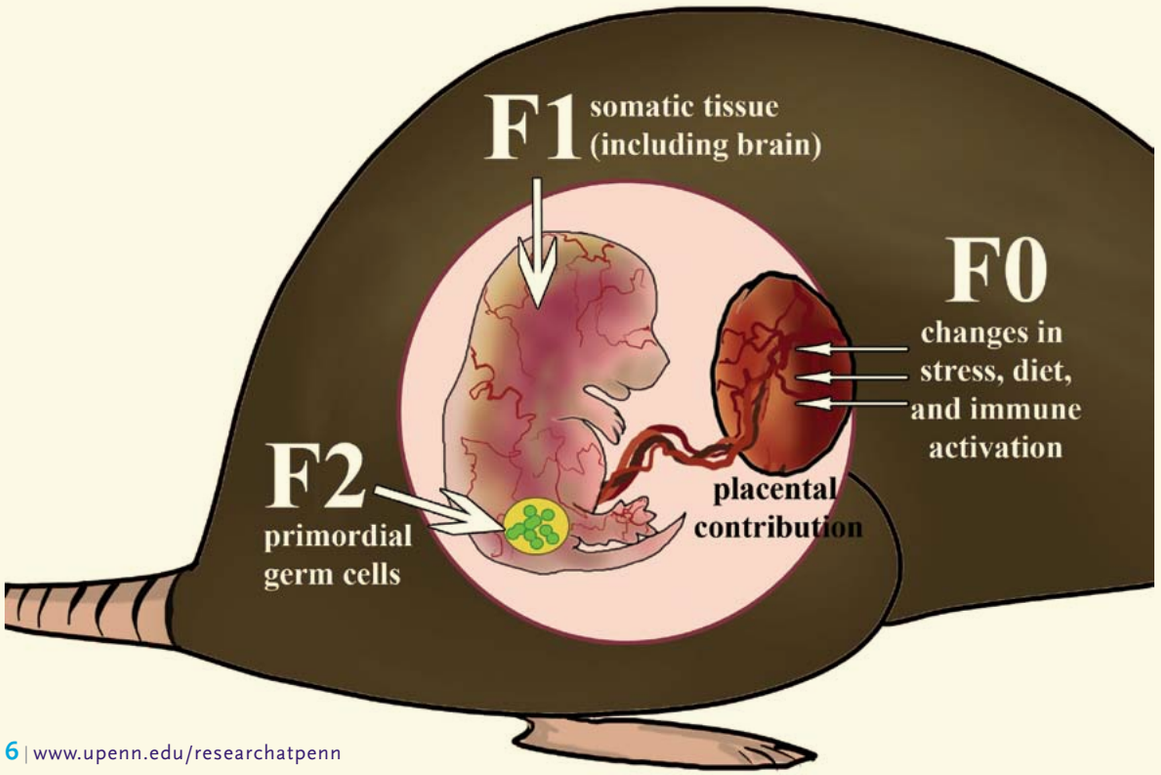
The disruption in signaling appears to extend to the son's germline, enabling him to pass on these effects to his own sons.

Something about the mismatch of female-like brain development in a male body, Bale says, may lead to abnormal stress responses in mice—and could explain some of the sex differences in autism and schizophrenia occurrence in humans.

Bale is seeking the mechanism by which this disrupted development occurs to identify a biomarker for neurodevelopmental disease.

"If I were to tell you your son may be at an increased risk for schizophrenia, that would be frightening to any parent," says Bale. "But wouldn't you want to follow that child closely? Earlier symptom recognition would allow for better intervention and hopefully, better outcomes."

*Tracy Bale's research has shown that when a mouse is pregnant, stress can trigger changes not only to her male offspring, but to the second generation as well.*



HEALTH | OPHTHALMOLOGY

# New Hope for Restoring Sight

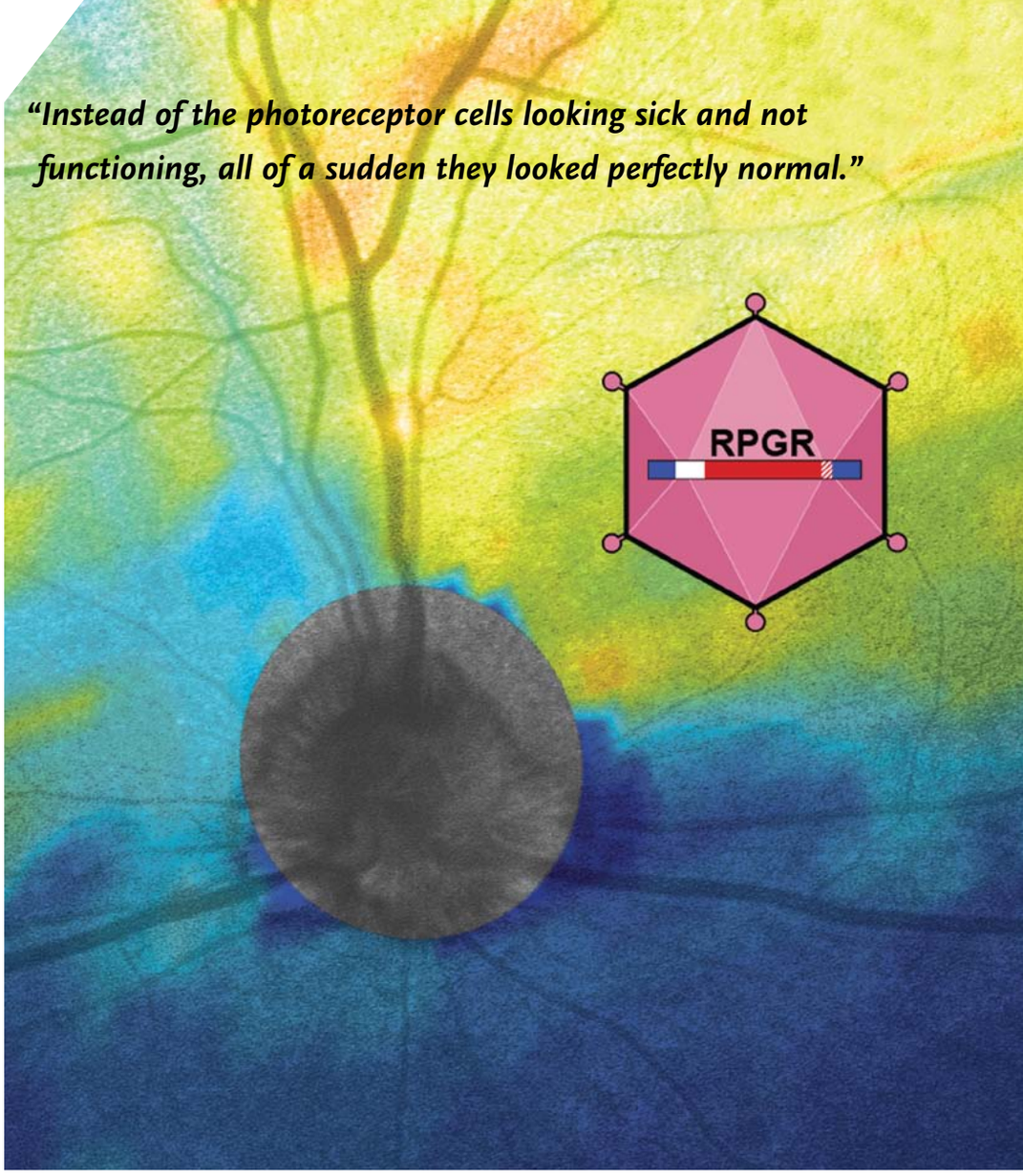
**A GENETIC DISEASE CALLED X-LINKED RETINITIS PIGMENTOSA IS AMONG THE MOST COMMON CAUSES OF BLINDNESS IN HUMANS.** Affecting mostly males, it can begin diminishing sight by the age of 10 and renders most individuals legally blind by 40.

Despite years of study, "we know almost nothing of the mechanism of this disease," says Gustavo Aguirre, professor of medical genetics and ophthalmology in Penn's School of Veterinary Medicine. But that didn't stop Penn scientists and their collaborators from achieving a major breakthrough by curing the condition in dogs—an important step toward stamping out the disease in humans.

To accomplish this, Aguirre teamed up with William Beltran, an assistant professor in Penn Vet's Section of Ophthalmology, as well as colleagues from Penn's Scheie Eye Institute, the University of Florida, the University of Michigan, the University of Massachusetts, and the National Institutes of Health (NIH).

Previous research had indicated the gene responsible for most cases of the disease was called retinitis pigmentosa GTPase regulator (RPGR). The researchers used gene therapy, which involves replacing a malfunctioning gene with a normal one, to attempt to recover sight in four dogs with the condition.

In a study funded primarily by the NIH, the scientists used a non-pathogenic viral vector containing a healthy version of the human RPGR gene and a promoter to precisely direct RPGR to rods and cones, the photoreceptor cells affected by the disease. Treating one eye in each dog, the researchers injected the RPGR-containing vector into a small area underneath the retina.




*"Instead of the photoreceptor cells looking sick and not functioning, all of a sudden they looked perfectly normal."*

The results were overwhelmingly positive. Not only did the treatment stave off the disease's progression, but it actually reversed signs of retinal damage.

"Instead of the photoreceptor cells looking sick and not functioning, all of a sudden they looked perfectly normal," says Aguirre. "It was amazing and totally unexpected."

"Every single marker of the disease that we had pointed out years ago was corrected following the treatment," Beltran says.

Next up for the research team is to ensure these results are lasting and the treatment is safe for the long haul. That would allow a gene therapy treatment to eventually help the thousands of people with this form of retinitis pigmentosa retain their vision.

# Q&A with Carl June

## THOUGH TRAINED AS A DOCTOR, CARL JUNE HAS SPENT MOST OF HIS CAREER IN THE LABORATORY, AT THE LEADING EDGE OF RESEARCH AIMED AT FINDING A CURE FOR CANCER.

Along the way he's been part of previously unimaginable feats: replacing the immune systems of sick people with new versions engineered to fight off HIV and cancer. The last year has been a particularly momentous one for June, the Richard W. Vague Professor in Immunotherapy at the Perelman School of Medicine. After two decades of trials and tribulations, he, along with a team of Penn colleagues, including Professor of Medicine David Porter and Research Associate Professor of Pathology and Laboratory Medicine Bruce Levine, demonstrated a truly groundbreaking treatment for chronic lymphocytic leukemia. They removed T cells from three patients, transformed them by inserting a gene that targets cancer cells, and then infused the beefed-up cells back into the patients. Next they watched as the new T cells killed literally pounds of tumor, sending two patients into complete remission and the third into partial remission.

A similar approach—using patients' own T cells to attack disease—has been shown to be safe in HIV patients, fostering hope that one day HIV may be not just a disease made manageable by antiviral drugs, but also one that is curable.

Efforts like these mark a new age in biology. "There's now this term 'synthetic biology,' which is using principles of engineering to change biological systems," says June. "I like to think of it as putting the immune system on steroids, with the goal of creating an immune system that is better than nature made it."

### Q: HOW HAS THE THINKING ABOUT CURING CANCER EVOLVED OVER THE COURSE OF YOUR CAREER?

After my medical training, I was a fellow in oncology and for many reasons I went into bone marrow transplantation. Back then that was the latest and greatest thing in cancer research. I was fortunate to be at the Fred Hutchinson Cancer Research Center [in Seattle] in the '80s and saw the first transplants as they worked. It was a really exciting time.

Unfortunately, though, in those early days, most patients died from the toxicity of graft-versus-host disease, where the incoming immune system from the bone marrow transplant actually kills a patient. Also, bone marrow transplants work best for younger people who can survive the toxicity. And to get a transplant, you need a donor, usually a brother or sister, who is a match. So what we've worked on since then is figuring out how you can have the kind of benefit that we saw with bone marrow transplants without the harmful effects. The way we've tried doing that is by using the patient's own immune system instead of a foreign one to fight cancer.

### Q: HOW DOES THIS APPROACH RELATE TO YOUR WORK ON HIV?

Over the years, part of my lab has been devoted to HIV and part to cancer. Each of those fields of research has really informed the other and allowed us to leap-frog forward faster than if we had only been doing one or the other.

The unifying idea is making a patient's own immune system work better. My first lab work was learning how to culture, or grow, T cells. Then we had to figure out how to safely introduce those cells back into humans. In a quirk of fate it turned out that, ethically, HIV/AIDS patients would make the best test case, because at that time drug resistance meant that many patients couldn't control their infections. If we could restore their T cells, they would directly benefit. So even though I'm trained as an oncologist, our first trials were in people with HIV and we had quite encouraging results. We could take someone's T cells, grow them up in the lab, give them back to the patients, and their circulating T cell count would double.

For our cancer trials, we applied what we learned from the data in HIV patients, where we used so-called natural T cells that hadn't been gene-modified, to genetically engineered cells.

### Q: PREVIOUS GENE THERAPY TRIALS HAVE FAILED OR EVEN MADE PATIENTS FATALLY ILL. HOW WAS YOUR GROUP'S STRATEGY DIFFERENT?

Our work in HIV patients showed that we had a safe system to deliver new genes into T cells, so we adapted it to target leukemia. We tested three things that had never been done in cancer patients before: One was that we used an HIV-based vector with the pathogenic elements removed to insert new genetic material into T cells. Another was that the engineered vector included a receptor called a chimeric antigen receptor (CAR) that targets leukemia cells and signals T cells to proliferate once they bind to the cancer cells. The third was that we used a much more efficient system than what had been done previously to grow T cells in the lab before transfusing them back into the patients. Other systems required three months and ours took only 10 days, so the T cells weren't all worn out before returning them to the patients. Some aspect amongst all of these manipulations is the magic ingredient that made it all work.

### Q: THE THREE PATIENTS YOU TREATED INITIALLY HAVE BEEN IN REMISSION FOR TWO YEARS NOW. WERE YOU EXPECTING SUCH A DRAMATIC RESPONSE?

Honestly, no, because there had been at least five previous trials using CARs for gene therapy in cancer patients and none of them had any responses. Here, within a week to three weeks of treatment, we saw these responses that were much more robust than they had been in our mouse models. In our mouse studies, each T cell would kill about 40 tumor cells. The *minimum* we found in our three adult human patients was that each T cell killed 1,000 cancer cells.

### Q: HOW WILL YOU BUILD ON THESE RESULTS?

We want to get our system FDA-approved so anyone can get it, not just patients in the sophisticated yet boutique medical center that we have here at Penn. To scale it up we need to have the pharmaceutical industry involved, and we are pleased to have established an alliance with Novartis that has a central objective to gain FDA approval of these new cell-based therapies. We're also testing this technique in more patients, including children with acute leukemia in collaboration with Stephan Grupp of Children's Hospital of Philadelphia.

Over the next five years we will be adapting our method to treat solid cancers. Virtually any tumor could be treated with this kind of approach because you can swap out a portion of the engineered T cells to change your target from leukemia cells to whatever kind of tumor you have. We're currently working with other scientists and clinicians at Penn to develop protocols for breast cancer, pancreatic cancer, and lung cancer.

Penn has the best infrastructure of any university in the country to do this; we've found the sweet spot where we have good basic science along with the ability to apply it in human patients. It's been an exciting last decade and I'm really excited about what's going to happen on campus in the decade to come.

# Microscopic Fossils Connect Climate Change to Sea Level Rise

One of the main challenges in researching climate change is reconstructing its history. To have a better sense of the causes and effects of future changes, scientists need to understand the past.

One effect with serious consequences is sea level rise. Hotter temperatures mean higher seas, and that could mean disaster for coasts the world over. Predicting the rate and magnitude of global sea level rise, as well as its local effects, is a high priority.

Benjamin Horton, associate professor of earth and environmental science in Penn's School of Arts and Sciences and director of the Sea Level Research Laboratory, is a leader in that quest. In the *Proceedings of the National Academy of Sciences,* he and an international team of colleagues published the first continuous sea level reconstruction that spans millennia.

"We took what was a 300-year record and made it a 2,200-year record," Horton says. "We increased the length of the continuous sea level record by seven times."

The direct recording of sea levels is a relatively recent phenomenon, especially compared with the geological timescales over which changes to sea levels and temperature both typically occur. Tide-gauge measurements stretch back into the early 17th century, but Horton and his team needed much more data to see meaningful trends and correlations.

Like temperature researchers who reach back into time using proxies, such as tree rings and ice cores that have bubbles of thousand-year-old air trapped inside, Horton's team studies historical sea levels using the fossils of microscopic organisms known as foraminifera.

**NATURAL SCIENCE** | *FAST FACT*

*Earth's average temperature rose* **1.4°F** *over the past century. A further rise of 2 to 11.5 degrees is projected in this century.*

*"Once you take records back in time, however, you can clearly see that there is an acceleration in sea level rise."*

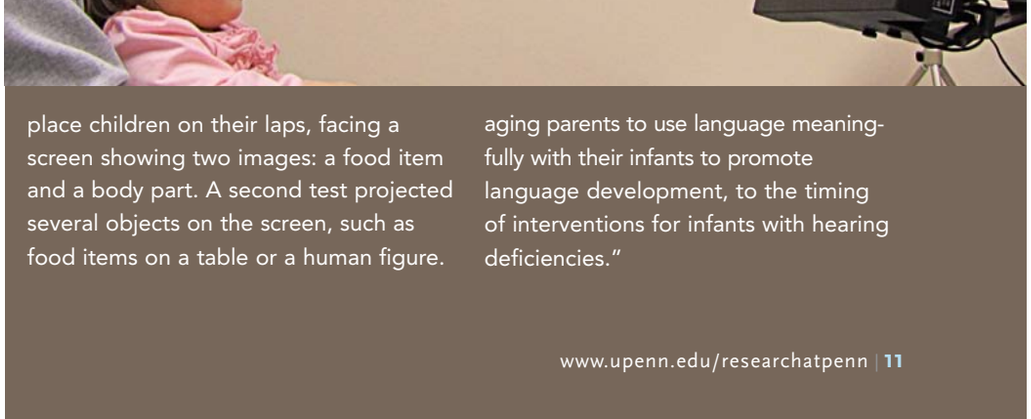
Horton and his students traveled to the salt marshes of North Carolina to collect sediment cores. Different kinds of foraminifera live at different depths, so by studying the concentrations of fossils at various layers of the cores, the researchers could extrapolate sea levels tracking backward in time.

The research team checked their findings against local and global tide-gauge data and confirmed their findings via a second reconstruction based on data gathered in Massachusetts.

Without historical context, anomalous stretches can obscure the overall changes in rate. The researchers found the rates of sea level rise closely match the reconstructed history of temperature rise over the same period, with a notable spike around the time of the Industrial Revolution.

"Once you take records back in time, however, you can clearly see that there is an acceleration in sea level rise, beginning in the latter part of the 19th century," Horton says.

Horton has since received grants from the National Oceanic and Atmospheric Administration and NASA to expand this line of research and compare the fossil records in different locations along the eastern seaboard. He was also appointed to a National Research Council committee tasked with providing an assessment of sea level rise along the West Coast of the United States.



NATURAL SCIENCE | PSYCHOLOGY

# BABY TALK: It's More Than Just Babble

**IN RESEARCH THAT CHALLENGES A WIDELY HELD CONSENSUS THAT INFANTS BETWEEN 6 AND 9 MONTHS OLD DO NOT POSSESS THE ABILITY TO GRASP THE MEANINGS OF WORDS,** Penn psychologists Elika Bergelson and Daniel Swingley have demonstrated that in their daily experience with language, babies can, indeed, learn the meanings of words for foods and body parts.

The study, conducted by Bergelson, a doctoral student, and Swingley, an associate professor in Penn's Department of Psychology in the School of Arts and Sciences, was published in the *Proceedings of the National Academy of Sciences*, and suggests that although most psychologists believed word comprehension didn't emerge until a child neared his or her first birthday, "by 6-9 months, infants have already begun to link words with their referents."

For the study, supported by the National Science Foundation and the National Institutes of Health, Bergelson and Swingley recruited caregivers to place children on their laps, facing a screen showing two images: a food item and a body part. A second test projected several objects on the screen, such as food items on a table or a human figure.

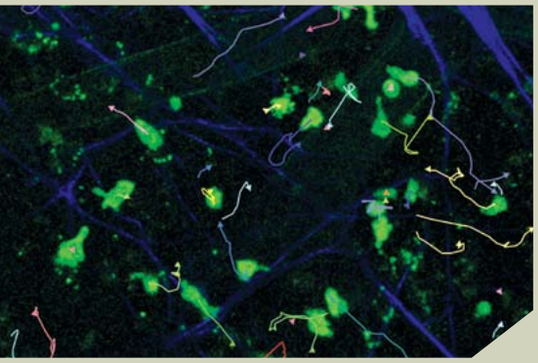
The caregiver was prompted through headphones to make statements such as, "Look at the apple," or "Where's the apple?" to the child. The caregiver also wore a visor to avoid seeing the screen.

An eye-tracking device that distinguishes precisely where a child is looking and when, followed the child's gaze, allowing researchers to determine whether hearing a word would lead the child to look at that object more, indicating the infant understood the meaning of the word. In total, Bergelson and Swingley tested 33 6- to 9-month-olds.

The researchers found the 6-to-9-month-old babies fixed their gaze more on the picture that was named than on the other image or images, signifying they understood the word associated with the appropriate object. The study's novel results contribute a significant finding in the ongoing debate about infant language acquisition and cognitive development.

"This has implications in several areas," Swingley says, "from programs encouraging parents to use language meaningfully with their infants to promote language development, to the timing of interventions for infants with hearing deficiencies."

# How Immune Cells Move



**IN A STUDY THAT COUPLED THE EXPERTISE OF PHYSICISTS WITH THAT OF IMMUNOLOGISTS,** a Penn-led team discovered that T cells—white blood cells responsible for fighting infectious and foreign material in our bodies—track down parasites using a zig-zagging search strategy similar to behavior employed by marine predators such as sharks and bluefin tuna hunting prey.

This was not what most immunologists suspected that T cells would do, according to Christopher Hunter, professor and chair of the Pathobiology Department in Penn's School of Veterinary Medicine. "We thought T cells would be very directed in their movement toward parasites," he says.

But when he and postdoctoral researchers Tajie Harris and David Christian tracked the paths of T cells in the brains of mice infected with a parasite using a powerful microscope that shows live cells in three dimensions in real time, they observed the cells moving in a seemingly random fashion. The immunologists called upon Andrea Liu, professor of physics in the Department of Physics and Astronomy in the School of Arts and Sciences, and graduate student Edward Banigan to help interpret the cells' movements.

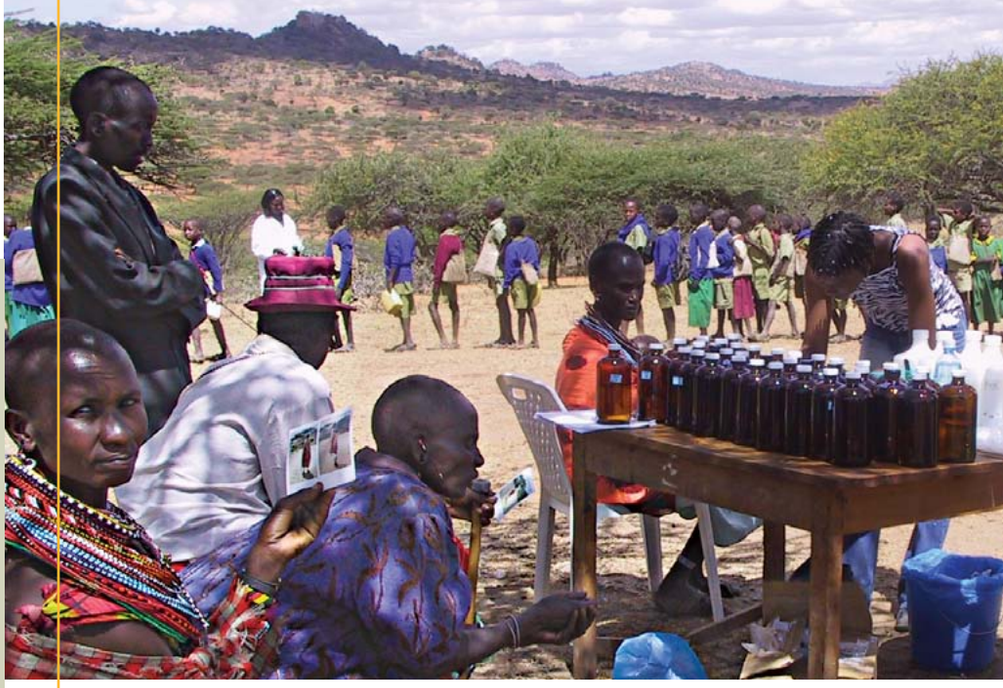
The physicists tried out several statistical models to fit the T cells' tracks. "After some work, we managed to find a model that did fit the tracks beautifully," says Liu. Their model involves the cells taking many short "steps" and occasional long "runs," with pauses in between.

Such a strategy is efficient at finding rare targets, according to the researchers' analysis, which may explain why some wildlife species—including tuna, sharks, and penguins—use a similar tactic to seek prey. The researchers' results were published in the journal *Nature*.

Now that they know how T cells navigate our bloodstreams, the researchers are busy characterizing the paths of other types of cells and thinking about what this new knowledge could mean for fighting infections, autoimmune disease, and even cancer.

"We are on our way to more accurately describing how the immune system functions," says Hunter.

The research was funded primarily by the University of Pennsylvania, the National Institutes of Health, and the National Science Foundation.



NATURAL SCIENCE | GENETICS

# Genes That Make Us Different

**FROM THE YORUBA IN THE WEST TO THE MAASAI IN THE EAST, IT'S CLEAR THAT AFRICANS ARE A DIVERSE GROUP OF PEOPLE.** That diversity has long interested Penn Integrates Knowledge Professor Sarah Tishkoff, who has led three recent studies of the human genome to unearth the genetic basis of some of the traits that distinguish African groups from one another.

Tishkoff, who has appointments in the Perelman School of Medicine's genetics department and the School of Arts and Sciences' biology department, collaborated with scientists from around the globe to pinpoint the genes responsible for encoding three specific traits: short stature in Cameroon's Western Pygmies, sensitivity to bitter taste in various African groups, and adaptations to high altitude in the Amhara people of Ethiopia. The work was funded primarily by the National Institutes of Health and the National Science Foundation.

"The common theme is, how do humans adapt to their local environment?" says Tishkoff. "We're particularly interested in Africa because it is the site of origin of all modern humans. Populations have been living there longest, so they've had a long time to accumulate genetic variation."

In one study, Tishkoff and her colleagues found several genes that might play a role in making Pygmies short. These genes may have been passed down through the generations because they imparted physiological benefits, such as shoring up the immune system against infectious disease.

Another project examined the expression of a gene that heightens sensation

of bitter tastes. Tishkoff's team showed that the presence of this "supertasting" gene did not correlate with the diets of the 57 African groups studied. Instead, the gene, which is expressed not only in the mouth but also in the linings of the lungs and guts, may confer other advantages, such as acting as a sentry against pathogens entering the body.

And in research on the Amhara, who live at elevations exceeding two miles above sea level, Tishkoff found that they possess genetic adaptations that permit them to thrive in low-oxygen surroundings. These genetic changes, however, are distinct from the adaptations that high-altitude-dwelling people in the Andes and the Tibetan plateau have acquired—a sign of the diverse ways in which evolution can act.

"People always ask, 'Is evolution still ongoing?'" says Tishkoff. "Here are examples of traits where, yes, we can see that it is."



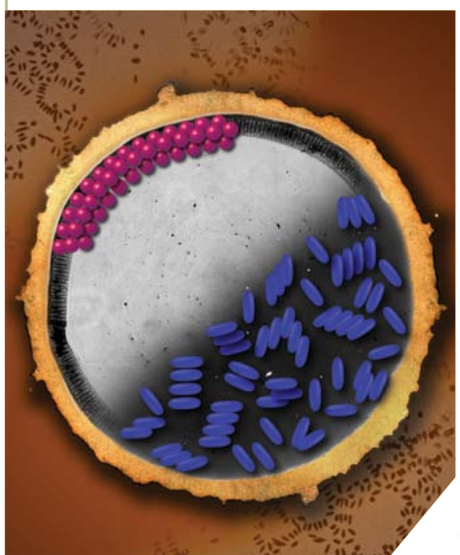
# Beating the *'Coffee Ring Effect'*

**IT'S A COMMON OCCURRENCE—A DROP OF COFFEE SLIDES DOWN THE SIDE OF YOUR MUG AND MAKES A STAIN ON YOUR KITCHEN COUNTER.** But look closer: The shape of that stain, called the coffee ring effect, is a phenomenon of great interest to physicists.

When a drop of water lands on a surface, its edges often get stuck in place. When the water in the coffee finishes evaporating, the coffee particles are left in a concentrated ring at the edge.

Scientists from Penn's Laboratory for Research on the Structure of Matter (LRSM) have shown that simply changing the particle's shape disrupts the effect, resulting in smooth, uniform coatings.

"Different particle geometries change the nature of the membrane at the air-water interface, and that has big consequences," says senior author Arjun Yodh, professor in the Department of Physics and Astronomy in the School of Arts and Sciences and director of the LRSM.

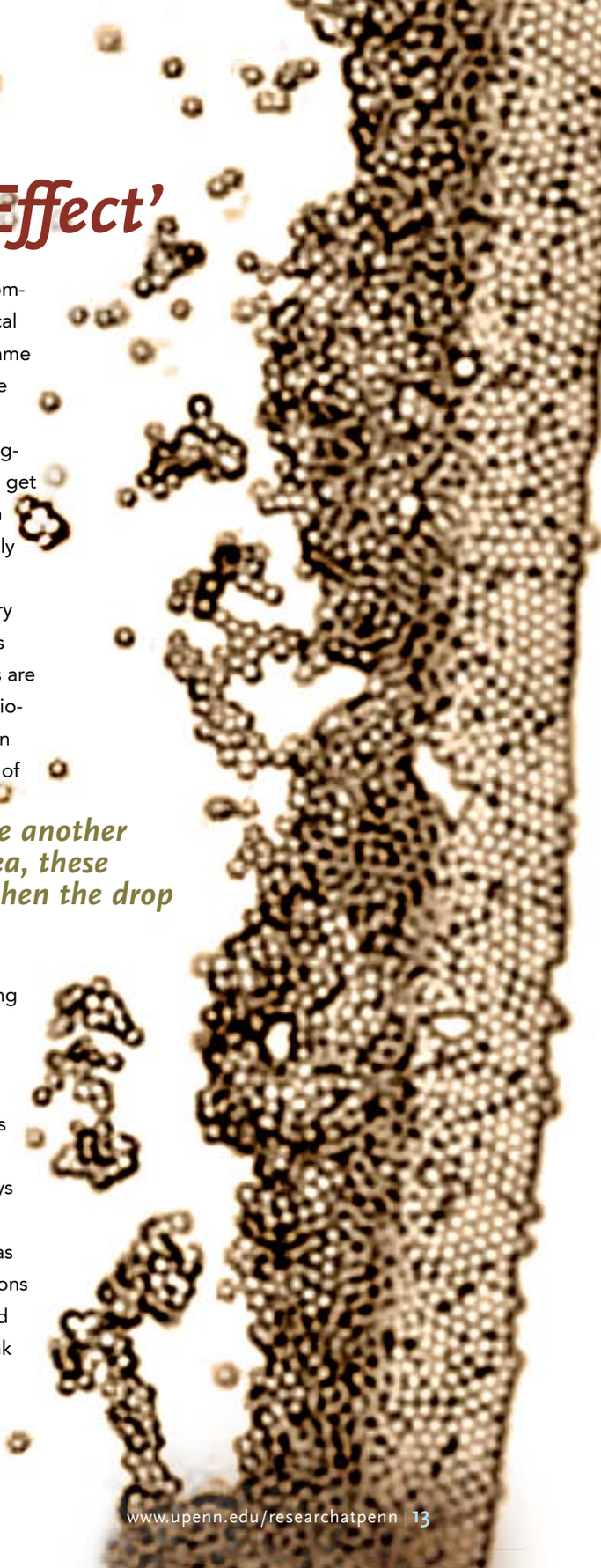


Under a microscope, researchers compared drops containing either spherical or elongated particles made of the same material. While spherical particles, like those in coffee, flowed freely to the edges, elongated particles created logjams on the drop's surface. Unable to get around one another or concentrate in one area, these particles settled evenly when the drop fully evaporated.

The study, published as a cover story in the journal *Nature*, has implications beyond basic physics. Liquid coatings are found in a number of industrial and biomedical applications, and achieving an even layer of particles on a surface is of paramount importance. But preexisting methods have required changing the chemistry of the coating.

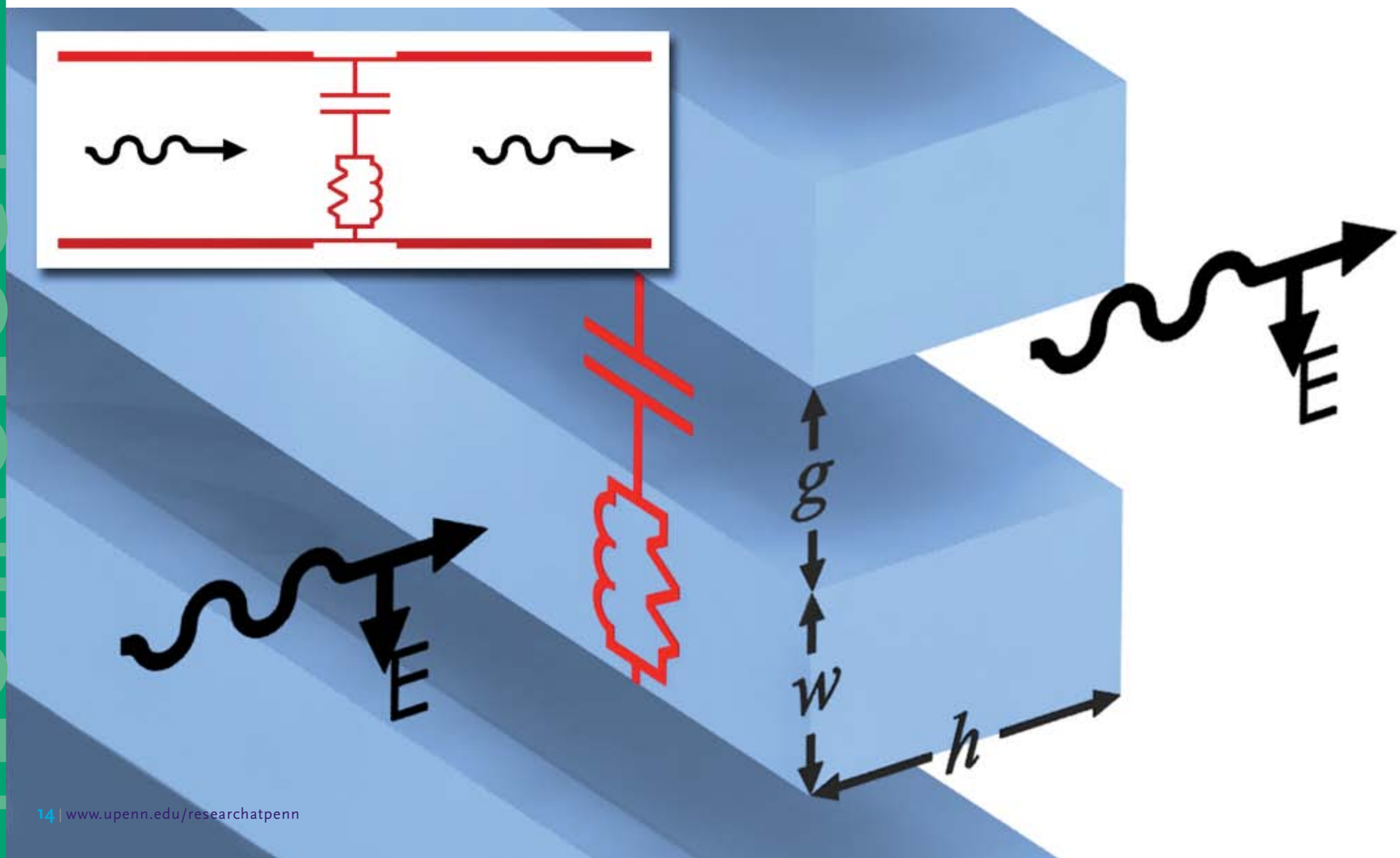
*Unable to get around one another or concentrate in one area, these particles settled evenly when the drop fully evaporated.*

"In many cases, the way we make coatings involves hazardous chemicals and if you need something that's biocompatible, it's more difficult," says lead author Peter Yunker, a doctoral candidate at the time the research was conducted. "There are a lot of situations where you want uniform coatings, and this work will stimulate people to think about new ways of doing it."



# Introducing Metatronics

*When the plane of the electric field crosses both the nanorods and the gaps, the circuit is wired in series.*



In the long history of electronics, scientists and engineers have been on a progressive quest to expand their toolkit of circuit elements and gain increasingly intricate control over electrons.

The field of metamaterials, in which scientists manipulate electromagnetic waves in ways not found in nature, has a much shorter history. But it is following a similar trend, as scientists use advances in nanotechnology to expand the range of the electromagnetic spectrum with which they work.

The nascent field of metamaterials is focused on creating human-made features that can bend and manipulate waves in ways that nothing in nature can. Just as a wave's shape determines its properties, the shape of objects that a wave interacts with can further influence those properties. Metamaterials must contain artificial structural features, known as inclusions or meta-atoms, which are smaller than a wavelength. The size, shape, material, and pattern of these inclusions produce the unusual properties of metamaterials and could lead, for example, to "invisibility cloaks" that bend light around objects, making them harder to detect.

Nader Engheta, professor of electrical and systems engineering in Penn's School of Engineering and Applied Science, who has roots in both electronics and metamaterials, has merged concepts from those two disciplines into a new sub-field he has dubbed "metatronics."

Engheta envisioned harnessing the properties of metamaterials to apply concepts in electronic circuitry to light waves, creating the potential for even smaller and faster electronic devices. In a 2005 paper, Engheta showed such an application was theoretically possible. But now, he and his research group have made the idea a reality.

They have fabricated tiny comb-like structures made of nanorods; the spacing of the rods and gaps between them serve as the device's inclusions. When a wave of infrared light passes through the comb, the wave's properties are changed in a way that's analogous to electrons passing through a circuit with an inductor, capacitor, and resistor.

The researchers published a paper describing this first physical metatronic circuit in *Nature Materials.* An experimental verification of another aspect of metatronics appeared in *Physical Review Letters.*

Using spectroscopy to measure the wave as it passed through the comb, Engheta's team showed the size and shape of the inclusions determined the parameters of the metatronic circuit's elements. By trying nanorods with different combinations of widths and heights, they proved that the optical equivalents to current and voltage were altered—almost as if an electrical engineer had switched out a traditional circuit's resistors and capacitors.

The study lays the foundation to what could be a major leap forward in information processing technology.

# Making Smartphones SMARTER

**TECHNOLOGY** | COMPUTER & INFORMATION SCIENCE

**AS COMPUTER PROCESSORS GET FASTER, THE HEAT THEY GENERATE INCREASES AS WELL,** and that heat must be dissipated before it destroys the chip. Engineers have found ways around this problem in larger devices: Mainframes reside in expensive climate-controlled rooms and desktop computers use fans, heat sinks, and even elaborate liquid-cooling systems.

But for smartphones and other hand-held devices, cooling options are limited.

"With hand-held devices becoming the dominant platform, we're looking at a trend where you have a lot of transistors, but you can't use them all at once in a sustained fashion," says Milo Martin, associate professor of computer and information science in Penn's School of Engineering and Applied Science. "So we asked, what if we designed a chip to run at 16 times the sustainable rate, but only for half a second? Can we do it without burning out the chip?"

Martin, along with his Penn students and researchers from the University of Michigan, calls this new approach "computational sprinting." Their research, published in the *Proceedings of the International Symposium on High-Performance Computer Architecture*, proposes boosting devices' power by concentrating their computation in brief bursts or "sprints."

Martin and his colleagues have simulated chips that exceed their thermal capacity by 10 times or more, giving hand-held devices the equivalent of desktop power during their sprints. Efficiency could be further improved by incorporating a phase-change material that would absorb heat by partially melting, and then slowly releasing it while hardening.

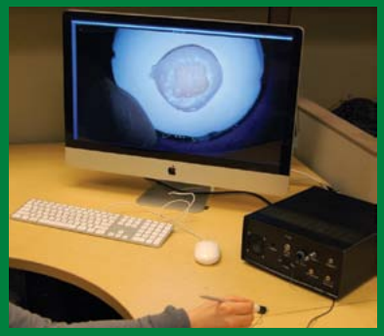
***Martin calls this new approach "computational sprinting."***

This approach is consistent with the way hand-held devices are actually used: People expect them to deliver rapid results, then put them away until it's time for the next job. With this technology, tasks like speech recognition could be vastly improved, and entirely new applications could be devised.

"We're enabling people to do things that they haven't even thought of yet," says Martin.

**TECHNOLOGY** | FAST FACT

**45%** *of all American adults own a smartphone and 85% have a cellphone.*



# Dental Teaching Tools Provide the Power to Feel

**WHEN IT COMES TO DRILLING A CAVITY, EVERYONE WANTS A HIGHLY TRAINED DENTIST,** but no one wants to be trained upon. Dental students practice on mannequins with plastic teeth before they have real patients in the chair, but even sophisticated computer programs that track the students' progress can't give them the most crucial information of all: what a tooth actually feels like. Unfortunately, there is no good substitute for the different layers of tissue in a living tooth and how they respond to the tip of a dental tool.

"Nationwide, the primary reason students fail the cavity preparation portion of their board exams is that they leave the last little bit of decay inside a tooth," says Margrit Maggio, assistant professor of preventive and restorative sciences in Penn's School of Dental Medicine. "They're not totally understanding the difference between the feeling of a healthy tooth and an almost-healthy tooth."

Looking for a better way of training dental students, Maggio approached Katherine Kuchenbecker, assistant professor of mechanical engineering and applied mechanics in the School of Engineering and Applied Science, an expert on touch feedback technology. Together, they designed a "haptographic" device, which was awarded Best Demonstration at the IEEE Haptics Symposium 2012.

Haptography captures the way something feels, much like how photography captures the way something looks. Taking a cue from Kuchenbecker's other haptography projects, such as a stylus designed to add the feeling of textures to a computer's touchscreen, the team outfitted a device with accelerometers that attach to several different dental tools, picking up the vibrations from the instruments as they are used on and in the tooth.

Another probe, outfitted with motors, allows students to feel what an instructor is doing as he or she is doing it, or play back recordings of dental examinations and preparation procedures that have a "touch track" in addition to a magnified visual track and sound track.

"Students need to understand the tactile, audio, and visual cues related to decay removal and cavity preparation," says Maggio. "This technology can help them do that before they have their first patient."

# Detecting Chemicals *With* Nanotubes

**NANOTUBES, ROLLED-UP SHEETS OF CARBON ATOMS ARRANGED IN HEXAGONAL RINGS,** are widely heralded as a next-generation material for building electronic components. Their microscopic size and tremendous strength make them ideal candidates for construction materials on the nanoscale, and their conductive properties mean they can be used like wires and transistors in tiny electrical devices.

A.T. Charlie Johnson, a professor of physics in the Department of Physics and Astronomy in Penn's School of Arts and Sciences, has taken this technology a step further, using nanotubes to make a kind of "digital nose." In a study published with colleagues from the Monell Chemical Senses Center in the journal *AIP Advances*, Johnson has shown single-stranded DNA can be attached to a carbon nanotube and used to detect chemicals with extreme precision.

In the body, DNA encodes genetic information through a series of matched chemicals, known as base pairs, which know how to find their partners when its two helical strands split up and come back together. Other researchers have shown that the single strands of DNA can recognize other kinds of chemicals, and since 2005, Johnson has been using nanotechnology to bridge the chemical-digital divide.

"DNA is very compatible with carbon nanotubes," Johnson says. "We can wrap a single strand of DNA around a nanotube and have the DNA-nanotube hybrid act as an electrical device, where the output changes when its immediate environment changes.

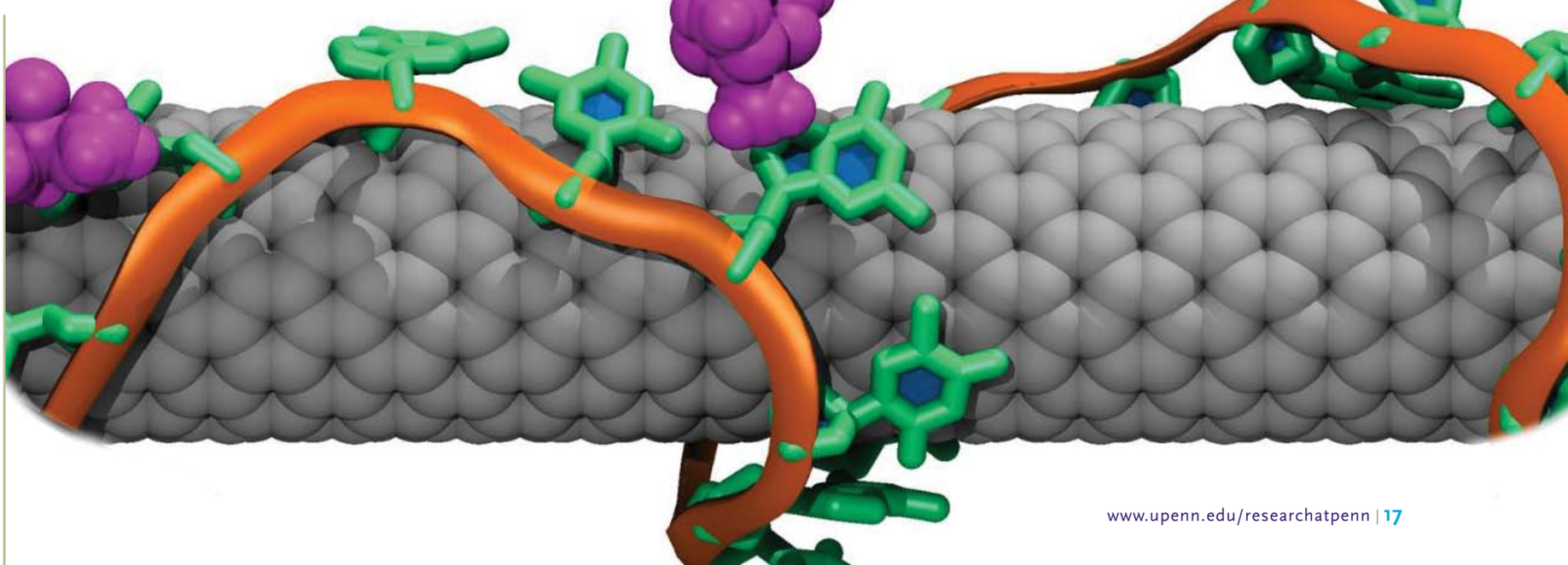
***Johnson has taken this technology a step further, using nanotubes to make a kind of "digital nose."***

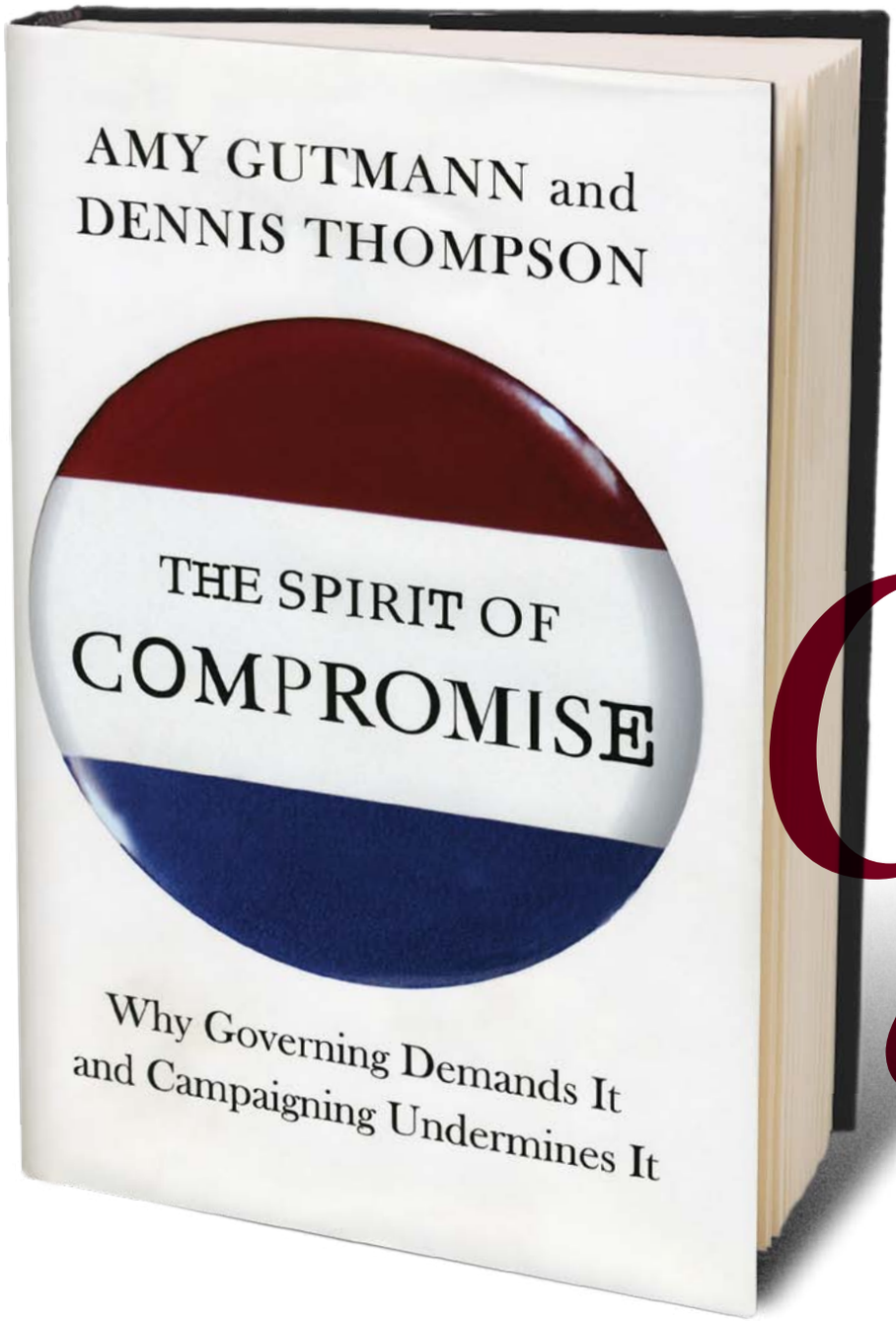
We're probing just how subtle a difference you can detect with this method."

The ability to tailor the attached DNA sequence could make these devices highly sensitive digital chemical detectors. In experiments, the devices were able to differentiate between enantiomers, or chemicals that are mirror images of each other, as well as between chemicals that differed by a single atom.

While further study is necessary to pinpoint the exact mechanism at work, the researchers believe chemicals nestle into the spaces between the DNA bases and the nanotube surface in different ways, causing varying electrical responses.

"Even if you take exactly the same bases and just reorder them, you really change the response," Johnson says. "That means that each base is not acting individually, but in combination with its neighbors."






# Is Compromise Doomed in American Government?

Gridlock in Washington is not a new occurrence. But the degree to which it has frozen Congress is significant.

Moderate members of Congress are retiring because politicians have become hard-line partisans, making governing difficult. Many seemingly uncontroversial pieces of legislation need to overcome a filibuster to get through the Senate. Some politicians pledge loyalty to extreme, uncompromising positions, no matter the effect on writing and passing legislation.

Is compromise doomed in this polarized political climate?

To be sure, crafting compromise is challenging, says Penn President Amy Gutmann, co-author of the book "The Spirit of Compromise: Why Governing Demands It and Campaigning Undermines It."

Not only do increased political polarization and a copious amount of money influence the political process, but, Gutmann and co-author Dennis Thompson of

SOCIAL SCIENCE | FAST FACT

**34%** *of Americans trust the legislative branch of government a great deal or a fair amount.*

Harvard contend, we live in an era characterized by "the permanent campaign." This fixation on mistrusting or demonizing opponents while adhering to principles at any cost creates what Gutmann calls an "uncompromising mindset"—something that is effective during the election cycle but stymies the work of governing.

"In contrast to that, governing requires what we call 'principled prudence.' Your principles should be guideposts rather than roadblocks," explains Gutmann, also the Christopher H. Browne Distinguished Professor of Political Science in the School of Arts and Sciences. "They're guideposts to signal where you want to go, but you figure out how you can actually start moving in that direction by respecting your opponents."

Ideally, once a campaign is over, Gutmann says we want leaders who sit down with their opponents to seize opportunities to compromise in order to move the country forward.

The authors highlight two examples of successful compromise—the Tax Reform Act of 1986 under President Ronald Reagan and the Patient Protection and Affordable Care Act of 2010.

"The Tax Reform Act of 1986 was the single greatest reform of taxation in a century, and it was done because strong partisans were able to sit down together," Gutmann says. "Fast forward to the Affordable Care Act. … As hard as it was to create a bipartisan compromise 25 years earlier, it was [equally difficult] to create this compromise within one party."

Compromise is made difficult by the ease and frequency with which politicians campaign and is exacerbated by the 24/7 news cycle, an unlimited flow of campaign money, and the increased use of the filibuster in the Senate.

But Gutmann notes that this country works best when there is compromise.

"Compromise gives all sides something they value, but it requires each side to sacrifice," she says. "Democracy requires compromise. Compromise is difficult, but governing without compromise is impossible. Most major legislation that moves this country forward requires our elected officials to sit down together and compromise."

***"The Tax Reform Act of 1986 was the single greatest reform of taxation in a century, and it was done because strong partisans were able to sit down together."***

# The Changing Face of Broadcast News

SOCIAL SCIENCE | COMMUNICATION


**IN THE GOLDEN AGE OF BROADCAST TELEVISION,** "CBS Evening News" Anchor Walter Cronkite was called the most trusted man in America, an image punctuated by his signature line, "And that's the way it is."

Today, increasing numbers of people get their news from a variety of websites, blogs, and social media, as well as non-traditional news sources that include "The Daily Show" and "The Colbert Report."

To be sure, the news world has changed dramatically in the past 20 years, says Michael X. Delli Carpini, professor of communication and dean of Penn's Annenberg School for Communication. And while many people say the old regime was a system in which journalists provided fair and neutral information, Delli Carpini contends that's both an exaggeration and historically shortsighted.

In his book "After Broadcast News: Media Regimes, Democracy, and the New Information Environment," co-written with colleague Bruce A. Williams from the University of Virginia, Delli Carpini says the shift to a new media regime has happened before.

"How the media plays out—what it looks like, what its role is, who are the producers and consumers, what we expect citizens to do—that has varied dramatically in the United States," says Delli Carpini.

The decay of the old system may not be all bad.

"Every time journalists and editors decided something was not newsworthy, we didn't know about it," he says. "[The new regime] makes citizens more active participants in the process."

He urges people to embrace the changing media landscape, but cautions against consuming information without casting a critical eye.

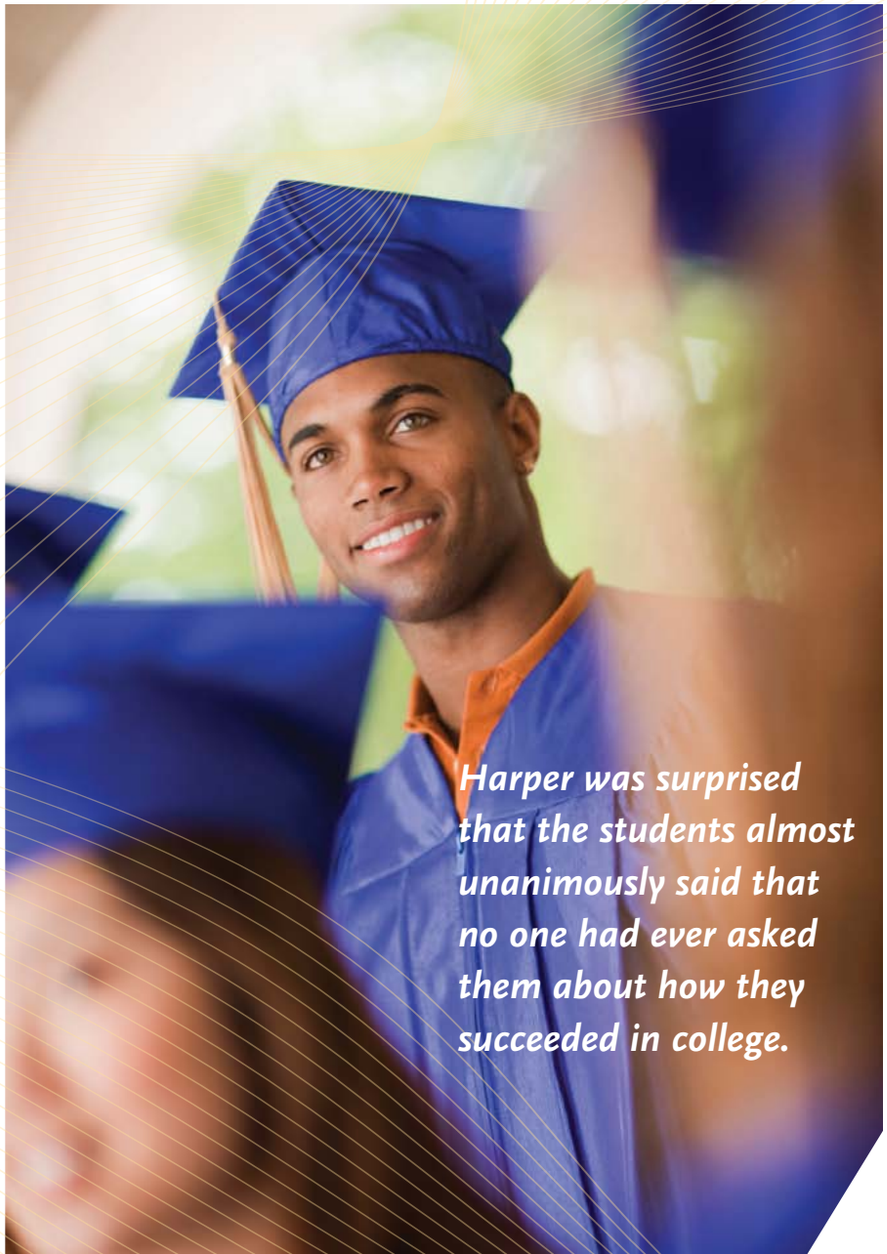
"Does [the news] help you understand and think about and talk about the public world that we live in, the lives of our fellow citizens, and the power structures that affect those lives? If it does, then it's useful and good for democracy," he says.

"We have responsibilities as citizens to make sure that our political leaders and media owners take us seriously and design, to the extent possible, ways in which we can benefit from this system as least as much as we do as consumers of products and entertainment."

# What's Behind the Success of Black Male College Grads?

**COLLEGES AND UNIVERSITIES ACROSS THE COUNTRY ARE GRAPPLING WITH HOW TO IMPROVE THE SUCCESS RATE OF BLACK MALE UNDERGRADUATE STUDENTS,** two-thirds of whom do not graduate.

Policymakers and administrators have been seeking solutions, but Shaun R. Harper, an associate professor in Penn's Graduate School of Education, says many researchers consistently use a singular deficit lens to view the academic failures of black men in colleges and universities, rather than examine the successes of those students who do well academically and graduate.



*Harper was surprised that the students almost unanimously said that no one had ever asked them about how they succeeded in college.*

He argues that those who endeavor to increase the rates of success for black undergraduate men could stand to learn from those black men who have been successful.

Harper's study, "Black Male Student Success in Higher Education: A Report from the National Black Male College Achievement Study," explores the experiences of 219 black male undergraduates who successfully navigated colleges and universities across six different institutional types. It is the largest research study ever on black undergraduate men. Lumina Foundation provided funding.

For his research, Harper visited 42 colleges across 20 states and interviewed each of the black male achievers in person. He says he was surprised that the students almost unanimously said that no one had ever asked them about how they succeeded in college.

"It was surprising because colleges and universities are throwing a lot of money at black male underachievement through initiatives and activities, but they have black men on their own campuses who are successful, and they don't pursue any insights from them into the enablers of their success," Harper says.

The study provides 12 recommendations for improving black male student success in college, including removing financial barriers and addressing toxic racial climates on campus.

Harper says he hopes educators learn from the black male achievers highlighted in his report.

# Why Some Government Programs Succeed and Others Fail

**AS A RENOWNED EXPERT IN DOMESTIC VIOLENCE AND CHILD WELFARE,** Richard Gelles has seen firsthand how policymakers' good intentions can go awry.

Gelles, dean of Penn's School of Social Policy and Practice and author of "The Third Lie," says one of the most common complaints about government programs is that some evolve into open-ended, costly entitlements. The state of Hawaii, for example, spent one-eighth of its 2001 budget on children who make up 0.009 percent of the population, in order to comply with the Individuals with Disabilities Education Act of 1993.

Why are some government programs successful and others a failure?

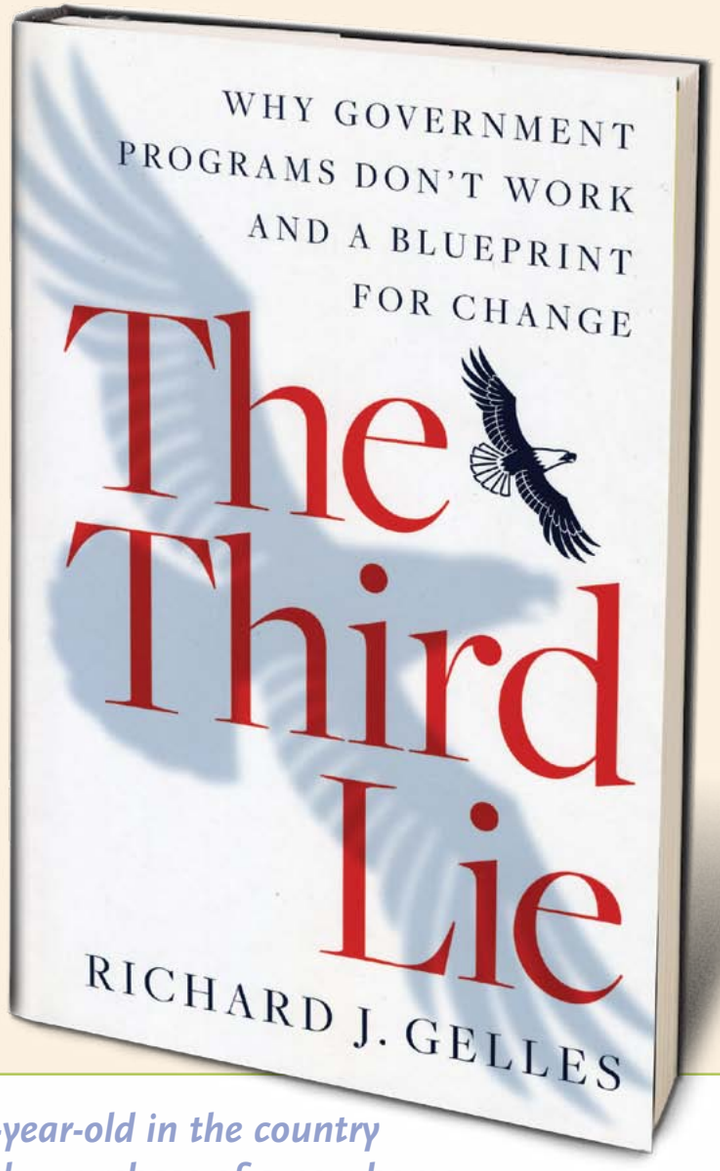
Gelles found that the difference lies in how programs determine eligibility. "Residual model" programs—those set up to meet individual and family needs when existing institutions fail—are typically unsuccessful because these programs are means-tested, he says. Good intentions are undermined and resources are diminished by a lack of precision about eligibility. "More money and more energy goes into the means testing and it dilutes whatever program you have left," Gelles says.

The more successful approach is the "institutional model," in which the government creates permanent and centralized programs with no means testing, as with Social Security, Medicare, and the GI Bill. "What [these programs] all had in common was universality and the acceptance of the fact that they were fair," Gelles explains.

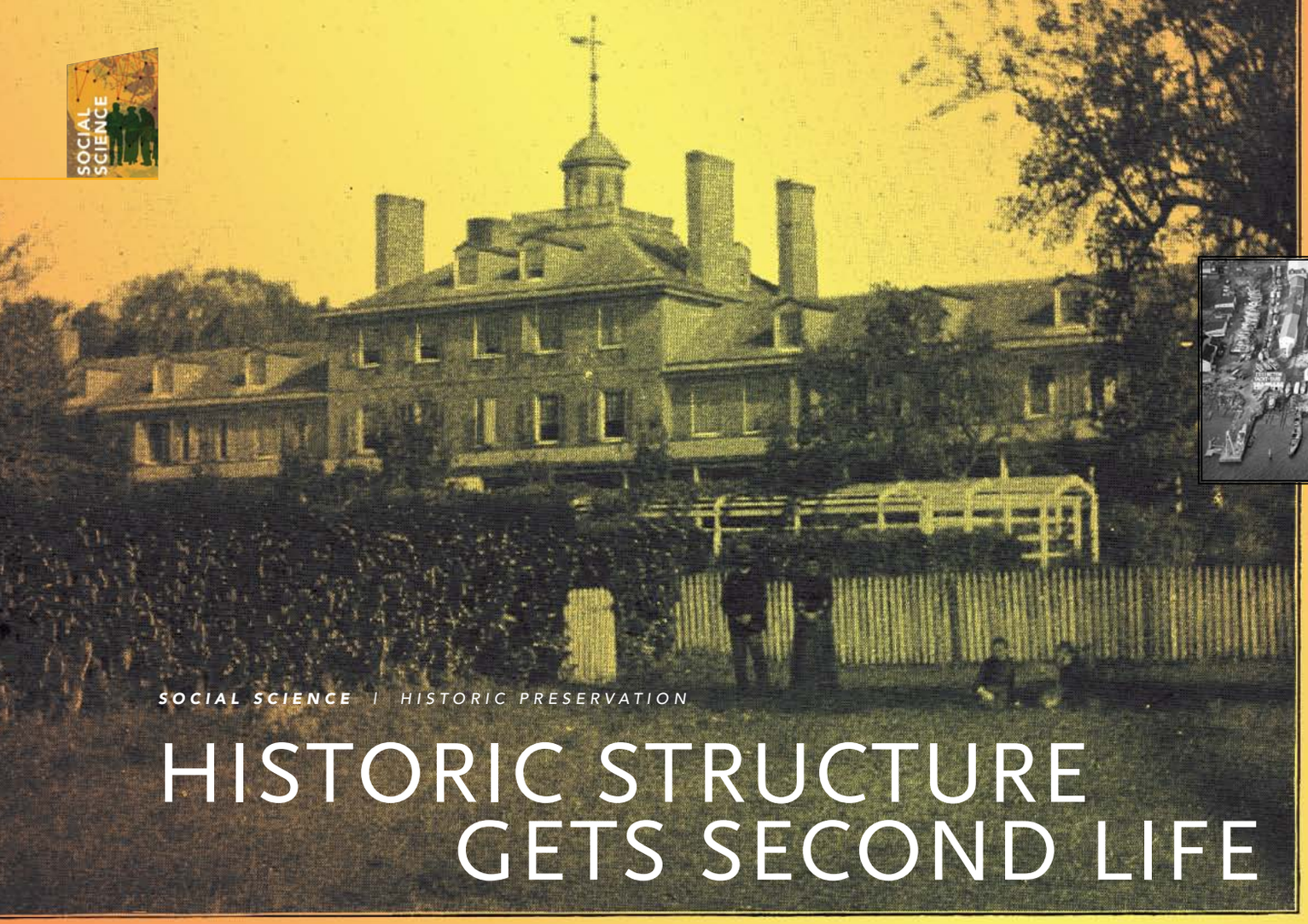
In his book, Gelles proposes a policy designed to support a vital, vibrant middle class that is based on the best practices of the institutional model programs. As he envisions it, a "Futures Account" would provide every 18-year-old in the country with $54,000 to be used either for education or toward the purchase of a new home.

The Futures Account, like all sound social policy, would direct resources straight to children and be universal, fair, and fundable, as well as consistent with the values and principles of a market economy, he says.

"Despite our misgivings about government, it has been able to develop and implement highly effective programs," Gelles says. "[These programs] should serve as a template going forward, particularly to deal with the ongoing economic crisis of the middle class, but also to provide bootstraps for kids who otherwise would fall by the wayside before they turned 18."




*As Gelles envisions it, a "Futures Account" would provide every 18-year-old in the country with $54,000 to be used either for education or toward the purchase of a new home.*



SOCIAL SCIENCE | HISTORIC PRESERVATION

# HISTORIC STRUCTURE GETS SECOND LIFE

**DESPITE THE MANY STORIES IT HAD TO TELL,** the old brick building complex perched on the bank of the Delaware River near Philadelphia International Airport was nearly lost for good.

Named after the patron saint of lepers, the Lazaretto served from 1801 to 1895 as a hospital and quarantine station for ships, cargo, and immigrants seeking entry to Philadelphia. Its history was rich and endangered.

Developers had proposed tearing down the buildings to put up parking garages. But in 2005, officials of Tinicum Township, Pa., saved the site from the wrecking ball; in subsequent years they started to raise money needed to restore the buildings. Now, the oldest standing quarantine facility in the Western Hemisphere is serving as a trove of interdisciplinary study for Penn students and researchers in history, historic preservation, and architecture.

Opened at the dawn of the 19th century following several outbreaks of yellow fever, the Lazaretto served as a place where products and people aboard ships bound for the Port of Philadelphia could be safely inspected. Passengers or crew who showed signs of illness were quarantined at the Lazaretto and treated in its hospital.

David Barnes, an associate professor in Penn's School of Arts and Sciences' Department of History and Sociology of Science, is conducting research on the Lazaretto, which he calls "the great-grandfather of Ellis Island," and its role in the history of epidemics and their prevention.

Students and faculty at Penn's School of Design are using the Lazaretto to learn about architectural history and the restoration of historic structures. In a graduate seminar, students design exhibits and interpret the history of the site. Associate Professor and Chair of Historic Preservation Randall F. Mason also teaches a course using the Lazaretto to illustrate practical challenges involved in preserving landmarks.

As work on the site progresses, Barnes says there will be even greater opportunities for interdisciplinary scholarship. "I would love to see scholars in nursing, medicine, and public health use the Lazaretto as a way of incorporating history into present-day teaching," he says. "For education and research, this site is just unparalleled."

# Do People Value Their Privacy Enough?

**EVERY DAY, PEOPLE READILY GIVE UP INFORMATION ABOUT THEIR BUYING HABITS, THEY CHECK IN AT LOCATIONS, AND THEY SHARE THEIR THOUGHTS IN 140 CHARACTERS.**

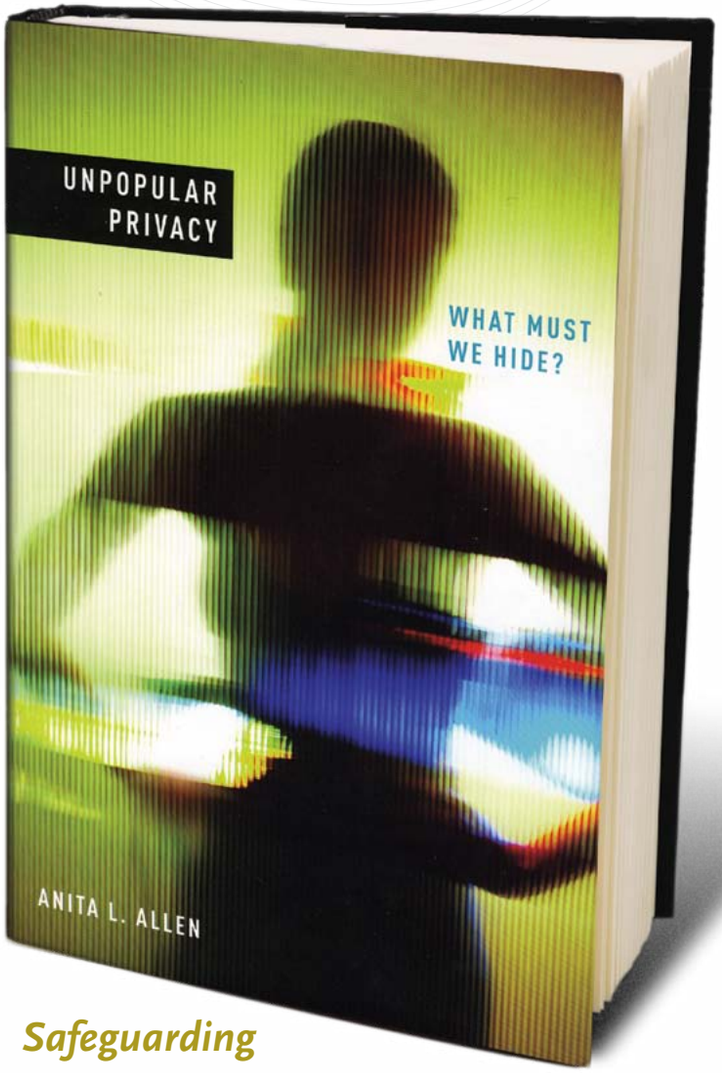
Women who wear traditional Muslim garments that cover the head and face may be asked to remove them for driver's license photos. Individuals who give to charity can have their names and donation amounts made public. And people walking down the street in many towns and on many college campuses are being monitored on camera.

We should care deeply about the diminishing value of privacy in the United States, says Anita Allen, professor of law and professor of philosophy at Penn Law School.

In her book "Unpopular Privacy," Allen makes the case that privacy is a fundamental foundational good much like liberty and equality, and people should be protected from giving up too much of it—whether they want these protections or not.

She also argues that "not being careless with your own privacy is an important obligation." Safeguarding your own privacy is "an ethical duty, like being honest, like not lying."

"My book encourages people to think about privacy as something that we shouldn't do without—and we shouldn't do without it even if, due to slick marketing and complex technology, we regrettably don't understand that we shouldn't do without it," Allen says.




*Safeguarding your own privacy is "an ethical duty, like being honest, like not lying."*

Allen describes her perspective as "modest paternalism," the idea that in a just society there may be a need for some laws that impose privacy and data protection on people who haven't demanded it, or who may not even want it.

The United States already restricts freedom in privacy-related contexts—from modesty and anti-nudity rules to laws that ban insider trading, collecting sensitive data from children online, and disclosing client and consumer secrets.

Allen notes that people are comfortable with mandatory confidentiality as an area of privacy policy, especially among doctors, lawyers, accountants, and government employees.

Allen says, "In the 19th century, it was assumed that the average person wouldn't want to give up privacy, whereas now, the average person is quite willing to give up privacy for a social life, easy access to shopping, and being able to work at home."

Allen hopes the public will grow to care more about privacy protection, and that Congress and state lawmakers will provide more electronic and online privacy protection in the years ahead.

# New Insight Into Hemingway's Life

Paul Hendrickson says he doesn't find book topics, they find him. So it was with "Hemingway's Boat: Everything He Loved in Life, and Lost, 1934-1961."

The idea to write about one of America's most celebrated authors didn't come from a sudden flash of inspiration, says the former staff writer for *The Washington Post* and a senior lecturer in the Department of English in Penn's School of Arts and Sciences. It built slowly, almost imperceptibly, over many years. In fact, the "origins of this book go back at least three decades," he says.

Hendrickson says he never intended his book to be a conventional biography of the great American author. Instead, he wanted to create what he calls a "hybrid" of journalism and biography, of personality profile and historical documentary, anchored to Hemingway's cherished fishing cruiser, Pilar.

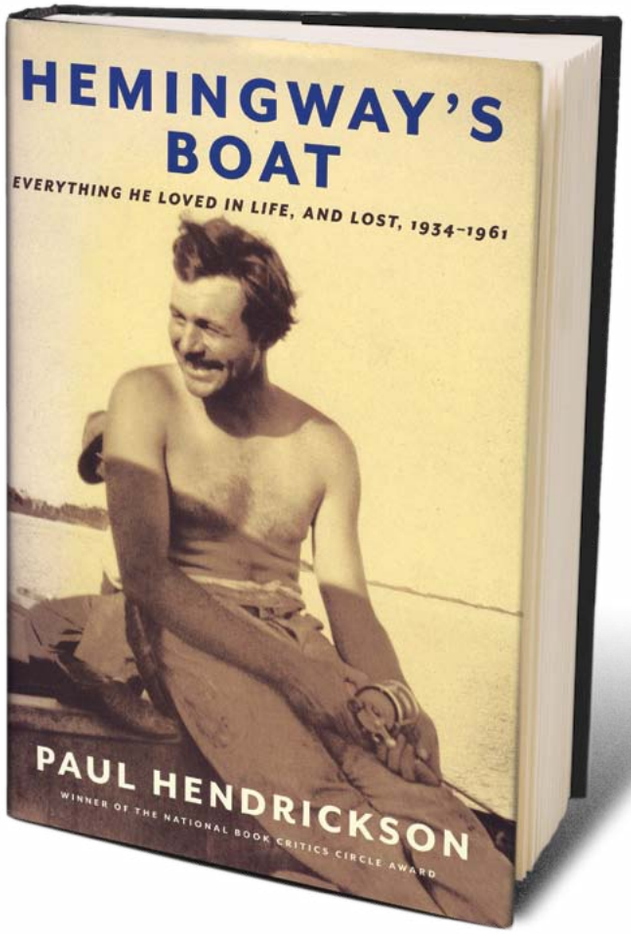
The boat served as a haven for Hemingway in the final 27 years of his life. "My aim," Hendrickson writes in the prologue, "is to try to lock together the words 'Hemingway' and 'boat' in the same way that the locked-together and equally American words 'DiMaggio' and 'bat,' or 'Satchmo' and 'horn,' quickly mean something in the minds of most people, at least of a certain age."

A finalist for the National Book Critics Circle Award, the book follows Hemingway through the height of his celebrity, his intense relationships with friends and family, and his eventual decline to suicide. It studies the impact that the novelist's mercurial personality had on the lives of people who came in contact with him, and how the most genuine moments of his life were often spent aboard Pilar.

"I wanted to find touchstones, stories, and people connected to the subject," Hendrickson says. "I'm very drawn to shadow stories, the stories that connect, that have otherwise been neglected, but that tell you something in a larger sense about the man."

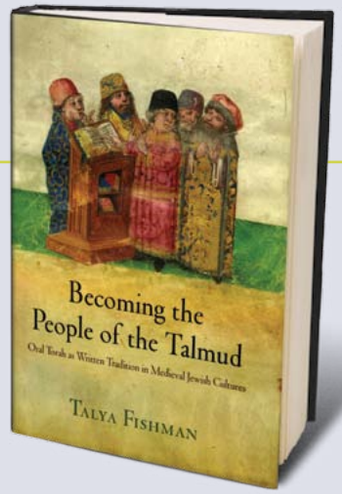
Hendrickson buoys the narrative with direct quotations from Hemingway's letters and interviews with people who knew the writer, including Hemingway's three sons. One of the most compelling sections of the book deals with Hemingway's youngest son, Gregory (aka Gigi/Gloria), a deeply troubled cross-dresser who died in a women's jail in Miami.

Writing the book led Hendrickson to believe that despite Hemingway's storied reputation for being belligerent and self-destructive, there was another side to the man. "What I came to understand," he says, "was that he was like a beautiful kaleidoscopic art object. You can see one angle, but if you tilt it just a bit, a whole new angle of light comes in. As awful and appalling as he could be, he could be kind and good and gentle."



HUMANITIES | RELIGIOUS STUDIES

# From 'Oral Torah' to Written Cultural Icon




**IN HER BOOK "BECOMING THE PEOPLE OF THE TALMUD: ORAL TORAH AS WRITTEN TRADITION IN MEDIEVAL JEWISH CULTURES,"** Talya Fishman tells the story of how the Babylonian Talmud—a collection of ancient oral Jewish traditions replete with legal controversies and non-legal material—came to be construed as a written reference work and a prescriptive guide to Jewish life.

Connecting insights from rabbinic research, medieval Jewish and Christian history, and orality-textuality studies, Fishman, an associate professor of religious studies in Penn's School of Arts and Sciences, reconstructs a multifaceted process of cultural transformation. She highlights how the ways that the Talmud was disseminated helped to shape the meaning of traditions.

The Babylonian Talmud's 63 tractates contain Hebrew and Aramaic teachings that were transmitted orally by Jewish scholars of the third through sixth centuries C.E. The Talmud, notes Fishman, "explains and is stimulated by" Mishnah, an earlier compilation of post-biblical, oral, Jewish traditions.

By the 11th century, writes Fishman, the geographic expanse of Jewish communities made it difficult for far-flung scholars to uphold the rabbinic injunction against transmitting "oral matters" in writing. So the Talmud began to circulate as a written work.

Once greater cultural authority was ascribed to written texts than to human models and teachers, other changes followed. These affected reading habits, compositional preferences, classroom practices, approaches to legal decision making, and even, Fishman argues, social hierarchies.

"Becoming the People of the Talmud" demonstrates that certain medieval Jews were aware of these changes. Some noted that books had replaced teachers. Others lamented that spiritual refinement was less valued than Talmud-centered learning.

Fishman also suggests that broader cultural phenomena—the prominence of custom in Ashkenazi culture, and the unprecedented Christian attack on the Talmud beginning in the 13th century—were indirectly linked to the new eminence of this written text in Jewish life.

"Becoming the People of the Talmud" was awarded the 2011 National Jewish Book Award for Scholarship.

HUMANITIES | HISTORY

# When Cities & Violence Collide

**IN THE 1960s, THE UNITED STATES OF AMERICA WAS ON FIRE.** Philadelphia burned in 1964. Watts burned for five days in 1965. Newark burned for six days in 1967, and dozens of cities, including Chicago, Baltimore, and Washington, D.C., burned after the Rev. Dr. Martin Luther King Jr. was assassinated in 1968.

But since the early 1970s, American cities have been relatively quiet, even though the sources of earlier disturbances have persisted and, in some instances, grown worse. With the exception of the uprisings in Miami and Los Angeles after the Rodney King verdict in 1992, American cities have not experienced massive civil violence.

In his book "Why Don't American Cities Burn?" Michael B. Katz, a professor of history in Penn's School of Arts and Sciences, explains the lack of civil violence as the result of three sets of factors: the changing ecology of power, the management of marginalization, and the incorporation and control of immigration.

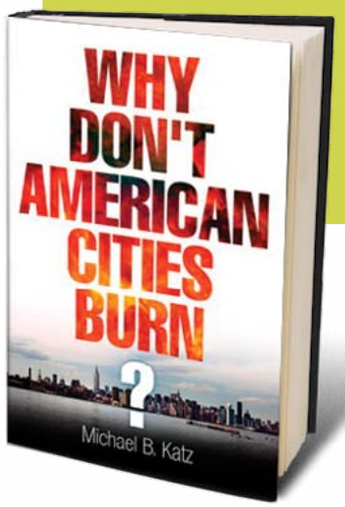
African-American men who are unable to leave desolate inner-city neighborhoods, Katz argues, have turned their rage inward on one another and not, as they did 40 or 50 years ago, "on the agents and symbols of politics, culture, and economy that exclude them from first-class citizenship."

The book also shows how massive economic and demographic changes have resulted in new kinds of cities and a new African-American social structure, as well as market-based strategies for dealing with poverty.

Katz says the book grew out of work he has been doing over the last 30 years on poverty and inequality. "I think of it in the largest terms as a book about the collision between the transformation of cities and rightward-moving social politics in the last half-century," he says.

"Why Don't American Cities Burn?" was published by Penn Press.

*Katz says the book grew out of 30 years of observation.*




HUMANITIES | FAST FACT

**15.9%** *of the U.S. population had income below the poverty level in 2011.*

# Why the 'Skills Gap' Is a Myth

During the most recent economic downturn, employers have echoed a common refrain: Job vacancies remain unfilled because applicants aren't qualified to fill them. Schools don't prepare students properly for the job market. College students simply aren't majoring in fields in which jobs are prolific.

But these are myths, says Peter Cappelli, professor of management at Penn's Wharton School and author of the book "Why Good People Can't Get Jobs." In fact, he says, there is no real evidence to support the notion that there is a "skills gap."

"On the employer side, these complaints are a mile wide and an inch deep," says Cappelli.

He notes the hardest-to-fill jobs as measured by employer surveys include those that are low skilled, and employers are often unwilling to offer competitive wages to attract the talent they seek.

Take, for example, the argument that employers must contend with a lack of knowledge and experience among prospects. Cappelli argues there may only appear to be a shortage because employers often define jobs in a way that requires applicants to have already done the job.

"What [employers] really want is somebody who is doing that job right now," Cappelli says. "They don't want anyone who needs any training or ramp-up time, and they often won't look at candidates who aren't working now. Once you define your skill problem that way, it sounds very different: 'We need people who are doing this job already somewhere else.'"

Also, job-seekers are often described as poorly educated and ill-prepared for the job market. But Cappelli says that surveys of hiring managers show that skills associated with education are far down the list of employers' concerns.

In addition, the notion that college students aren't majoring in job-rich fields is undermined by evidence: Business is now the most popular college major, with the number of degrees in that field having tripled since 1970.

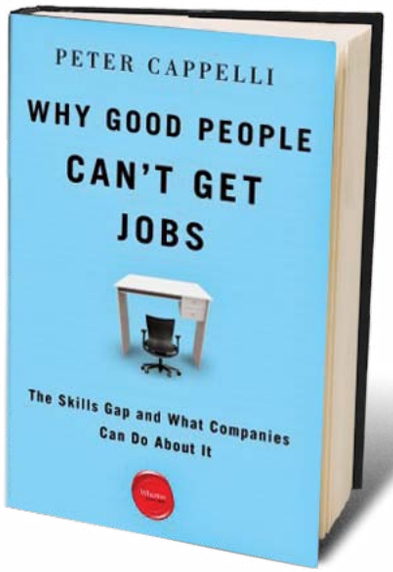
One impediment to people not getting work lies with the hiring process itself, Cappelli says. While it's true that the application process has been made easier by online systems, the sheer number of applicants can overwhelm hiring officers.

Employers are also investing less in workers. Cappelli notes that nearly 80 percent of today's workforce report that they had no training in the past five years.

"You never heard employers complain until the 1990s," Cappelli says. "What is different is employers have stopped training new hires. They expect people to already have the skills."

Cappelli offers solutions, from in-house and employer/employee training programs, to cooperation between the public and private sectors on apprenticeship programs.

He writes that "the time has finally come for employers to develop a more realistic sense of what their own interests are with respect to workforce issues and what best serves both their interests and the well-being of society as a whole."




**BUSINESS** | FAST FACT

*Employers need roughly* **5%** *fewer workers now than at the beginning of the recession, yet there are about 4% more people who could want jobs.*

# 'Underwater' Mortgages Make People Stay Put

**BUSINESS** | *REAL ESTATE*

**AMERICANS LIKE TO THINK OF THEIR COUNTRY AS A LAND OF OPPORTUNITY.** But research into the plight of homeowners stuck with "underwater" home mortgages shows they are 30 percent less likely to be mobile enough to pick up and move in pursuit of a better economic situation.

"Let's assume that we are identical in every way—the same age, same wealth, same family structure—except you have negative equity and I don't," says Joseph Gyourko, chair of the Real Estate Department at Penn's Wharton School. "You will be one-third less likely to move."

Gyourko's research found each additional $1,000 in mortgage or property tax costs decreases mobility by 10 to 16 percent. His findings were published in September 2011 as a National Bureau of Economic Research working paper titled "Housing Busts and Household Mobility: An Update." The paper, co-authored by Wharton Associate Professor of Real Estate Fernando Ferreira and Joseph Tracy of the Federal Reserve Bank of New York, builds on previous research on the same topic, published in 2010.

Both studies show people will remain in their houses even when they have negative equity, and even when it makes more sense to get out and move to a new area with greater job prospects. Gyourko cites several reasons for this: People may like where they live, or may be reluctant to take a hit to their credit if they default on a mortgage. They may even feel a moral or ethical duty to pay back loans.

All of this adds up to a significant decrease in mobility. Data from the Census Bureau shows the number of Americans who are changing their address is at its lowest point since the government began tracking the statistic in 1948.

A reluctance to move may contribute to the nation's unemployment rate as homeowners with negative equity are less likely to move for work.

"This has important ramifications for households, not just housing markets," says Gyourko. "Young people need to be mobile. If you are 35 and you need to move for a job opportunity, and you have negative equity, there's a big cost."

**THE ROAD TO FORGETFULNESS IS OFTEN PAVED WITH GOOD INTENTIONS.** That's not precisely how the old adage goes, but for the Wharton School's Operations and Information Management Assistant Professor Katherine Milkman, it describes the essence of her recent research.

Can simple interactive "nudges" help people keep plans they've made to complete tasks that keep getting shoved aside?

In a paper published in the *Proceedings of the National Academy of Sciences*, Milkman and fellow researchers from Stanford, Harvard, and Yale reported the results of an experiment designed to measure the effectiveness of planning prompts—one new type of nudge—on the behavior of employees who were offered a flu vaccine at work.

The experiment took place at a Midwestern utility company with 9,029 employees. Workers who met the 2009 federal recommendations for flu vaccine— those 50 years old or older and those with chronic health conditions—were sent mailers informing them of the time and place of on-site flu vaccine clinics. That number totaled 3,272.

**BUSINESS** | *OPERATIONS & INFORMATION MANAGEMENT*


# To Prevent Forgetfulness, It Doesn't Hurt to Nudge

Partnering with healthcare communications company Evive Health, the researchers created three versions of the mailers. The control group received information on how and why they should get vaccines. The two other mailings also included prompts to make a plan—a space to note a specific date to get the shot, or a place to note a specific date and time.

"The theory," says Milkman, "is that there are a lot of behaviors we mean to do, but we don't do because of forgetfulness or procrastination. … A prompt creates a concrete cue, embedding your intention in your mind." It also creates a greater sense of personal commitment to follow through, she says. People will be less likely to postpone a concrete appointment.

The research found that employees who received the time and date planning reminders had a 37.3 percent participation rate, which was 4.2 percentage points higher than the control group.

Milkman says that, psychologically, people may respond better to nudges than to more negative incentives such as fines or penalties. "Prompts aren't perceived as paternalistic. You don't feel you are being shoved. You are just being nudged."

***Research at Penn:* Volume 11**



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