Focus
THE CHRONICLE OF HIGHER EDUCATION

Applying Research to Real-World Problems

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PRODUCTS DEVELOPED through university research can save lives and produce other social benefits. The same results can be achieved by the knowledge discovered through research. But how can that scholarship be disseminated in ways that help society? At universities around the country, professors are trying to share their insights, even without the promise of financial return or academic rewards like tenure. Sometimes, as was demonstrated by a Virginia Tech professor who warned of the dangerous lead levels in the water in Flint, Mich., scientific knowledge can have a considerable impact on a community's well-being.

Cover photo illustration by Kevin Van Aelst for *The Chronicle*

Is University Research Missing What Matters Most?

By PAUL BASKEN

NOAH BERGER FOR THE CHRONICLE

Eleni Linos, a dermatologist at the U. of California at San Francisco, has seen her research on the health risks of tanning salons published in big journals. But her efforts to take her findings to the real world with an awareness campaign have received little support from academe.

ELENI LINOS AND DAVID M. YOUNG are professors at the same prestigious research university, both developing innovations that could save lives.

Dr. Young, a professor of surgery at the University of California at San Francisco, leads a team making a product — an electronic bandage that could alert patients to potentially fatal infections. He is being helped by multimillion-dollar federal programs, and the work is expected to turn into a company and, hopefully, a profit for his institution.

Dr. Linos, an assistant professor of medicine, is testing a behavioral intervention — using Internet ads to convince teenage girls that tanning salons pose a deadly danger. But her work has no market value, meaning no product will come from it. So she supports it with her own salary and some donated assistance, and she will probably be paid back with little more than a sense of accomplishment.

The experiences of the two doctors reflect a growing divide in university research. On the one side, cash-strapped universities, bolstered by sympathetic government policies and public and private grant programs, are working hard to develop ways of monetizing their research. The latest annual numbers from the Association of University Technology Managers show good results: a 12-percent increase in start-up companies in 2014, a 17-percent gain in commercial licenses, and a 34-percent surge in new products — all while federal support for research fell 5 percent.

On the other side, when research applications don't involve products, patents, and profits, the record can be tougher to quantify. Academic research endorses physical activity and warns against economic divides, but obesity and wide disparities in opportunity persist. Dozens of university studies examine conflict resolution, but the United States still engages in wars. Other well-studied but seemingly intractable societal troubles include pervasive violence, mental stress, environmental toxins, and educational underachievement.

In short, university scientists have shown they're good at turning research into products, and they're getting better by the day. But are researchers, and their funders, making the same effort to translate the work of greatest benefit to society?

In their official statement of purpose, the nation's top research universities describe themselves as committed to "innovation, scholarship, and solutions." When moving from innovation to solutions, however, they recognize that researchers confront an increasingly obvious limitation. "Let's face it: Money drives a lot of behavior, whether you like it or not," said Tobin L. Smith, vice president for policy at the research group, the Association of American Universities.

Money, of course, does matter. According to the latest National Science Foundation data, three fields — biological sciences, medical sciences, and engineering — accounted for about two-thirds of the $64 billion in total academic research-and-development spending in 2014. Various social sciences — fields that could play a huge role in turning research into policy — accounted for only about $2.2 billion, and psychology for $1.1 billion. But examine factors across academe, and you'll find money is not the only barrier to university researchers' bringing their findings into the real world. Often their attempts to do so are compromised by personal, professional, political, and institutional imperatives and traditions.

Some researchers feel that their job is in the lab, not outside it. Many universities still reward and promote based largely on publication rather than public accomplishment. Public and private funders of research rarely step back to comprehensively and scientifically ask which projects and approaches would make the biggest difference for the most people, without first having set some kind of constraint such as a field of study or type of disease.

In some instances, such as Dr. Young's electronic "smart bandage," the academic world seems increasingly enthused to help derive real-world benefit from the federal government's $40-billion annual expenditure on university research. The electronic bandages could help prevent bedsores, which affect some 2.5 million people a year in the United States at an estimated cost of $11 billion.

But in other instances, such as Dr. Linos's campaign against tanning salons — which are believed responsible for 400,000 new cases of skin cancer each year in the United States — the academic structures seem decidedly less friendly.

It's a result of not being truly attuned to what matters most in university research, said Sandro Galea, dean and professor of public health at Boston University. "We have veered away from keeping our eye on the prize," Dr. Galea said. "And the prize is paying attention to why we're doing what we're doing."

IT'S not hard to find researchers who share that view. There's Eli Berman, a professor of economics at the University of California at San Diego, who spends his own time and money trekking to Washington in the hope that someone dealing with wars, insurgencies, and human trafficking might make use of insights compiled by the university's Institute on Global Conflict and Cooperation.

Or Utpal M. Dholakia, a professor of marketing at Rice University, who studies how measuring people's capacity for self-control can be helpful in assessing the effects of public policies. He says he feels far more pressure from his institution to publish his findings than to figure out ways to implement them.

There's Mary Flanagan, a professor of digital humanities at Dartmouth College who builds party games that subtly incorporate lessons on social biases and stereotypes. She has found university technology-transfer offices uninterested in helping her build connections to major companies and advertisers.

There's even David H. Guston, a professor of politics and global studies at Arizona State University who studies the societal implications of nanoscale science. ASU is perhaps the nation's most aggressively outcomes-oriented institution, and yet Mr. Guston still sees much inertia behind promotion systems that reward faculty for publishing rather than making progress toward a specific public benefit.

The 200 largest universities in the United States all have technology-transfer offices that promise financial returns for important, marketable discoveries, Mr. Guston said. "But there are a whole host of things that are important that may not have markets," he said.

Universities and their researchers now face heavy and growing pressure to financially justify their decisions. And that can steer them away from choices that can't be connected to definable profits, grants, or publications with known academic value. Universities and funders of science could respond to those expanded market pressures by rewarding scientists who work societal problems all the way through to a solution, said Alan Durning, executive director of the Sightline Institute, a nonprofit research center in Seattle that works on policy-implementation strategies. But too often, Mr. Durning said, they reinforce discipline-centered hierarchies that encourage researchers to specialize, not to embrace the "integrative problem-solving" that can make a difference in most real-world contexts. "It's an enormous problem," he said.

While some university leaders concede the point, they often can't agree on who is responsible for breaking out of narrow discipline-based metrics. At a conference last year on academic engagement in public and political discourse, the presidents of two leading research institutions, Teresa A. Sullivan of the University of Virginia and Mark S. Schlissel of the University of Michigan, both said they had surprisingly little ability to change faculty reward structures to better emphasize cross-departmental problem-solving.

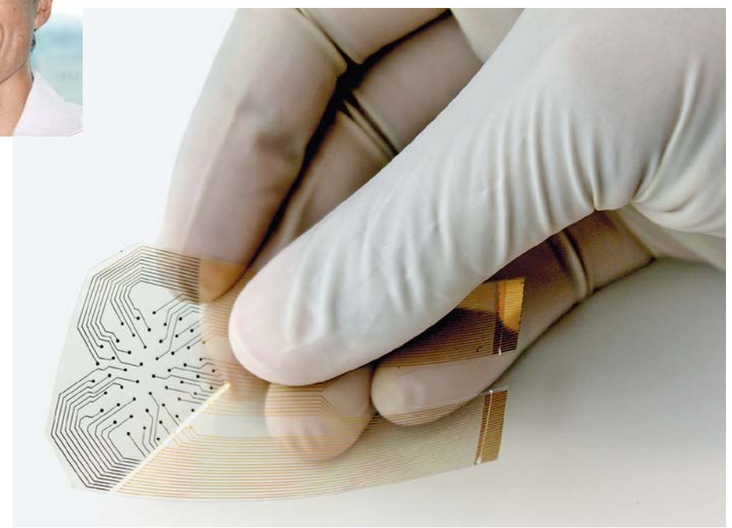
"Departments have their own culture and customs," said Ms. Sullivan.

"University presidents are less powerful than you think," Mr. Schlissel added.

Without help from the top, even change- minded researchers can feel stuck. A few institutions, like Arizona State, now seek to reward an out-

COURTESY OF UCSF

David Young (left), a professor of surgery at the U. of California at San Francisco, led the development of an electronic bandage (below) that can warn of dangerous infections. Research that results in a product often has an easier time getting attention and funding.



UC BERKELEY

comes-based record of accomplishments, largely by placing professors in multidisciplinary institutes rather than departmental silos. But it's still risky to base a career on that approach when most institutions still value more-traditional measures like publications, said Braden R. Allenby, a professor of engineering and ethics at ASU. Mentors of junior faculty and graduate students should be careful about "getting them involved in projects that their peers aren't going to recognize as academically valid," Mr. Allenby said.

Ronald F. Levant, a professor of psychology at the University of Akron, knows that very well. A former president of the American Psychological Association, Mr. Levant studies male adherence to traditional masculine norms, and the ways in which that can fuel a wide range of societal problems.

One of the most frustrating examples: Working-class men can impoverish themselves by refusing to abandon the pursuit of jobs such as steelworker and trucker for alternatives such as child care, elder care, and food preparation — occupations that are stereotypically associated with women.

Ideally, Mr. Levant said, he'd find partners outside his academic field to develop and test public-education campaigns that might help poorly educated, working-class men throw off "the shackles of traditional masculinity."

"I wouldn't know where to turn," Mr. Levant said, "but I would love to do that." But, he added, "I don't think anybody in my academic institution would be receptive to it, because it's not really defined as part of our mission."

One prime target for blame is Congress. Universities and funders might want to be more aggressive in confronting the behavioral factors behind so many social problems, but many academic leaders say they're deterred by the current political climate.

The leadership of the U.S. House of Representatives, in particular, has waged a dedicated campaign against the social sciences. More broadly, lawmakers who exert influence over research-funding priorities tend to respond to pressure from patient advocates, who are naturally more interested in cures than in societywide preventions.

Private foundations also have limitations. As with lawmakers, foundations are often responsive to patient-advocacy groups that emphasize cures over prevention. And deep-pocketed foundations usually come with defined missions.

The world's largest private foundation, the Bill & Melinda Gates Foundation, sets its funding priorities largely based on where it thinks it could have the greatest effect, said a spokesman, Christopher Williams, but the personal interests of the founders also play an important role in project selection. Another large foundation that emphasizes research, the Gordon and Betty Moore Foundation, established by Intel's co-founder, Gordon E. Moore, lists its four priority areas as science, conservation, patient care, and the Bay Area. "We have to focus, and so we do," said Robert P. Kirshner, the foundation's chief program officer for science.

The kind of patchwork approach to funding can pose a problem: Government agencies and foundations support meaningful work, but they also leave much potentially-vital research to slip through the cracks. Could universities and their advocates join with private donors and draft a plan for addressing the major societal problems that don't or won't get addressed by Congress? It's possible, said Mary Woolley, president of Research!America, the nation's largest academic and industry partnership for promoting scientific research funding. But that does not appear likely to happen, said Ms. Woolley, who has led Research!America for 25 years. "It is a matter of convincing the folks that have deep pockets and patience," she said.

The idea of using science to measure one social goal against a range of others deserving of research raises many major difficulties, said Mr. Kirshner, a former professor of science and astrophysicist at Harvard. Obstacles cited by Mr. Kirshner and others include the difficulty of making feasibility comparisons across fields, putting values on human life and the natural world, and predicting variables that could change priorities in the future.

"It would be very helpful to have an empirical way of determining the magnitude of problems."

Still, it's worth trying to rank social problems as a way of keeping campus researchers on target, said Fred H. Cate, vice president for research and manager of the new Grand Challenges program at Indiana University.

The Grand Challenges concept is a loosely defined framework that some universities are using to tackle major scientific problems with potentially broad applications. Indiana, for example, has pledged to spend at least $300 million over five years on as many as five projects that Mr. Cate and his team will choose later this year. "It would be very helpful to have an empirical way of determining the magnitude of problems that we could address in the university research community," Mr. Cate said.

Some lawmakers agree. "If the scientific community concludes via peer-reviewed research there is a process by which to determine what science would be most valuable for the federal government/taxpayers to fund, Congress would be obliged to consider," said Zachary Kurz, a spokesman for Rep. Lamar Smith, the Texas Republican serving as chairman of the House science committee, in a written comment.

The government has shown it can be creative in encouraging real-world applications of science, when it wants to be. One of the most ambitious such efforts is the National Center for Advancing Translational Sciences, a $660-million division of the National Institutes of Health established in 2011 largely to speed the development of pharmaceuticals from lab discoveries.

But the NIH has no comparable translational effort outside of drugs, and doesn't feel one is necessary. "In the many other spheres that NIH operates, I think that goes on naturally," said Lawrence A. Tabak, the NIH's principal deputy director, "and I'm not sure that one would need any additional catalyst, as NCATS has been."

Another example is the Innovation Corps, a boot-camp-like program for teaching university scientists to behave more like entrepreneurs that was adopted by the National Science Foundation in 2011 and has since spread to the NIH and other federal sponsors of research.

That project favors interventions that involve products — one version of the I-Corps curriculum helped Dr. Young and his team market their electronic bandage. The NSF, however, just awarded a grant to the University of Texas at Austin to figure out ways that it might adapt the I-Corps approach to help researchers pursue public-policy goals.

That kind of thinking is being encouraged across the Obama administration. The White House is especially intrigued by a public-policy strategy known as "nudging," put forth by two university experts — Richard H. Thaler of the University of Chicago, and Cass R. Sunstein of Harvard, who led White House oversight of federal regulation earlier in the Obama administration — and has been busily incorporating behavioral-science insights into a range of federal activities.

The nudge concept blends research insights in areas such as psychology and behavioral science to create situations in which people are gently coaxed into making more-beneficial choices. Examples include painting targets inside men's urinals to encourage cleaner floors and building rumble strips along highways to encourage inattentive drivers to stay in their lanes.

And the new Behavioral Science & Policy Association assembled more than 200 researchers and practitioners this past summer for its inaugural conference, sharing tips on the value of such nudge-like interventions as text-message homework reminders for students and truthfulness affirmations placed at the beginning of tax returns rather than the end.

"We're on the cusp of the transformation from behavioral economics, which is still young and rapidly developing, to the broader and more appropriate frame of behavioral public policy," said one member of the association's advisory board, Paul Slovic, a professor of psychology at the University of Oregon.

Just nudging, however, may not be enough for major societal challenges. "Nudges ain't going to do it on big policy issues," said Paul C. Light, a professor of public service at New York University. "Economists have been trying for years to figure out promising ways of regulating without regulating, but it's mostly small beer."

Again, politics — or at least the perception of politics — stands as a major obstacle to valuable translational research. When an issue reaches a certain level of public ferment, many researchers regard it as politically out of bounds. "There's a line," said Andrew J. Hoffman, a professor of sustainable enterprise at the University of Michigan at Ann Arbor. "And you want to be careful not to cross it as an academic, or you move into the field of advocacy."

Yet if politics is a line that shouldn't be crossed, there's little agreement on where to draw that line. Cancer can be political, given that people may disagree over its probable causes or the best methods of fighting it. Few researchers, however, abstain from the war on cancer for political reasons.

It may end up taking a new generation of scientists to redraw the lines of acceptability. That generation includes Nik Sawe, a doctoral student in environmental sciences at Stanford University, whose research uses sophisticated brain-scanning technology to help understand whether and why people really believe what they say they believe.

If that approach proves reliable, Mr. Sawe said, it could have obvious uses in policy making. But within the university setting, he said, the pressure is far stronger to publish papers describing the science than to find places to actually use it. "There's still enough old guard that has that older view, which is, Do the research and leave that translational thing to someone else," he said.

Dr. Linos did not have that attitude. After her work on the health risks of indoor tanning beds won her front-page coverage last January in *The New York Times*, she quickly realized that major professional accomplishment would do little to catch the attention of all the teenage girls in need of warnings.

"I was frustrated," Dr. Linos said, "that I kept on writing papers, publishing papers, getting them into big journals, and then feeling like it wasn't actually doing anything to change behavior."

That urge to have her research make an actual difference in people's lives led Dr. Linos to Google. Colleagues in Silicon Valley had told her that the Internet giant offered free advertising space to academics and nonprofit organizations, and she wanted to see if that might help deliver her research findings more directly to those who needed to know about them.

So she set up an account with Google, and began testing ads that would appear alongside the results for anyone searching for terms such as "tanning," "tanning bed," and "tanning salon." In the space of a few weeks, the ads were shown 235,000 times and generated more than 2,000 user clicks — a success rate generally considered sufficient for commercial advertisements.

It was just an initial experiment, done without any outside grant support, she said. For her next step, Dr. Linos would like to find grant money — she's putting together an application for the National Institutes of Health — and hire a marketing expert who knows how to write the ads. Eventually she'd like to work with many more social-media platforms.

But it's not clear the NIH or anyone else would support such an interdisciplinary attempt to solving a medical problem, even if her research suggests it could be crucial to helping girls avoid skin cancer. The scientists reviewing these grants are used to seeing different types of grant proposals, Dr. Linos said. "But I'll try it."

Younger researchers willing to pursue similar attempts might ultimately make a major difference. Those scholars are part of a "sea change" that could eventually leave university research more focused on solving the world's most important problems, said Mr. Smith, of the AAU. "These people don't just want to go out and publish work in some arcane journal," he said. "They want to do something that matters."

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What It Might Take to Tackle the Most Important Problems

What can universities, governments, journals, and private funders of research do to ensure they are making the greatest possible efforts toward solving society's most pressing issues? *The Chronicle* asked experts for their suggestions. Here is a sampling of the steps they proposed:

Develop statistical approaches to identify the social problems that are most important and most worthy of intensive translational research.
Who could do it: universities and foundations

Reward "project-based solutions" that reduce the dominance of departmental structures that inhibit interdisciplinary work.
Who could do it: universities

Prioritize long-term preventative strategies over short-term cures, which are often favored by supporters who already have a disease or condition.
Who could do it: foundations and political leaders

Conduct more complicated experiments in the real world, while giving less attention and reward to incremental discoveries in controlled lab settings.
Who could do it: universities, researchers, and foundations

Appoint more social scientists to review panels, increasing the likelihood that social considerations will be reflected in research and research-based solutions.
Who could do it: federal grant agencies

Emphasize curricula that develop and promote social-science expertise to help in interdisciplinary realms.
Who could do it: universities

Revise the standard formatting for research papers — with sections for discussion, analysis, comment, and application — to add a section that describes strategies for acting on the article's findings.
Who could do it: journals

Restructure government agencies to emphasize bottom-line solutions and translational work — a role that basic-science-first agencies such as the National Institutes of Health and the National Science Foundation are not fully equipped to handle.
Who could do it: federal government

Create government agencies to give lawmakers the best current research on issues they are considering.
Who could do it: state and federal governments

Integrate academics into the leadership of federal agencies to help the translational bridge go both ways.
Who could do it: federal agencies

Sponsor more "grand challenges" that involve research contributions beyond just one university.
Who could do it: universities and foundations

Establish "centers for responsible innovation" that consider the social value of research, much as institutional review boards help ensure human protections.
Who could do it: universities

Create a presidential "Council of Psychological Science Advisers," modeled on the existing Council of Economic Advisers, to incorporate human behavioral realities into policy decisions.
Who could do it: federal government

Quantify the value of the natural world in financial terms to build economics-based arguments for incorporating environmental concerns into policy decisions.
Who could do it: researchers and foundations

Schedule the release of reports with policy implications for times when the information is most likely to be acted upon by policy makers.
Who could do it: researchers and foundations

Recognize that exceptionally large problems require exceptionally large commitments of time and money.
Who could do it: universities and foundations

— PAUL BASKEN

Originally published on January 24, 2016

Temporary signs go up in Broward County, Fla., when streets become waterways during seasonal "king tides." The Southeast Florida Regional Climate Change Compact, a policy effort developed by four counties, has enlisted the help of Dan Kahan, a Yale professor who is both a psychologist and a lawyer.

PAUL KRASHEFSKI

Data Could HelpScholars Persuade, If Only They Were Willing to Use It

By PAUL BASKEN

THANKS TO WHAT they've learned from university research, consultants like Matthew Kalmans have become experts in modern political persuasion.

A co-founder of Applecart, a New York data firm, Mr. Kalmans specializes in shaping societal attitudes by using advanced analytical techniques to discover and exploit personal connections and friendships.

His is one of a fast-growing collection of similar companies now raising millions of dollars, fattening businesses, and aiding political campaigns with computerized records of Facebook exchanges, high-school yearbooks, even neighborhood gossip. Applecart uses that data to try to persuade people on a range of topics by finding voices they trust to deliver endorsements.

"You can use this sort of technology to get people to purchase insurance at higher rates, get people to purchase a product, get people to do all sorts of other things that they might otherwise not be inclined to do," said Mr. Kalmans, a 2014 graduate of the University of Pennsylvania.

And in building such a valuable service, he's found that the intellectual underpinnings are often free. "We are constantly reading academic papers to get ideas on how to do things better," Mr. Kalmans said.

That's because scholars conduct the field experiments and subsequent tests that Mr. Kalmans needs to build and refine his models. "They do a lot of the infrastructural work that, frankly, a lot of commercial companies don't have the in-house expertise to do," he said of university researchers.

Yet the story of Applecart stands in contrast to the dominant attitude and approach among university researchers themselves. Universities are full of researchers who intensively study major global problems such as environmental destruction and societal violence, then stop short when their conclusions point to the need for significant change in public behavior.

RESEARCHER RELUCTANCE

Some in academe consider that boundary a matter of principle rather than a systematic failure or oversight. "The one thing that we have to do is not be political," Michael M. Crow, the usually paradigm-breaking president of Arizona State University, said this summer at a conference on academic engagement in public discourse. "Politics is a process that we are informing. We don't have to be political to inform politicians or political actors."

But other academics contemplate that stance and see a missed opportunity to help convert the millions of taxpayer dollars spent on research into meaningful societal benefit. They include Dan M. Kahan, a professor of law and of psychology at Yale University who has been trying to help Florida officials cope with climate change.

Mr. Kahan works with the four-county Southeast Florida Regional Climate Change Compact, which wants to redesign roads, expand public transit, and build pumping stations to prepare for harsher weather. But Mr. Kahan says he and his Florida partners have had trouble getting enough policy makers to seriously consider the scale of the problem and the necessary solutions.

It's frustrating, Mr. Kahan said, to see so much university research devoted to work inside laboratories on problems like climate, and comparatively little spent on real-world needs such as sophisticated messaging strategies. "There really is a kind of deficit in the research relating to actually operationalizing the kinds of insights that people have developed from research," he said.

That deficit appears to stem from academic culture, said Utpal M. Dholakia, a professor of marketing at Rice University whose work involves testing people's self-control in areas such as eating and shopping. He then draws conclusions about whether regulations or taxes aimed at changing behaviors will be effective.

Companies find advanced personal behavioral data highly useful, said Mr. Dholakia, who works on the side to help retailers devise sales strategies. But his university, he said, appears more interested in seeing him publish his findings than take the time to help policy makers make real-world use of them. "My dean gets very worried if I don't publish a lot."

Because universities have been reluctant to push big data and analytics into public-policy realms, it's hard to assess exactly how useful those techniques could be — and where the ethical lines should be.

Behavioral data-crunching "absolutely" could be used to reshape entrenched attitudes in areas of societal challenge, said Mr. Kalmans, whose company has been working for the Republican presidential candidate John Kasich but is seeking more work with advocacy organizations.

It's not a stretch to suggest that university researchers could become adept at using tactics like Mr. Kalmans's, either to influence public behaviors or to show others how to do it, said Lynda Tran, a founding partner at 270 Strategies, a Democratic-leaning version of Applecart whose customers include the Obama presidential campaigns. The basic components of the practice should be familiar to many researchers, Ms. Tran said: "At its core, it's basically multivariate regression analysis."

Whether that's worth doing is another question. In areas like global warming, researchers have already tried "very, very hard" to influence public behavior, said Michael B. Gerrard, a professor of professional practice at Columbia University and director of the Sabin Center for Climate Change Law. "I don't think most of this is susceptible to most of the sorts of solutions that are developed in academia."

"We don't solve these problems by crawling in a hole, and massaging a whole bunch of data."

DEFINING WHAT'S ALLOWED

Even within Google, one of the giants of big data, there are conflicting views. The company recently recruited Thomas R. Insel, longtime director of the National Institute of Mental Health, to

head a project that would apply algorithms to data in the hope of detecting early signs of psychoses. Yet one of the company's intellectual paragons, Vinton G. Cerf, is dubious about the broad ability of big data to solve society's major challenges.

In the real world, people need tangible incentives to make meaningful change, said Mr. Cerf, the web pioneer who holds the titles of vice president and chief Internet evangelist at Google. "We don't solve these problems by crawling in a hole, and massaging a whole bunch of data, and getting an analytic result," he said.

Then there are matters of propriety and legality. The Republican Ted Cruz has moved into the upper ranks of his party's crowded presidential contest with the assistance of statisticians and behavioral psychologists who help his campaign set personalized tones and topics for emails, phone calls, and even at-home visits. The increasingly aggressive nature of such data collection has left companies like Facebook and government regulators struggling to define what is allowed, both for research purposes and for private uses.

Even stricter limits are involved when the government is legally responsible for the messaging. The nonpartisan Government Accountability Office ruled in December that the U.S. Environmental Protection Agency had illegally sought political support for a clean-water regulation when it asked people to post positive comments on social media.

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With those and many other potential pitfalls in mind, some data experts in academe are urging restraint toward corporate, governmental, and political clients. At an international cryptographic conference in December, Phillip Rogaway, a professor of computer science at the University of California at Davis, pleaded with his colleagues to think hard about the possible human effects of their work before they agree to help any particular project. "The problem occurs," Mr. Rogaway said, "when our community, as a whole, systematically devalues utility or social worth."

But other scholars argue that society faces greater risks from scientists abstaining while others around them rush to deploy all available technologies in ways that aren't always positive and constructive.

Coming generations face two fundamental shifts that researchers aren't adequately addressing, said Braden R. Allenby, a professor of engineering and ethics at Arizona State. One is the reality that the planet is undeniably being shaped by human activity, Mr. Allenby said. The other is that genomic sciences are redesigning our understanding of a human life.

"So the human becomes a design space, the planet is terraformed, and the complexity and the moral and ethical implications of those two fundamental shifts are ones that we haven't begun to deal with," Mr. Allenby said. "Not in universities, certainly not in government, and not in granting organizations."

On Climate Change, Are University Researchers Making a Difference?

They've studied it and written about it, but some experts say scientists haven't done enough to shape public opinion on what may be the most important issue of our time

By PAUL BASKEN

JESSICA PERSSON, AGENCE FRANCE-PRESSE, GETTY IMAGES

Tobacco executives are sworn in before testifying on Capitol Hill in 1998. Some scholars point to that year's federal settlement with tobacco companies as a possible model for how scientists might push energy companies to take action on climate change.

University scientists have a formidable record of accomplishment in the field of climate-change research.

Fueled by billions of dollars in financial support, they've used mile-long ice cores to calculate temperatures and carbon concentrations from centuries ago. They've figured how to grow crops under unusual heat conditions. They're now predicting how warmer climates will speed the spread of diseases.

What they haven't done with climate change is figure out how to stop it.

For that, one of the best hopes might be the work of a small nonprofit trade publication, InsideClimate News. A three-member team there took less than a year to compile evidence that the world's biggest oil company, ExxonMobil, spent millions of dollars publicly casting doubt on climate science that it knew internally to be true.

That's helped sparked government fraud investigations of ExxonMobil and other oil companies. The investigations might one day become a tipping point similar to the 1998 legal settlement that forced the tobacco industry to spend more than $200 billion reversing false claims about the safety of cigarette smoking.

As with cigarettes years ago, public failure to understand the dangers of climate change has been a key obstacle to policy solutions, said Matthew L. Hale, an associate professor of political science at Seton Hall University. "Having billions of dollars to tell that story through advertising and media is certainly one way that things are going to flip," Mr. Hale said.

Of course there's a long way to go before the legal pursuit of ExxonMobil — one investigation initiated by the New York attorney general, Eric T. Schneiderman, and another by his California counterpart, Kamala D. Harris — forces the industry to finance an ad campaign admitting a deception of the American public. But given decades of failed attempts to change public policy, it's hard to find a more plausible near-term threat to those promoting public skepticism of climate-change science.

That raises the question of whether the basic strategy pursued by InsideClimate News — a direct assault on companies seen as financing the public misunderstandings — should have been among the tools employed or at least advocated by university researchers struggling to solve climate change. And, more broadly, why have research universities become really good places for analyzing the world's major problems, but perhaps not the best places for solving them?

'A VERY HEAVY LIFT'

There's no single answer. Some researchers say they should steer clear of politics. Some say they don't have the right incentives. Or adequate tools. Or the necessary sophistication.

Others in and around the university research community, however, see evidence of fainthearted-ness. As "the mother of all externalities," climate is perhaps the clearest case where academics concerned about societal impact of their work should be involved in comprehensive problem-solving strategies, said Daniel M. Kammen, a professor of energy at the University of California at Berkeley. "That's a completely fair criticism" of university research, Mr. Kammen said.

Alan Durning, the founder and executive director of a Seattle-based think tank, has tried to work with university scientists on public-service projects. Consistently, he said, he has encountered institutional barriers. Mr. Durning got a taste of that resistance when his organization, the Sightline Institute, tried to get researchers at the University of Washington to help it with a project to make clear the risks of climate change by calculating impacts specific to various interest groups.

It's a classic communications strategy: defining an audience segment and tailoring a message to it. In this case, the Sightline Institute wanted to hone messages to seniors, children, Asian-Americans, and Hispanic Americans. To reach Hispanics, Sightline suggested calculating the potentially deleterious effects of warmer temperatures on some of their most commonly held jobs. But the university scientists, Mr. Durning recalled, said they'd prefer to assess heat exposure and its effects on construction and agricultural workers. Predictions about job losses are more compelling to people than data on their likely heat exposure for making a strong case about climate change, Mr. Durning said. But, he learned, numbers with wider uncertainty measures — even if the bottom-line message is scientifically valid — are a lot tougher for academics to defend in peer review.

"To get a fundable proposal" in the peer-based system of federal grant allocations, Mr. Durning said of the researchers, "they would need to have a methodology that was pretty watertight." Protecting the taxpayer dollars that support research is important, he said, but that kind of precision may cost the nation even more in the long run. "Many of the biggest problems we face have high uncertainty levels," Mr. Durning said. "I would rather know the most important forces, even if the error bars were wide, than whatever is the most measurable thing."

Such caution can even be seen at the Massachusetts Institute of Technology, a globally renowned leader in combining research with real-world applications. MIT in October announced a five-year plan for fighting climate change, with a key element being a global ideas competition hosted by MIT's Climate CoLab, a crowdsourcing platform. CoLab emphasizes breaking the challenge down into smaller chunks. It gave one of its top funding awards to a group that suggested teaching maintenance staff in office buildings to make better use of their sophisticated energy-efficiency systems.

But CoLab is putting less emphasis, for now, on trying to broadly change public attitudes and behaviors, said its head, Thomas W. Malone, a professor of management at MIT. "It's not at all easy to align the incentives to get faculty members to focus on these things," Mr. Malone said. "People might be willing to come for a lunch meeting or something and say, 'Yeah, here's what I think,' but what we really need are people who are seriously willing to commit some time to thinking this through at multiple levels."

Behavioral-intervention strategies also get a skeptical reception among potential partners outside universities. The million-member Natural Resources Defense Council is among many environmental groups that are deeply concerned by climate change, and that are largely encouraging technology-based solutions as the most practical response. "Trying to advocate for a lower-consumption lifestyle is a very heavy lift," said David G. Hawkins, the council's director of climate programs, "and one that is much more difficult politically than one that essentially is saying, 'Take advantage of a technical solution that is there.'"

But experts warn that hoping for a technological solution to climate change simply may not be enough. "I have never seen a credible scenario to get to where we need to get without a big demand-side contribution," Ernest J. Moniz, the U.S. secretary of energy, told *The Chronicle*. "Demand side is just central in any solution."

NO PUBLICATIONS, NO UPSIDE?

As with tobacco, that's often been the case in major societal challenges — even if inventing new technologies seems easier than changing human attitudes about them. Mr. Hale sees that lesson in his studies of how seemingly insurmountable political forces eventually lose power. But he also says he can't imagine professors of environmental science seeing a historical precedent such as the downfall of the tobacco industry and responding by filing open-records requests to prove that ExxonMobil really did have its own scientific understanding of the dangers of climate change.

"There's no upside for a professor to do that," he said. "There's no publications involved in it; there's no university support for that."

That reluctance needs to be changed, said Howard Frumkin, dean of public health at the University of Washington. Ending ExxonMobil's political dominance, Dr. Frumkin said, is at least as important a role for scientists fighting climate change as more-conventional projects like developing heat-resistant crops or improving solar-energy technology.

"It's fair to ask, Is academia paying enough attention to practical and real-world solutions, especially when they're political?" he asked. "I think the answer is no." But many others strongly disagree, he said, "especially in the sciences, and that's one of the reasons why you don't see academia doing more."

The view that science and politics should not mix has influential proponents. They include Daniel Kahneman, an emeritus professor of psychology and public affairs at Princeton University whose study of behavioral economics and flaws in human judgment led to his sharing the 2002 Nobel in economic science. Mr. Kahneman said researchers should scrupulously avoid politics and set a broad definition for that: If it is a matter "that anybody in Congress is going to be offended by, then it's political," he said.

Others see room in the middle. University researchers looking to be more solutions-oriented wouldn't have to go as far as suing Exxon themselves, said Andrew J. Hoffman, a professor of sustainable enterprise at the University of Michigan at Ann Arbor. Scientists concerned about climate change could have just done investigative work of the type done by InsideClimate News (and a similar probe published a few weeks later by the *Los Angeles Times*), Mr. Hoffman said, and then handed off their findings to a group that would make use of it.

A new generation of problem-solving researchers is more likely to try that, he said: "Young people are coming into this field because they want to make a difference, and they don't want to just have citation counts as the measure of their success."

For now, Mr. Hoffman said, many universities' approaches seem like a "huge cop-out." In his view, academe's reluctance to develop a more outcome-based strategy on climate change sends a message to the outside world: "Don't have us change anything we do, don't have us change the questions we ask, or the methods we use, or the outlets we use — let's just get someone to come along and translate our work for us."

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How Fresh Funding Structures Could Support Research With Impact

By PAUL BASKEN

Eli Berman, a professor of economics at the University of California at San Diego, does work that many would see as vitally important: He analyzes global trouble spots in the hopes of keeping the country out of wars. But he has struggled to get the money he needs to finance his research.

Yes, that's a woefully familiar lament these days.

Yet Mr. Berman's problem is far more fundamental than just a shrinking federal budget: While his work may have broad implications, it's not clear that any single agency is responsible for supporting it.

That's because Mr. Berman, research director for international security studies at the UC Institute on Global Conflict and Cooperation, is filling a need that government structures seem not to have anticipated. He flies to war zones, then to meetings with State Department and Pentagon officials, trying to keep them up to date on world crises and scientific insights that might help in dealing with them.

The job, basically, is to "explain to the federal government what to do with the research that they spent money" on, Mr. Berman said. But, he said of his mission, "it's dark and cold and lonely, because it really falls between the cracks."

That appears to be an increasingly common problem, not just in national security, but across the research spectrum. Government structures for financing science may make sense for reasons of professional development, economics, and tradition, but they're not necessarily built for optimal problem-solving.

The National Institutes of Health is the largest provider of basic research money to universities. Like the National Science Foundation and other agencies, it also finances work to convert research findings into real-world uses. At NIH, that translational work includes spending more than $600 million a year on a division devoted primarily to converting lab discoveries into new pharmaceuticals. It spends another $200 million apiece on major new initiatives in neuroscience and individually tailored medicine.

DAN AGUIRRE

The structures that support university science should be designed from the start to identify and pursue society's biggest problems, says Sandro Galea, dean of public health at Boston U., rather than to focus only on discipline-based segments of those problems.

Benefits undoubtedly will flow from such efforts, said Sandro Galea, dean of public health at Boston University. But more valuable, Dr. Galea said, would be structures designed from the start to identify and pursue society's biggest problems, rather than tackle discipline-based segments of those issues. "When you start asking what matters most, it really changes how you look at things, and it changes what you take on," he said.

COMMON CALCULATIONS

The interest in government structures comes, in part, because private funders may be little better. Alzheimer's disease, as one major and growing example, is estimated to cost the nation more than $200 billion a year, making it one of the most expensive chronic diseases. Research so far shows that exercise can help prevent Alzheimer's better than any known medication. Yet out of about a dozen grant programs offered annually by the Alzheimer's Association, the largest nonprofit funder of Alzheimer's research, just one focuses on non-pharmacological strategies.

Meanwhile, some of the most-ambitious research universities have embraced a "grand challenges" format, in which they pick a formidable problem or two and then assemble research teams to tackle them. One of the biggest programs, at the University of California at Los Angeles, aims to make the city fully self-sustainable on energy and water by 2050, and eliminate the burden of depression by 2100.

But even a grand challenge has its limits. While scientific projections suggest that much of the city might be underwater by 2100, climate didn't show up on UCLA's list. That's because UCLA's two choices reflect not just the importance of the challenges, but also the university's ability to grow existing research strengths, said Michelle Popowitz, assistant vice chancellor for research and executive director of UCLA Grand Challenges program. "We could see there's funding in these areas," she explained.

Those types of calculations are common, said Benjamin G. Bishin, a professor of political science at the University of California at Riverside. "We essentially have a system where problems are prioritized based on economic impact for the people who are going to do the studies," Mr. Bishin said.

Universities increasingly engage in "cluster hiring," through which they strategically recruit for select departments with an eye toward revenues and future fund raising, Mr. Bishin said. "The problem is that the foci of those clusters doesn't come about from a discussion of what are the most pressing social problems. It comes about from how the faculty think we can improve the research profile of the university," he said. Mr. Bishin cites the opening in 2013 of Riverside's new medical school — a financial gamble for California's cash-strapped public-university system, he said, but a clear winner for the campus's leadership and its credentials as a research hub.

Far too much university research and funding, Dr. Galea said, is dedicated to making increasingly precise tallies for relatively minor issues. Instead of paying researchers to count how many blueberries per day may cut the risk of heart attacks, Dr. Galea said, universities and their funders could more systematically identify and tackle the root causes of social problems — such as tolerance of violent attitudes, indifference to environmental concerns, and large and persistent gaps in wealth, education, and economic opportunity.

'PICKING WINNERS AND LOSERS'

Some federal support for science does reflect that ambition. Robert C. Bailey, a professor of epidemiology at the University of Illinois at Chicago, gets money from the U.S. Centers for Disease Control and Prevention to promote male circumcision in Kenya as a way of reducing AIDS infections. His team works directly with Kenyan villagers to discuss their concerns on matters including the pain and cost of the process and how it fits with cultural and religious mores. He also tells them about the benefits he sees, such as improved hygiene, protection from disease, and enhanced sexual performance. Mr. Bailey said his team was about halfway to its goal of 23 million circumcisions, which would be expected to spare Kenyans millions of new infections and save them billions of dollars.

The NIH has one division, the Fogarty International Center, that is especially concerned with real-world implementations of research, said its director, Roger I. Glass. Its projects include reducing farm injuries in China, khat addiction in Yemen, and fetal alcohol syndrome in Russia. Putting research into practice is a tough learning process for scholars, Dr. Glass acknowledged. "We know a lot about science here, but we don't know how to implement the science that we discover," he said.

Those efforts are rarer for problems within the United States, where NIH's focus on real-world outcomes is largely a matter of assisting drug development. "Their translational push is much more at the lab bench than it is in society at large," Rush D. Holt Jr., chief executive of the American Association for the Advancement of Science, said of NIH.

NIH and other government agencies are acting out of fear of Congress, Mr. Holt said. "If you're actually trying to take some technology or some social-science finding or some medical-science finding and drive it out there to help people, immediately you'll be accused of picking winners and losers," he said. "They'd rather let the market pick the winners and losers, and of course what that means sometimes is some of these technologies don't get to people who need them, or particularly they don't get to the neediest of people."

Perhaps one of the hottest hot-button issues in American society is gun violence. Congress has largely forbidden the NIH and CDC from studying the problem. Those restrictions wouldn't be

COURTESY OF ROBERT BAILEY

Robert Bailey, a professor of epidemiology at the U. of Illinois at Chicago, discusses plans for clinical trials on male circumcision with a research coordinator in Kisumu, Kenya. Mr. Bailey's work focuses on reducing AIDS infections.

such a concern, said Garen J. Wintemute, who researches gun violence at the University of California at Davis, if more government-sponsored science was aimed at larger-scale solutions, such as confronting macho attitudes and promoting mental calm and empathy.

"There are more than 300 million firearms in the U.S., and they're not going away," said Dr. Wintemute, a professor of emergency medicine. "We need strategies that work with those firearms present."

Change may be coming. Despite his frustrations in getting national-security research into the hands of policy makers, Mr. Berman said the Pentagon now has one of the government's better models for making effective use of science because it hires enough experts to give it a significant capability to conduct its own research in-house. "Because they do research, they're connoisseurs of research," he said. "They know good research when they see it."

And the NSF has just embarked on a project that could give a huge boost to putting research in the real world. In 2011 the agency created a program known as the Innovation Corps, which teaches researchers to think like entrepreneurs and create businesses based on their product ideas. The program has since spread to NIH and other federal agencies. And now the NSF has awarded a grant to Angela M. Evans, dean of public affairs at the University of Texas at Austin, to create a new version of I-Corps for researchers working on public policy and nonprofit endeavors.

Armed with some of the key I-Corps skills — how to define and find customers, for example — university researchers could make real-world implementation a more standard component of their grant-financed work, Ms. Evans said. With time, she said, government support might also help overcome the fact that universities' tenure-and-promotion systems tend to reward scientific outreach that generates patents and licenses rather than broad social benefit.

"If you prove what you can do, and you prove it makes an impact," she said, "it would be very hard for people to say it doesn't matter.

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Teaching Young Engineers to Find Problems, Not Just Solve Them

By PAUL BASKEN

A new wave of campus programs encourages undergraduates to think broadly, aggressively, and across disciplines about how they can help with real-world challenges

The most important thing Amos Meeks learned in engineering school was not engineering.

It was to talk to people, and to listen to them.

Now, just a year after graduating from the Franklin W. Olin College of Engineering, Mr. Meeks is the co-founder and chief technology officer at a company that produces low-cost scales designed for wheelchair users.

That idea came from a standard class at Olin that focuses not on designing a product, but on simply asking people about their lives and learning from their answers to identify unmet needs.

"At almost no point do you actually do any kind of what people would normally think of as engineering," Mr. Meeks said. "But I think that is a really important part of engineering."

The program at Olin is among a series of attempts at universities nationwide to teach undergraduates to think more broadly and aggressively about how they can help solve real-world problems. The strategy is proving popular, helping institutions boost enrollment and helping students find jobs.

It can be seen at other career-focused campuses, such as the Rose-Hulman Institute of Technology, where one class invented a cheap roofing material for poor villagers in Haiti. And it can be seen at liberal-arts institutions like Agnes Scott College, which has just begun a first-year program emphasizing interdisciplinary problem-solving skills.

For too long, "engineering and technology has been divorced from other disciplines," said Elaine Meyer-Lee, associate vice president for global learning and leadership at Agnes Scott. Research "needs to be moving the world ahead and making the world a better place in some way," said Richard E. Stamper, interim vice president for academic affairs at Rose-Hulman.

Yet that's still a relatively rare concept. "At most academic institutions — though certainly not all — students receive no or very little training in how to translate their work, either to a larger audience or to actionable policy steps," said Bethany A. Teachman, a professor of psychology at the University of Virginia. Ms. Teachman helped compile a special section of the journal Perspectives on Psychological Science looking at ways that behavioral science could be used to deliver social benefits.

'A BLANK SHEET OF PAPER'

Mr. Meeks's company, Lilypad Scales, is an example of both the potential and the challenges of teaching students to apply research. The idea for Lilypad grew out of a 2012 project in a mandatory sophomore course at Olin called "User Oriented Collaborative Design."

Rather than being told what to design, or even just to design something, the students are asked to start by identifying a group of people whose lives they want to change. It's the difference between "design-based projects" and the more common "project-based learning," said Olin's president, Richard K. Miller. "A design-based project starts with a blank sheet of paper, not a paint-by-numbers diagram."

The students in Mr. Meeks's class chose to concentrate on elderly people, and then spent a couple of hours interviewing residents of an assisted-living facility near the campus. From that, the students learned that being dependent on wheelchairs makes it tougher to avoid weight gain. It's tougher even to measure body weight — a widespread problem for wheelchair users often not recognized by those who walk.

That's where the engineering finally came in. The students set about designing an electronic carpet that could separate out the weight of the wheelchair and wirelessly transmit the reading to a phone.

"And now," Mr. Miller said, "they're on fire to learn what pressure sensors are, how radio transmitters work, and how you write software for the iPhone."

Rose-Hulman's approach has some key similarities. There, in a "grand challenges" course, the students are given a specific place in the world and asked to research the local population and figure out a technology that might help them. That's led to classes designing filters to clean water in Kenya and inventing a process for converting plastic trash into roofing tiles in Haiti.

As at Olin, an interdisciplinary team of teachers provides instruction in specific fields as the students grasp the context of the problem at hand. To make the Haitian roofing tiles, for instance, the class got "some on-the-fly teaching on heat transfer," so they could figure out how much reflected and concentrated solar heat they'd need to melt plastic, said one Rose-Hulman student, Christopher J. Schenck, a junior from Terre Haute.

Agnes Scott is newer to the world of interdisciplinary problem-based learning, and its approach is more basic than those of Olin and Rose-Hulman. For a now-mandatory first-year course, students choose from a variety of topics — such as America's cultural influence on Europe, gender and music, and the Bible and human rights in nearby Atlanta. Each class examines how the academic methods and approaches common to one discipline might inform the study of another one, with an eye to recognizing the crossover skills necessary for many real-world challenges in complex problem-solving.

"We want students to learn something in one domain and be able to apply it in a completely different one," said Lilia C. Harvey, a professor of chemistry and associate vice president for academic affairs at Agnes Scott. "That's what knowledge transfer is."

Liberal-arts colleges have always valued academic breadth and integration, but haven't always done enough to put that into practice, said Ms. Meyer-Lee. "So that's where we're catching up," she said.

THE HUMAN DIMENSION

Even in the more-advanced programs, it's tough to do everything in four years. Rose-Hulman lets its students continue a single project across different courses and academic years, sometimes all the way into their senior "capstone" presentations. Still, Mr. Schenck and his classmates never made it to Haiti to test their idea in the field. Instead they are leaving that to some collaborators at Clemson University to hopefully try out.

Tackling society's most important problems, said Anneliese Watt, a professor of English at Rose-Hulman, is not the priority at the undergraduate level. "We're ultimately educators, and so what's most important to us is what the students learn in the course," she said. "Really honestly, solving the problems, I think, is secondary to us."

Job preparation is also a priority. Jacob N. Hiday, a senior biomedical-engineering student at Rose-Hulman, led a project in which students measured paper-towel use in campus bathrooms and tested out various strategies for reducing waste. The work was part of a class in Six Sigma, a widely used business strategy for making systems and processes more efficient.

After each group in the class made its presentation, Mr. Hiday said, the teacher encouraged the students to copy-and-paste the best elements into a single document. "That way, we could have our own very professional-looking document in the end," he said. "We would have something very presentable for potential employers."

The concept of social value remains the most difficult aspect of problem-solving, said Mr. Miller, of Olin. It's relatively easy to teach students to consider the feasibility and the viability of a project idea, he said. Adding the human dimension — that is, determining whether a solution will be seen as acceptable and desirable — takes much more work.

The best answer is to consider all three elements as part of problem-solving, and "to repeat that framework over and over and over again in every semester, so that they start projects by just thinking of the world that way," Mr. Miller said.

"Science has leaped way ahead, and what we know about ethics and about human behavior has not," he said. "It's stuck back a long ways back in the past."

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To Curtail Violence, Researchers Say, Reduce Economic Inequality

COURTESY THOMAS ABT

The most successful antiviolence programs identify problems down to the level of individuals and direct intensive resources at them, said Thomas Abt, a senior research fellow at Harvard's Kennedy School of Government.

By PAUL BASKEN

Mass murder. Child abuse. Spousal battery. International conflict. Schoolyard bullying. Aggressive driving. Sexual assault. Police misconduct. Suicide.

They're all forms of violent behavior, and they've all been the subject of study by university researchers trying to figure out how to reduce their incidence.

But do they have other significant traits in common? Might researchers find more success studying them collectively than by continuing to treat them individually?

The answer, according to some experts in the field, is a resounding "Yes, but." That's because reducing economic inequality, a widely recognized key to deterring various forms of violence, is largely outside the purview of researchers in the field.

"If we are looking for long-term, more or less permanent, solutions to the violence problem in the United States," said Richard B. Rosenfeld, a professor of criminology and criminal justice at the University of Missouri at St. Louis, "then we have to be thinking about greatly expanded economic opportunities."

And if a coherent antiviolence strategy exists beyond the reduction of inequality, it's the idea of thinking small: concentrating resources in limited areas, where the potential gains are most promising.

The big problem there, however, is that effective programs are costly and appear to benefit primarily the politically marginalized. That makes it tough to maintain funding for them, even when they show success.

"Sustainability is a real challenge," said Thomas Abt, a senior research fellow and adjunct lecturer in public policy at the Center for International Development at Harvard University's Kennedy School of Government. "I don't think there is any place that has been practicing focused deterrence without any interruption for 20 years."

Boston is a chief example. After tallying 150 homicides a year in the early 1990s, the city used findings from federally funded research to create a program called Operation Ceasefire. It hired young adults to meet with gang members in violence-plagued neighborhoods to get them to the services they needed to turn their lives around.

The effort was a success, giving Boston an 18-month period without a single youth killed.

Even so, the program then withered, as organizers moved on and attention waned. Homicides again rose. So in 2010 the city created a new program, this time called StreetSafe Boston, largely as an attempt to replicate the up-close-and-personal approach of Operation Ceasefire. Again violence rates fell.

CONCENTRATED ATTENTION

While frustrating, the experience nevertheless affirms that research does produce useful answers for reducing violence, and that those solutions require concentrated attention in specific high-need areas, Mr. Abt said.

Boston's strategy, he said, stemmed from two key recognitions by researchers. First, 1 percent of youths aged 15 to 24 were responsible for more than 50 percent of all shootings across the city. Second, 70 percent of total shootings over a three-decade period took place in an area covering about 5 percent of the city.

Helping those people and areas — jobs, education, government services — is expensive but clearly works, Mr. Abt said. Yet programs that do that can quickly become victims of their own success, he said, as violence ebbs and others in the city begin questioning the financial outlays.

That basic experience has been repeated elsewhere, said Mr. Abt, who led a review that covered more than 1,400 antiviolence initiatives. The most successful programs, he found, identify problems down to the level of individual people and direct intensive resources at them, while stepping up enforcement and penalties for those who still refuse to abandon violent behavior.

Other recognized examples of concentrating resources on leading incubators of violence include the Nurse-Family Partnership, a government-funded nonprofit group that gives expectant mothers from difficult backgrounds a nurse assistant and then counseling during their children's infancy. The program pays for itself many times over, largely through eventually lower crime rates among their children, Mr. Abt said.

Researchers need to pay close attention to what the data show to be effective, Mr. Rosenfeld said. Then they must resist the temptation to hunt for alternative strategies that might satisfy policymakers operating on short-term reward systems, he said.

"I do not claim that knowledge of the cultural and social conditions that influence crime rates is to be preferred over knowledge of individuals and their immediate social settings," he said in a 2010 speech as president of the American Society of Criminology. "I maintain simply that criminology would be better off with more systematic and sustained attention to the big picture."

Another recognized expert on violence, Steven Pinker, a professor of psychology at Harvard, said he saw little value in trying to deal collectively with disparate types of violence. But even so, he said, there's far too little cross-talk among researchers studying different kinds of violence. "Few authors or institutions do so at present," he said. Studies assessing violence can be invaluable, he said, for calibrating responses that are based on the actual threats posed by each type.

Without better comparisons, he and other researchers said, policymakers and the public worry far too much about statistically low-level threats such as terrorism and mass shootings while paying too little attention to more common forms of violence, such as suicides and single-victim homicides.

The police may not be able to directly prevent many homicides and suicides, Mr. Rosenfeld said. But reducing all kinds of violence and improving the public trust in the police through programs like StreetSafe Boston might, over time, make people less likely to feel the need to carry weapons or settle disputes with violence, he said.

Beyond that, he said, solving violence is a matter of economic commitment. And that must involve significant involvement from the public sector, because the private sector alone cannot create all the jobs that are needed.

"It's a question of whether the will is there to do it," Mr. Rosenfeld said of confronting violence holistically. "But jobs has to be at the top."

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Zika Moves Quickly, and Scientists Fear That Journals Aren't Keeping Pace

By PAUL BASKEN

With the Zika virus spreading north into the United States, Alessandro Vespignani of Northeastern University pulled together some important information he wanted to share.

Mr. Vespignani, a professor of computer science, led a research team that created the first model of the global spread of Zika based on the travel patterns of individual people.

In the hands of policy makers such as the U.S. Centers for Disease Control and Prevention, the model could give health experts critical guidance on what to tell the public and where to deploy medical resources at a time of widespread anxiety and uncertainty.

Mr. Vespignani and his team, however, faced their own anxiety and uncertainty. It typically takes months to shepherd a piece through the publication process of a major academic journal. The researchers were projecting an epidemic's spread within days. What good options existed for sharing those projections?

One method — posting the work online before seeking peer review — is fast. But it can jeopardize the chances that the work is taken seriously or allowed for publication by a peer-reviewed journal, which is a critical part of the academic reward structure. Publishing in a fast-paced journal was another option, but that too could prioritize speed at the possible cost of academic respect. The top-ranked journals increasingly offer their own faster publishing channels, but those are often reserved for just a select set of top-priority papers.

In the end, Mr. Vespignani chose the first option. He posted his paper last month to bioRxiv, a free online distribution service run by the Cold Spring Harbor Laboratory. "There are many more pros in posting the paper and giving the community the ability to look at all the results in real time," he explained.

But the dilemma still unsettles him and many other researchers working on fast-moving public-health threats. In the past decade or so, experiences with outbreaks that include SARS, H1N1, and Ebola have greatly improved the mechanisms and strategies that journals and scientists use to quickly share vital information. But in the eyes of many researchers who study epidemics, the solutions remain scattered and incomplete.

"We're not getting information to the scientific community in a timely manner," said Peter Jay Hotez, dean of the National School of Tropical Medicine at the Baylor College of Medicine and founding editor-in-chief of *PLOS Neglected Tropical Diseases*. "And as a result, for things like Zika, we're relying on this informal system of journalists from major newspapers, emails from colleagues, picking up the phone and talking to thought leaders, and it creates misinformation."

Finding solutions is complicated because the tradeoffs are complicated. In 2009 Kamran Khan, an associate professor of medicine at the University of Toronto, faced a situation similar to that encountered by Mr. Vespignani. Dr. Khan and some colleagues analyzed the flight itineraries for passengers leaving Mexico to try to predict the global spread of H1N1, both to help manage public concerns and help medical professionals prepare.

A leading medical journal, which he asked not be named, printed their findings. But even with an expedited process it took more than a month, greatly reducing the ultimate value of the published information, Dr. Khan said. His research team had to consider not only the expected time of publication, but the need to pare down their report to help speed the process, he said.

'FAST' VS. 'EASY'

Years later, Dr. Khan said, systems have improved. But they still leave researchers with perishable information struggling to figure out their best options. "It consumes a lot of energy and a significant amount of time thinking through some of this," he said, "just because we're trying to navigate a process that is inherently slower than the pace of many of these emergencies."

Pioneering efforts include arXiv.org and bioRxiv.org (pronounced "archive" and "bio-archive"), where researchers can freely post findings. But the lack of peer review on such sites can leave readers uncertain about quality while exposing researchers to the prospect — albeit now dwindling — that major peer-reviewed journals will reject the work as no longer novel.

Journals in the *PLOS Currents* series are specifically designed to handle reviews quickly, though they do not maintain the strong reputation of a top medical journal. Meanwhile, the more widely acknowledged top journals, including *Science and Nature*, have created their own fast-track processes for selected articles.

"Fast" at such top journals can mean as little as 48 hours to online publication, said Lone Simonsen, a research professor in the Department of Global Health at George Washington University and an editor at *PLOS Currents Outbreaks*. For that kind of treatment, however, "you have to have something that's spectacular," she said.

Quicker also doesn't mean "easier" peer review, said Steven J. Cooke, a professor of environmental science and biology at Carleton University who has studied journals' efforts to speed their publication processes. Instead, editors seeking outside reviewers work even more aggressively to find them, sending multiple emails and following them with phone calls, or using their own editorial teams, Mr. Cooke said.

"There are ways to move really key pieces forward with more speed, while maintaining the same rigor," he said.

That attitude has become an every-day priority at the *Journal of Infectious Diseases*, said one of its associate editors, William Schaffner, a professor of preventive medicine and infectious diseases at Vanderbilt University. The editor in chief, Martin S. Hirsch, regularly grades the associate editors on how quickly they move manuscripts through the review process, Dr. Schaffner said.

In many cases, Mr. Schaffner said, the journals move so fast that the limiting factor is the speed with which the authors can respond to reviewer questions. But there are limits to increasing both speed and volume, Dr. Hotez said. After all, peer reviewers are fellow researchers who are already being asked to take time to read and assess papers without compensation.

Many journals also have revised policies that ban the consideration of manuscripts that have already appeared on publicly available sites such as arXiv.org and bioRxiv.org. The World Health Organization helped push that change by creating its own online space for such manuscripts, called Zika Open, and asking leading journals not to treat such submissions as ineligible for publication.

'HABITS OF ACADEMIA'

Sites like bioRxiv can complicate life for public-health officials as much as it helps them, Mr. Cooke said. In some cases, he said, the quick release of working papers could create public pressure for a response that policy makers might not yet see as justified.

Mr. Vespignani discussed his findings separately with experts from the CDC and other agencies to get feedback and help them understand his work. Such agencies typically have their own ways to evaluate science, Mr. Cooke said, with an eye on potential applications that a journal peer-review process might not include.

The paper from Mr. Vespignani's group is a good example of the challenges confronting researchers and journals facing public-health emergencies, said Stephen S. Morse, a professor of epidemiology at Columbia University. The work appears to be valuable, Mr. Morse said, yet it's not a simple matter to assess whether it could or should have waited for peer-review treatment.

Among the questions the Vespignani team has helped highlight, Mr. Morse said, is whether researchers and universities are placing appropriate emphasis on journal publication as a measurement of career success. Mr. Vespignani, for his part, feels journals need to work harder to balance oversight with timeliness. "We should get out of the habits of academia," in which peer review has become too much of a struggle for perfection, he said.

For Dr. Hotez, a chief concern is accuracy. He said he's troubled by repeated references in the media to the idea that some 80 percent of people with Zika are asymptomatic, because there's little scientific basis for such an estimate, and because people on the ground in South America warn him against believing that. Giving more researchers better options to report their findings quickly might help counter such misimpressions, Dr. Hotez said.

Either way, he said, the struggle of the scientific community to respond to Zika is "yet another wake-up call that business as usual is not adequately keeping the scientific community informed."

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The Water Next Time: Professor Who Helped Expose Crisis in Flint Says Public Science Is Broken

By STEVE KOLOWICH

DANNY MILLER, AP IMAGES

Marc Edwards, a professor of civil engineering at Virginia Tech, has been investigating dangerously high lead levels in the Flint, Mich., water supply. "The agencies paid to protect these people weren't solving the problem," he says. "They were the problem. What faculty person out there is going to take on" the government?

When Marc Edwards opens his mouth, dangerous things come out.

In 2003 the Virginia Tech civil-engineering professor said that there was lead in the Washington, D.C., water supply, and that the city had been poisoning its residents. He was right.

Last fall he said there was lead in the water in Flint, Mich., despite the reassurances of state and local authorities that the water was safe. He was right about that, too.

Working with residents of Flint, Mr. Edwards led a study that revealed that the elevated lead levels in people's homes were not isolated incidents but a result of a systemic problem that had been ignored by state scientists. He has since been appointed to a task force to help fix those problems in Flint. In a vote of confidence, residents last month tagged a local landmark with a note to the powers that be: "You want our trust??? We want Va Tech!!!"

But being right in these cases has not made Mr. Edwards happy. Vindicated or not, the professor says his trials over the last decade and a half have cost him friends, professional networks, and thousands of dollars of his own money.

The infrastructural problems go beyond the public utilities of certain American cities, he says. In an interview with The Chronicle, Mr. Edwards said that the systems built to support scientists do not reward moral courage and that the university pipeline contains toxins of its own — which, if ignored, will corrode public faith in science.

The following interview has been edited and condensed.

Q. I just came back from Flint, and it may not come as a surprise to you that you're something of a folk hero there. What do you think about that?

A. It's a natural byproduct of science conducted as a public good. Normal people really appreciate good science that's done in their interest. They stepped forward as citizen scientists to explore what was happening to them and to their community, we provided some funding and the technical and analytical expertise, and they did all the work. I think that work speaks for itself.

Q. Scientific studies by university-affiliated researchers, namely you and Mona Hanna-Attisha, were a big part of what broke this case open. On the other hand, it took a Flint resident writing to a professor in Virginia to start the process of finding out that there was lead in the drinking water. Do you see this as an academic success story or a cautionary tale?

A. I am very concerned about the culture of academia in this country and the perverse incentives that are given to young faculty. The pressures to get funding are just extraordinary. We're all on this hedonistic treadmill — pursuing funding, pursuing fame, pursuing h-index — and the idea of science as a public good is being lost.

This is something that I'm upset about deeply. I've kind of dedicated my career to try to raise awareness about this. I'm losing a lot of friends. People don't want to hear this. But we have to get this fixed, and fixed fast, or else we are going to lose this symbiotic relationship with the public. They will stop supporting us.

Q. Do you have any sense that perverse incentive structures prevented scientists from exposing the problem in Flint sooner?

A. Yes, I do. In Flint the agencies paid to protect these people weren't solving the problem. They were the problem. What faculty person out there is going to take on their state, the Michigan Department of Environmental Quality, and the U.S. Environmental Protection Agency?

I don't blame anyone, because I know the culture of academia. You are your funding network as a professor. You can destroy that network that took you 25 years to build with one word. I've done it. When was the last time you heard anyone in academia publicly criticize a funding agency, no matter how outrageous their behavior? We just don't do these things.

If an environmental injustice is occurring, someone in a government agency is not doing their job. Everyone we wanted to partner said, Well, this sounds really cool, but we want to work with the government. We want to work with the city. And I'm like, You're living in a fantasy land, because these people are the problem.

Q. Now that your hypothesis has been vindicated, and the government has its tail between its legs, a lot of researchers are interested.

A. And I hope that they're interested for the right reasons. But there's now money — a lot of money — on the table.

Q. Not as much as some of them would like. I heard a lot of people say they thought that a zero might have been missing from the grant money that the University of Michigan made available.

A. Right. But the expectation is that there's tens if not hundreds of millions of dollars that are going to be made available by these agencies. And some part of that will be directed toward research, so we now have a financial incentive to get involved. I hate to sound cynical about it. I know these folks have good intentions. But it doesn't change the fact that, Where were we as academics for all this time before it became financially in our interest to help? Where were we?

Q. Now, of course, when you walk around Flint and ask people about the reassurances they're hearing now, they don't believe anybody. When is it appropriate for academics to be skeptical of an official narrative when that narrative is coming from scientific authorities? Surely the answer can't be "all of the time."

A. I'm really surprised how emotional this interview is making me, and I've given several hundred interviews. What these agencies did in [the Washington, D.C., case] was the most fundamental betrayal of public trust that I've ever seen. When I realized what they had done, as a scientist, I was just outraged and appalled.

I grew up worshiping at the altar of science, and in my wildest dreams I never thought scientists would behave this way. The only way I can construct a worldview that accommodates this is to say, These people are unscientific. Science should be about pursuing the truth and helping people. If you're doing it for any other reason, you really ought to question your motives.

Unfortunately, in general, academic research and scientists in this country are no longer deserving of the public trust. We're not.

Q. I think of that rock with the spray paint on it that says, "You want our trust??? We want Va Tech!!!" That's a vote of confidence in you at the expense of confidence in anybody else. Is that a happy piece of graffiti in your eyes?

A. It's a symbol of the total failure of our government science agencies, and also of our academic institutions. I really derive no personal satisfaction from that. I feel shame. That's what I feel.

Q. I keep coming back to these university researchers in Flint who said: "The state has 50 epidemiologists. They say that the water's safe. So I'm going to focus my energy on something that's less settled." How do you decide when the state should be challenged?

A. That's a great question. We are not skeptical enough about each other's results. What's the upside in that? You're going to make enemies. People might start questioning your results. And that's going to start slowing down our publication assembly line. Everyone's invested in just cranking out more crap papers.

So when you start asking questions about people, and you approach them as a scientist, if you feel like you're talking to an adult and they give you a rational response and are willing to share data and discuss an issue rationally, I'm out of there. I go home.

But when you reach out to them, as I did with the Centers for Disease Control and Prevention, and they do not return your phone calls, they do not share data, they do not respond to FOIA [open-records requests], y'know. ... In each case I just started asking questions and turning over rocks, and I resolved to myself, The second something slimy doesn't come out, I'm gonna go home. But every single rock you turn over, something slimy comes out.

Q. But at some point in a place like Flint, trust has to be restored somehow in order for the system to continue working.

A. Exactly.

Q. I talked to this woman yesterday at the university pavilion. She's a senior, a nursing student. We looked at the stickers the university had put on its water fountain, saying that this has a filter, that this is safe. And she said: "No. I don't drink the water here. I don't care what they say. I don't care if it's from the university." At that level of mistrust, the system doesn't work. What do you think people would have to see in order to start trusting what scientists tell them?

A. It's going to take time for the people in Flint. They have been so betrayed, and the callous way that our most vulnerable were treated in Flint by the very agencies paid to protect them is so profoundly disturbing. That's why this is striking such a chord.

Q. You teach a course on ethics and heroism at Virginia Tech. How exactly does one teach heroism to college students?

A. We teach aspirational ethics. What I teach my students is, You're born heroic. I go into these animal studies, and heroism is actually in our nature. What you have to do is make sure that the system doesn't change you, that our educational system doesn't teach you to be willfully blind and to forget your aspirations, because that's the default position.

We talk about the realities of heroism too. It's not fun. These are gut-wrenching things. But the main thing is, Do not let our educational institutions make you into something that you will be ashamed of.

Q. And you sort of warn them that you're preparing them for a life of possible sadness and alienation?

A. Well, yeah. There's a price to be paid.

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