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The Security Scientists

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At USC, the first U.S. Department of Homeland Security-funded Center of Excellence fights terrorism with game theory, computer algorithms and weapons of social science.

Security expert Erroll Southers, left, and computer scientist Milind Tambe at the Port of Los Angeles, a potential terrorist target and focus of research by USC's National Center for Risk and Economic Analysis of Terrorism Events. Photo by Noe Montes

HEATHER ROSOFF HAD IT all planned out. She'd spent weeks figuring out how to obtain radioactive material. She'd looked for blueprints on bomb construction. She'd scoped out abandoned industrial spaces suitable for bomb building and collected maps showing the layouts of her targets: the ports of Los Angeles and Long Beach.

So perhaps she shouldn't have been startled when two government agents banged on her front door one morning. The stone-faced men flashed their badges, insisting she answer some questions. Right now.

"At first I thought it was a joke, so I didn't let them in," recalls the assistant research professor from the USC Price School of Public Policy. But mentally reviewing her sinister-sounding research, she could see how it might be misconstrued.

Rosoff never determined exactly why "the suits" showed up on her doorstep, but she had been "playing terrorist" as part of a USC study on the likelihood of a bomb attack spewing radioactive material throughout the ports.

The potential attack could cripple operations there, costing billions a day. The researcher had perhaps played her role too well.

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Years ago, those from the shadowy world of counterterrorism might have bristled at the idea of university scholars treading on their turf. Not anymore.

Rosoff's work was conducted just months after USC opened the country's first university-based terrorism research center funded by the U.S. Department of Homeland Security (DHS).

Launched in 2004 with a three-year, $12 million DHS grant, the National Center for Risk and Economic Analysis of Terrorism Events — known as CREATE — is a "living laboratory," says the center's director, Stephen Hora. It brings together more than 100 researchers from fields as disparate as psychology, computer science, mathematics, economics and public policy, all intent on identifying the next potential terrorist attack before it happens. DHS has twice renewed the grant, pouring another $26.3 million into CREATE.

"It's not a natural instinct for the intelligence or homeland security community to get universities involved, because universities are so open and free thinking," says risk analyst Detlof von Winterfeldt, a professor with USC Price and the USC Viterbi School of Engineering. Von Winterfeldt, who co-founded and formerly directed CREATE, teamed with Rosoff to create the bomb simulations in the ports of Los Angeles and Long Beach.

"The value of a university center is to put some rationality and creativity into the decision making on security," von Winterfeldt says.

IN 2001, JUST MONTHS AFTER 19 men armed with crude weapons hijacked four planes and killed nearly 3,000 people, USC researchers gathered in downtown Los Angeles, anxious to know how their expertise might help protect the nation from the next terrorist threat.

Randolph Hall, vice president for research in the Office of the Provost, convened that first meeting, knowing the university already possessed sufficient expertise to staff a world-class terrorism research center. USC faculty members had studied nuclear power plant safety in the wake of Chernobyl, created a mini-Internet to serve as a test-bed for cyber-security efforts, and trained more than 20,000 professionals in aviation safety.

"Many people were studying homeland security and terrorism in a controlled environment — in government labs or private

institutes, with constraints on what they could publish and how they could communicate," says Hall, a systems engineer who formerly worked for General Motors. "But as a university, we could have open debates on the different threats and different strategies. We could do something special."

IT'S 8:48 A.M., and computer scientist Milind Tambe is in the bowels of an East Hollywood subway station, watching as a team of Los Angeles County sheriff's deputies pat down a fare jumper some 20 feet away.

The suspect, tattoos ringing his neck, glowers at the deputies. Little does he know it is the USC professor, busily tapping notes into his smartphone, who helped engineer his run-in with the law that morning.

Tambe developed Assistant for Randomized Monitoring Over Routes (ARMOR), a sophisticated software system that spits out intricate patrol schedules for law enforcement, helping police not only catch criminals but also scour trains with bomb-sniffing dogs. Because the schedules are randomized, they have no discernible pattern to, say, assist a potential terrorist casing a target.

Tambe's research is rooted in game theory — a mathematical approach to predicting how conflict might play out between adversaries, be they countries at war or corporations seeking a leg up in the marketplace.

He applies the rules of a "leader-follower" game, commonly used to predict the behavior of competing businesses. After 9/11 Tambe wondered: Could this chess-like strategy be applied to counterterrorism, where a faceless adversary — or follower — could be lurking, looking for patterns or vulnerabilities in the leader's movements, and waiting to exploit them.

"The problem is a game, and computer science allows us to solve some very big games," Tambe says.

The rules of this game involve limited security resources, a large number of potential targets and a terrorist adversary who will react and adapt. If badly played, the outcomes can be horrific.

That's why the patrol schedules ARMOR generates aren't completely random. The system is smart enough to "load the dice," providing greater protection to what's most vulnerable or important, such as a heavily trafficked subway stop or airport terminal.

Since 2007, police checkpoints monitoring vehicle traffic at Los Angeles International Airport and canine units dispatched throughout the airport's terminals have relied on ARMOR. In 2009, Tambe's software began shuffling the schedules of thousands of air marshals — the undercover police deployed on flights around the world as a last line of defense against hijackings. A test is under way using the technology with U.S. Coast Guard patrols in the ports of Boston and New York. The National Football League wants to know how Tambe's software can help screen for dangerous or illicit items among crowds entering stadiums. And officials from the Global Tigers Initiative, an international organization dedicated to saving tigers from extinction, are interested in Tambe's randomization software as a tool in the fight against poachers and the trade in illegal animal parts.

SHOES OFF, NO MANICURE SCISSORS, a ban on liquids, pat downs or potentially embarrassing body scans — the restrictions on air travelers seem to change every few months. Erroll Southers, associate director for research transition at CREATE and an adjunct professor at USC Price, has observed these tightened security measures with keen interest.

Southers is no outsider; he spent years with the FBI working as an undercover agent and on the bureau's SWAT team. He was deputy director of California's Office of Homeland Security under Gov. Arnold Schwarzenegger. He was President Barack Obama's first pick to head the Transportation Security Administration.

While law enforcement is increasingly reliant on high-tech tools, Southers firmly believes that, when it comes to terrorism, the focus needs to be on finding the bomber, not the bomb.

"At the end of the day, it doesn't matter what kind of technology we have," he says. "An attack is thought about, developed, delivered or detonated by a human being."

Straddling the worlds of academia and law enforcement, Southers has been the key to putting some of CREATE's most successful projects into practice. He helped get Tambe's ARMOR software out in the field. He also backed CREATE computer scientist Michael Orosz's PortSec system, which culls data and intelligence in real time from various agencies tasked with operating and securing the ports of Los Angeles and Long Beach.

Despite the heavy emphasis on digital technologies, CREATE actually has an interdisciplinary mission.

Fighting terrorism, Southers explains, leverages nearly every academic discipline imaginable. In a recent class, one of his students tried to challenge that assertion: If terrorism can be linked to any academic subject, then how about music?

That's an easy one. Southers pointed to Omar Hammami, the Alabama-born radical Islamist who joined a group of al-Qaeda-linked Somali militants in 2007 and made rap videos to recruit followers. Hammami's titles include "Send Me a Cruise [Missile]" and "Make Jihad With Me."

TO ANTICIPATE WHICH TARGETS terrorists will choose, Rosoff, the role-playing would-be bomb maker, and her colleague Richard John, a psychologist from the USC Dornsife College of Letters, Arts and Sciences, try to get into terrorists' heads.

Rosoff's dissertation topic is the stuff of nightmares: She spent months poring over the writings of terrorists and interviewing those who have had close contact with them in search of a fuller understanding of what makes groups like al-Qaeda and Hezbollah tick. The result: a model for the terrorist mindset, showing how the beliefs and values of different terrorist groups influence the likelihood that they'll choose a specific target or method of attack.

"Terrorist organizations are probably some of the easiest organizations to model — much easier than Apple or any Fortune 500 company or certainly the U.S. Congress," John says. "Terrorists are very upfront about their motivations and what their objectives are."

Rosoff and John say their model can help law enforcement direct its resources toward the most likely threats. That's an important priority. Since the 9/11 attacks, the United States has spent $1.1 trillion on homeland security. And that sum represents only part of terrorism's economic impact.

On an Al Jazeera website in 2004, Osama bin Laden claimed al-Qaeda had spent just $500,000 to perpetrate the 9/11 attacks while inflicting $500 billion in economic damage on America. It turns out the actual cost was much, much higher. On the 10th anniversary of the 9/11 attacks, *The New York Times* put the overall cost of 9/11 to the U.S. at $3.3 trillion, or about $7 million for every dollar al-Qaeda spent planning and executing the attacks.

The *Times* was relying in part on data compiled by CREATE economist Adam Rose. But the story that went untold, Rose says, was America's economic resilience after the attacks. Rather than folding, 95 percent of businesses operating in or near the World Trade Center reopened their doors in new locations soon after the attacks.

"Osama bin Laden did not succeed in achieving one of his major stated goals: to destroy the U.S. economy," Rose says.

This parallels what CREATE architect Randolph Hall thinks will be the center's legacy — protecting the United States against catastrophic threats, while keeping the fear of terrorism in perspective.

"We could build walls around the country, build walls around our city and feel that we're safe," Hall says. "But [we would also be] destroying our economy, our culture, our vibrancy. In some ways, that's what al-Qaeda wanted. We need to provide safety by also providing the ability for the world to thrive."

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