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Research Frontiers

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Fall 2014

## Research Frontiers, Fall 2014

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History in the Sweep of a Laser



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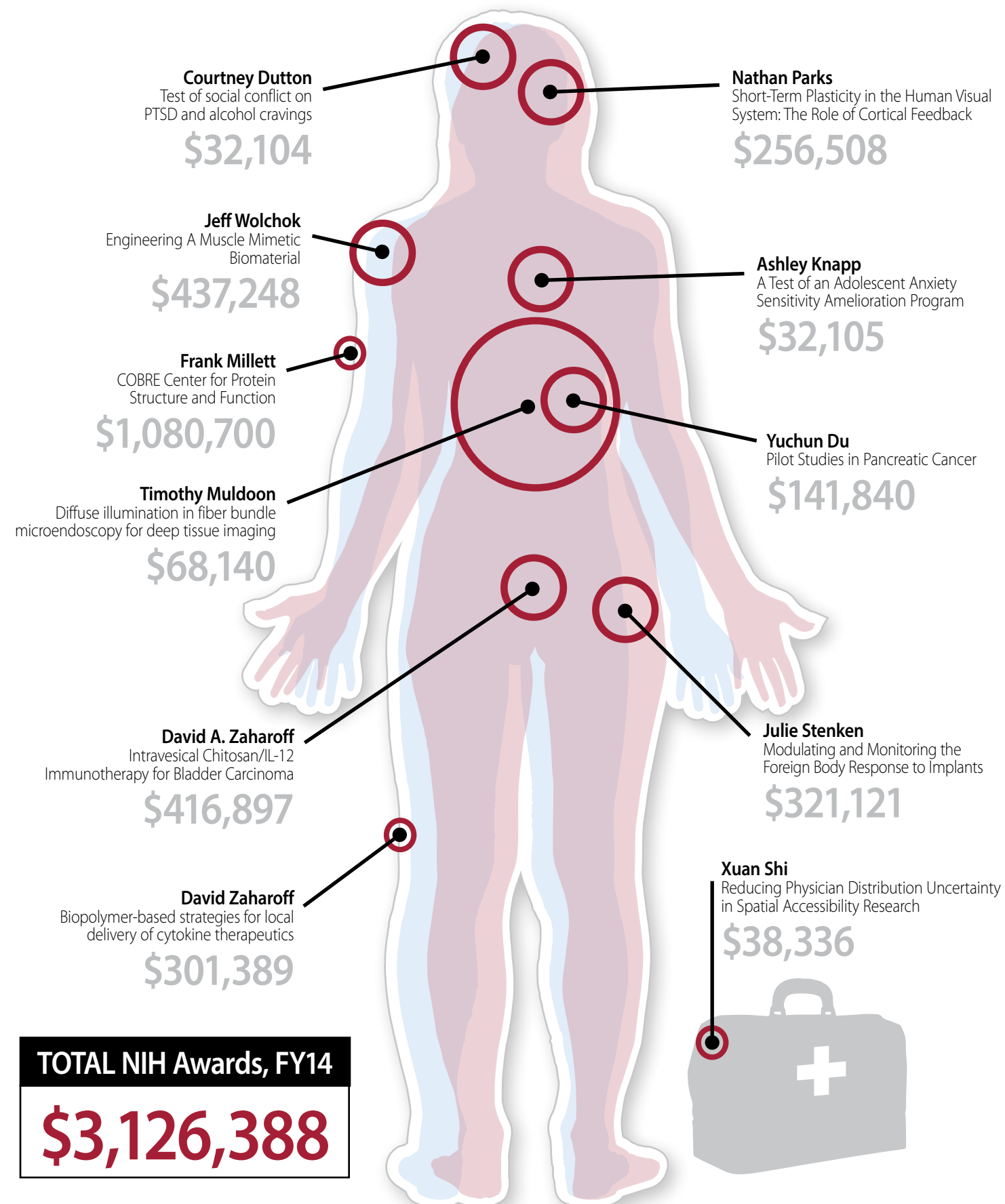
**Honors College**  
Curt R. Rom, Interim



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## TOTAL NIH Awards, FY14



UNIVERSITY OF ARKANSAS  
**RESEARCH FRONTIERS**

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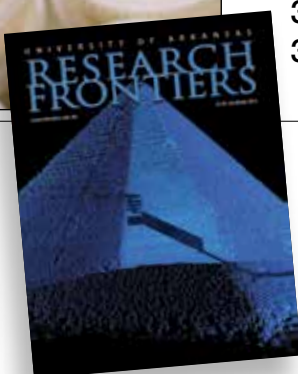
When the Justices of the United States Supreme Court wanted to better understand the Constitution's Commerce Clause, they called on Mark Killenbeck.

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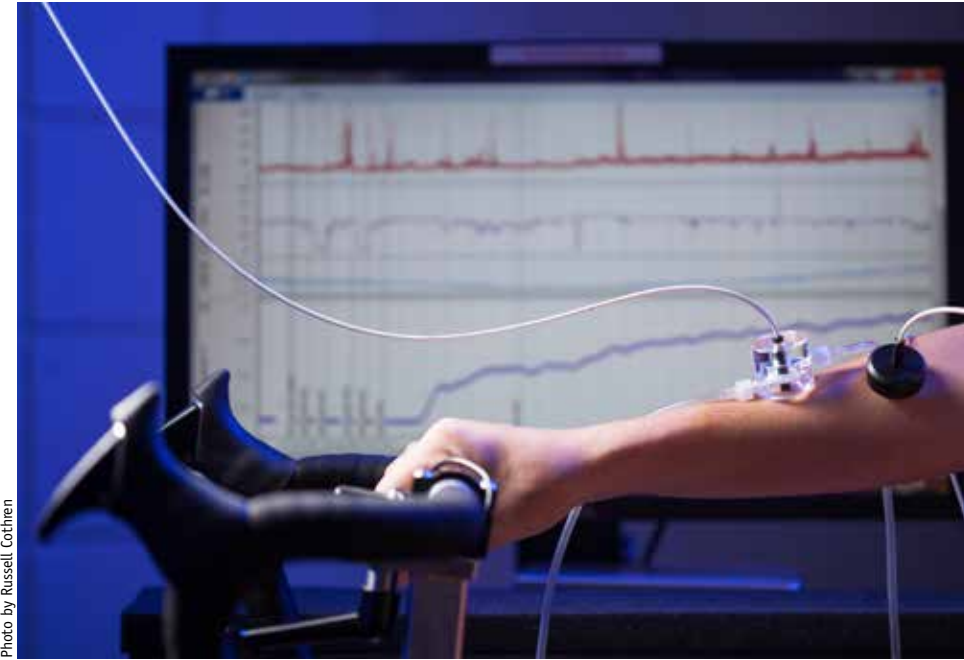
32 Infographic: NIH Awards



**On the Cover:**

The Great Pyramid of Giza in a point cloud, millions of measurements made by the Center for Advanced Spatial Technologies. (Photo courtesy of Atlantic Productions.)  
Story on page 8.

## Research Aimed at Obesity



Young non-obese and obese females have similar core temperature responses to low-intensity exercise in the heat. Future studies, Ganio said, should examine the various moderating factors on body temperature when comparing obese and non-obese individuals, including hydration status and exercise intensity.

Also attending the symposium was Rodolfo Nayga, who holds the Tyson Chair in Food Policy Economics in the Bumpers College as well as a faculty appointment in the Division of Agriculture. He moderated a panel on the environmental influences on weight status and weight-related behaviors. Nayga currently leads a child obesity research project funded by a \$4.78 million grant from the National Institute of Food and Agriculture of the U.S. Department of Agriculture.



**Matthew Ganio**, Assistant Professor and Director, Human Performance Laboratory

Department of Health, Human Performance and Recreation, College of Education and Health Professions

For more: <http://bit.ly/ResearchObesity>

Matthew Ganio was a feature presenter at the 2014 SEC Symposium, the Southeastern Conference's annual showcase of academic excellence, which focused on obesity prevention.

In his research, Ganio has examined one possible hurdle to exercise for obese individuals: fatigue induced by increased body temperature during exercise. Epidemiological data suggest that obese individuals have a two- to five-fold increased risk for heat exhaustion and heat stroke compared to non-obese people. However, Ganio noted, there is a lack of laboratory-based research identifying thermoregulatory impairments in obese individuals.

## Viswanathan Shortlisted for Scotiabank Giller Prize

Padma Viswanathan was named a finalist for the Scotiabank Giller Prize, one of Canada's most prestigious literary awards. Honored for her novel, *The Ever After of Ashwin Rao*, Viswanathan joined a shortlist of six Canadian authors in the running for the prize.

Of Viswanathan's novel, the prize jury wrote, "Scotch-drinking, McGill-educated psychologist Ashwin Rao wrote about those bereaved by India's state-sponsored anti-Sikh pogrom of 1984. In 2004, he returns to Canada researching another book on comparative grief, attending the trial over the 1985 bombing of Air India 182, a bombing that claimed 329 lives, including his sister and her children. Guided by Viswanathan's ever-compassionate gaze, and her ability to render a polyglot world in English, Ashwin meets Canadians affected by the tragedy, some

as complex as himself. This often droll, fiercely-intelligent novel with its cat's-cradle of a plot challenges the twin deadly lures of religious fundamentalism and racism, revealing the learning and unlearning at the core of the immigrant experience."

Founded in 1994, the Scotiabank Giller Prize aims to recognize excellence in Canadian fiction. This year, it awarded \$10,000 to each of the six finalists, and \$100,000 to the ultimate winner, novelist Sean Michaels.



**Padma Viswanathan**, Assistant Professor

Department of English, Fulbright College

For more: <http://www.scotiabankgillerprize.ca/>

## Methanogens Could Manage Mars

New research suggests that methanogens — among the simplest and oldest organisms on Earth — could survive on Mars.

Methanogens use hydrogen as their energy source and carbon dioxide as their carbon source to metabolize and produce methane, also known as natural gas. Methanogens live in swamps and marshes, but can also be found in the gut of cattle, termites and other herbivores as well as in dead and decaying matter.

Since methanogens are anaerobic, they don't require oxygen. They don't require organic nutrients and are non-photosynthetic, indicating they could exist in sub-surface environments.

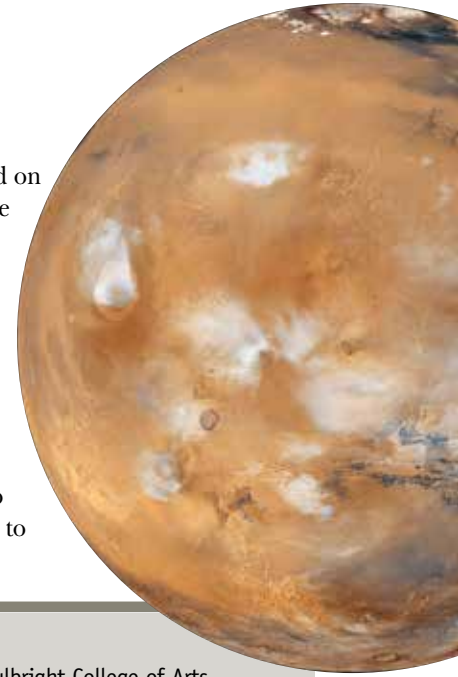
Therefore, methanogens are ideal candidates for life on Mars.

Since the 1990s, Timothy Kral has been studying methanogens and examining their ability to survive on Mars. In 2004, scientists discovered methane in the Martian atmosphere, and immediately the question of the source became an important one.

Working with Kral in the Arkansas Center for Space and Planetary Sciences, graduate student Rebecca Mickol subjected two species

of methanogens to conditions found on Mars, where the surface temperature varies widely in a single day, often ranging between minus 90 degrees Celsius and 27 degrees Celsius.

"If any life were to exist on Mars right now, it would at least have to survive that temperature range," Mickol said. "The low temperature on Mars inhibited their growth, but they survived. Once they got back to a warm temperature, they were able to grow and metabolize again."



**Timothy Kral**, Professor  
Department of Biological Sciences, Fulbright College of Arts and Sciences

**Rebecca Mickol**, Doctoral Student  
Department of Biological Sciences, Fulbright College of Arts and Sciences

For more: <http://bit.ly/Methanogens>

## Connected CEOs More Likely to Broker Deals that Harm Firms

When Tomas Jandik and colleagues examined networks among nearly 400,000 U.S. corporate officers and directors, they found that chief executive officers with extensive social connections initiate mergers and acquisitions more frequently than their less-well-connected peers. But, they also found that these deals tend to destroy value for the businesses involved.

"CEOs are often lauded for being influential and well connected," Jandik said. "What we found, though, is that highly connected executives can also use their influence to become entrenched and to pursue activities regardless of the potentially negative impact on shareholders. This should be an important concern for corporate boards and other market participants, especially in cases of multi-billion dollar M&A deals."

The researchers investigated possible motives for the value-destructive behavior. They found that highly connected CEOs who launched such deals tended to receive substantial salary increases, as well as non-monetary prizes such as honorary degrees or alumni awards, even as their firms suffered negative returns.

Jandik worked with colleagues Kathy Fogel at Suffolk University and Rwan El-Khatib at Zayed University in United Arab Emirates.



**Tomas Jandik**, Edward W. and Anna L. Reed Endowed Professorship in Finance

Walton College of Business

Published (forthcoming): *Journal of Financial Economics*

For more: <http://bit.ly/DealsThatHarm>



## Grant Supports Research in Novel Quantum Materials

Jak Chakhalian has been selected as an investigator by the Gordon and Betty Moore Foundation, which is now developing a \$1.8 million grant to support Chakhalian's research.

The five-year grant will allow Chakhalian to create and investigate novel quantum materials and the relationships at the interface between those materials on the nanoscale. It will fund a state-of-the-art facility to grow artificial quantum materials at the atomic scale, with the ultimate goal of controlling their properties.

His findings could represent a breakthrough in the field of exotic magnetism and high temperature superconductivity. New discoveries in this field could eventually lead to revolutionary applications in electronics, computing, catalysis and energy technology.

Chakhalian was among those who were invited to enter an intense national competition conducted by the foundation, based in Palo Alto, California. The Moore Experimental Investigators in Quantum Materials program awarded a total of \$34.2 million to 19 scientists at 11 universities across the United States, including Harvard, Johns Hopkins, Princeton, Stanford and the Massachusetts Institute of Technology.

"I'm very excited," Chakhalian said. "This is amazing. It was a strong competition. Most

importantly, any award is like an allowance given to a scientist. Money enables the science but it doesn't do the science, so there is exciting, hard work ahead and a lot of responsibility that comes with this award."

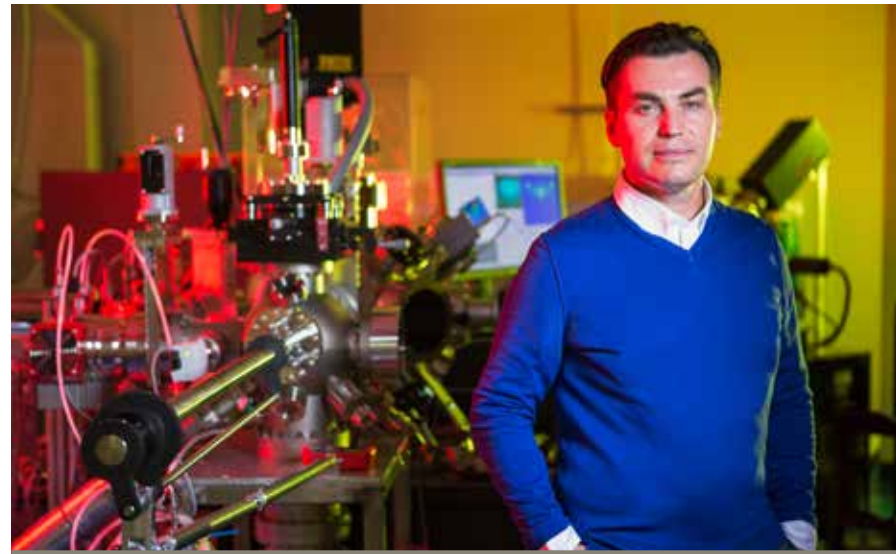


Photo by Matt Reynolds

**Jak Chakhalian**, Charles E. and Clydene Scharlau Endowed Professorship and Director, Laboratory for Artificial Quantum Materials

Department of Physics, Fulbright College of Arts and Sciences

For more: [http://bit.ly/Experimental\\_Investigators](http://bit.ly/Experimental_Investigators)

## Supporting Students from Military Families

A new study will develop and test a system that school districts can use to offer mentoring to students from military families.

Tim Cavell's team will research strategies for schools to identify and support students from military families experiencing deployment-related stress. This form of stress puts military-connected students at risk for disruptions in learning, academic performance and social behavior. The delivery model that is developed may enhance how school districts support students affected by deployment-related stress or by military parents struggling to reintegrate into civilian life.

"Military service members and families are known for being highly resilient, but the wear and tear of combat deployment can exceed a family's capacity to cope," Cavell said.

Previous studies have shown that school-based mentoring can reduce student absenteeism and school-related misconduct and increase academic performance and peer support. Most school districts are not located on or near military installations, and the

school personnel in these districts might not identify, and thus not support, military-connected students in their schools.

Cavell said that to successfully serve military students, school district personnel must dedicate resources to establish a network at each school that connects military parents, school staff, community organizations and local mentoring agencies.



**Tim Cavell**, Professor

Department of Psychological Science,  
Fulbright College of Arts and Sciences

Funding: U.S. Department of Education's  
Institute of Education Sciences

For more: [http://bit.ly/Supporting\\_Students](http://bit.ly/Supporting_Students)

## Can LeBron James Sell Insurance?

From a consumer perspective, what happens when a celebrity endorses different products in two advertisements that appear in the same magazine? Do you remember both equally? One better than the other? Neither?

Katie Kelting found when consumers see two ads featuring the same celebrity, they are more likely to forget information when the celebrity is endorsing a product that is only moderately associated with the celebrity's fame. When a product is either a really good or a really bad fit compared to the celebrity's fame, consumers are more likely to remember the information.

An example of a moderate fit would be the professional basketball player LeBron James featured in a State Farm Insurance advertisement. As an industry or product, insurance

does not fit the nature of James' celebrity. But appearing in an advertisement for a sports drink—a high match—or a fast-food advertisement—a low match—is easy to remember.

"A low match is just weird enough for people to remember," said Kelting. "It may not make sense to them, and they may not feel particularly good about it, but they will remember it, more so than LeBron James endorsing an insurance company."



**Katie Kelting**, Assistant Professor

Department of Marketing, Walton College of Business

Published: Psychology and Marketing

For more: [http://bit.ly/Celebrity\\_Endorses](http://bit.ly/Celebrity_Endorses)

## Using Nanosensors to Detect Brain Injury

Imagine a physician, sitting in a stadium press box and equipped with technology that makes it possible to continuously monitor each player's physiological signs indicating concussion. A new system of nanosensors may soon make that possible.

"Wearable nanosensor systems can detect the severity of head injury by quantifying force of impact, be it light or violent," said Vijay Varadan. "In real time, our system continuously monitors neural activity and recognizes the signs and symptoms of traumatic brain injury, such as drowsiness, dizziness, fatigue, sensitivity to light and anxiety."

The system is a network of flexible sensors woven or printed into a skullcap worn under a helmet. Sensors are constructed of carbon nanotubes and two- and three-dimensional textile nanostructures. The system uses wireless telemetry to transmit data from the sensors to a receiver, which then transmits the data via a wireless network to a remote server, such as a computer or a smart phone.

The sensor chips used are sturdier than printed circuit-board chips. They can withstand high impacts, temperatures and

moisture, while measuring motion and pressure. Some sensors measure electrical activity in the brain, such as signs of mild traumatic brain injury.



From Wikimedia Commons: Werner100359



**Vijay Varadan**, Distinguished Professor and Twenty-First Century Endowed Graduate Research Chair in Nano, Bio and Medical Technology

Department of Electrical Engineering,  
College of Engineering

For more: [http://bit.ly/Brain\\_Injury](http://bit.ly/Brain_Injury)

## SiC Likes It Hot

Engineering researchers Alan Mantooth and Jia Di designed integrated circuits that can survive at temperatures greater than 350 degrees Celsius (660 degrees Fahrenheit). Their work will improve the functioning of processors, drivers, controllers and other analog and digital circuits used in power electronics, automobiles and aerospace equipment – all of which must perform at high and often extreme temperatures.

The researchers worked with silicon carbide, a semiconducting material that is more rugged than conventional materials used in electronics. Silicon carbide is able to withstand extremely high voltage and is a good thermal conductor, meaning it can operate at high temperatures without requiring extra equipment to remove heat.

“This ruggedness allows these circuits to be placed in locations where standard silicon-based parts can’t survive,” Mantooth said. “The circuit blocks we designed contributed to superior performance of signal processing, controllers and driver circuitry.”

One-third of all power produced in the United States passes through a power electronic converter or motor drive before it reaches the end user. Circuits developed by the team will enable tight integration of control in the environmental conditions these applications demand. They will also improve electrical efficiency while simultaneously reducing the overall size and complexity of these systems.

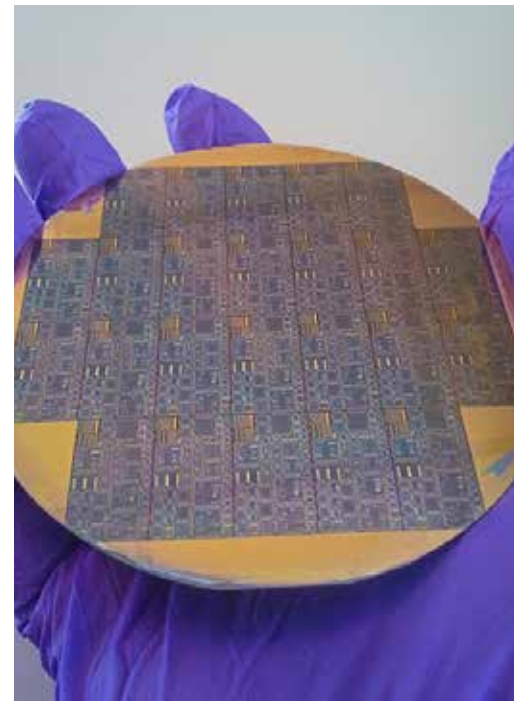
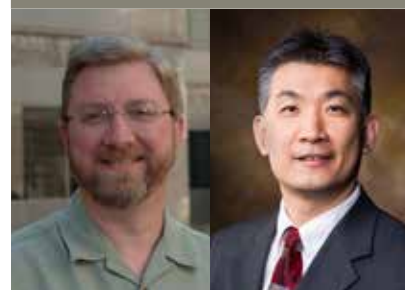


Photo submitted



**Alan Mantooth**, Distinguished Professor and Twenty-First Century Chair in Mixed-Signal Integrated Circuit Design and Computer-Aided Design

Department of Electrical Engineering, College of Engineering

**Jia Di**, Professor

Department of Computer Engineering, College of Engineering

Funding: National Science Foundation

For more: [http://bit.ly/SiC\\_Likes\\_It\\_Hot](http://bit.ly/SiC_Likes_It_Hot)

## Pain of Spending That Last Dollar

A study by Robin Soster confirms the “bottom-dollar effect,” which occurs when a consumer’s satisfaction with a product decreases as the consumer’s budget is exhausted.

Participants whose purchases depleted their financial resources reported lower satisfaction with a movie download compared to those who purchased the same movie with plenty of money remaining in their budget. Satisfaction was based on the financial situation, not the purchase.

Soster and her co-authors considered the pain of spending. They found if a consumer thinks it is difficult to replenish a budget, or if budget replenishment is a long way off, the consumer experiences lower purchase satisfaction.

“Because the consumers’ budgets may influence satisfaction with a product, marketing managers might consider the timing of promotions to coincide with resource availability,” Soster said.

“Initial promotions might be better timed at the beginning of a month or immediately after consumers receive tax refunds to ensure that budgets are not approaching exhaustion at the time of purchase.”

Gift money maintains purchase satisfaction when a consumer has an exhausted budget, but gift money does not influence purchase satisfaction when a consumer has a secure budget. The bottom-dollar effect on satisfaction also disappears if consumers are told their budgets will be replenished soon.



**Robin Soster**, Assistant Professor

Department of Marketing, Walton College of Business

Published: *Journal of Consumer Research*, October 2014

For more: [http://bit.ly/Last\\_Dollar](http://bit.ly/Last_Dollar)

## Multiferroic Superlattice Could Mean Longer Battery Life

Theoretical research by an international team of physicists, including Yurong Yang and Laurent Bellaiche, has revealed rare materials that possess both controllable magnetic and electric polarization properties at near-room temperatures.

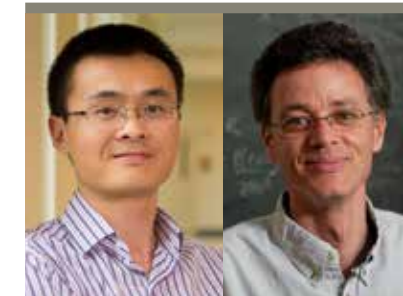
The discovery, which was published in *Nature Communications*, could lead to longer battery life and increased memory storage for electronic devices, Yang said.

A rare class of materials known as multiferroics can change their electrical polarization when under a magnetic field or can change magnetic properties when under an electric field. But multiferroics usually exhibit these properties at temperatures far colder than room temperature, which makes them useless for everyday applications. Thus, today’s memory devices are powered

through electricity or magnetism, but not both.

Yang used computer modeling to perform extremely accurate calculations on a specific class of materials to find combinations that would display these properties.

The researchers found that a class of multiferroics, when periodically alternating along a specific direction to make what is called a superlattice of nanometer-thick layers, should exhibit both controllable magnetic and electrical polarization properties at near-room temperature, Yang said.



**Yurong Yang**, Research Assistant Professor

Department of Physics, Fulbright College of Arts and Sciences

**Laurent Bellaiche**, Distinguished Professor and Twenty-First Century Endowed Professorship in Optics/Nanoscience/Science Education

Department of Physics, Fulbright College of Arts and Sciences

Publication: *Nature Communications*, May 28, 2014

For more: <http://bit.ly/LongerBatteryLife>

## Margulis Builds Bridge to Past With Sordino Pedal

Jura Margulis has collaborated with German manufacturer Steingraeber & Söhne to return the sordino pedal to the grand piano. He introduced the piano prototype at Musikmesse, the world’s leading fair for music instruments and live music.

Margulis calls the pedal “a bridge to the past.”

“Hayden, Mozart, Schubert and Beethoven, they were all familiar with the sordino pedal and used it when they composed,” Margulis said. “It is arcing back to the fortepianos of the older times. When you play this augmented instrument, you have the full range of the modern concert grand and you have a second piano under your hands. It’s not just softer; it is different. You can play with an enriched overtone mixture. You can also play articulations that Schubert wrote that you can’t play on the modern grand.

“We don’t play exactly what he wrote in many places in the compositions because it is not doable with the modern concert grand,” he said. “With this pedal, it is.”

Noted pianist Martha Argerich wrote, “The Margulis Sordino



Photo by Russell Cothren

**Jura Margulis**, Emily J. McAllister Endowed Professorship in Piano

Department of Music, Fulbright College of Arts and Sciences

For more: [http://bit.ly/Sordino\\_Pedal](http://bit.ly/Sordino_Pedal)

Pedal is a very important, interesting and inspiring invention. Sound is the soul of music. The sound of the piano increased in colour and capacity – a desire of every pianist. The MSP may very well be the future of piano construction. Bravo!”

# CAST:

## Capturing History in the Sweep of a Laser

By Chris Branam

Malcolm Williamson gingerly fastens the Leica ScanStation C10 to the top of a 5 ½ foot yellow tripod. He's working in a computer lab down the hall from his office in the Center for Advanced Spatial Technologies at the University of Arkansas.

"This is a survey-grade instrument and has to be handled as such," says Williamson, one of the researchers at the center who use the laser scanner and other advanced remote sensing technology to collect and analyze millions — and sometimes billions — of measurements to help document historic or archaeological sites. They use the data collected by the device to produce what is known as a 3-D point cloud.

Williamson presses a button and the laser scanner begins humming. It is a sound that is reminiscent of those Apple Macintosh Classic II desktop computers that began appearing in offices in the early 1990s. With an oblong shape and hard plastic shell, it is also about the same size and weight as those Macs. A small grayish screen on the scanner comes to life and Williamson begins poking at it with a stylus, inputting specifications for the area of the lab to be scanned.



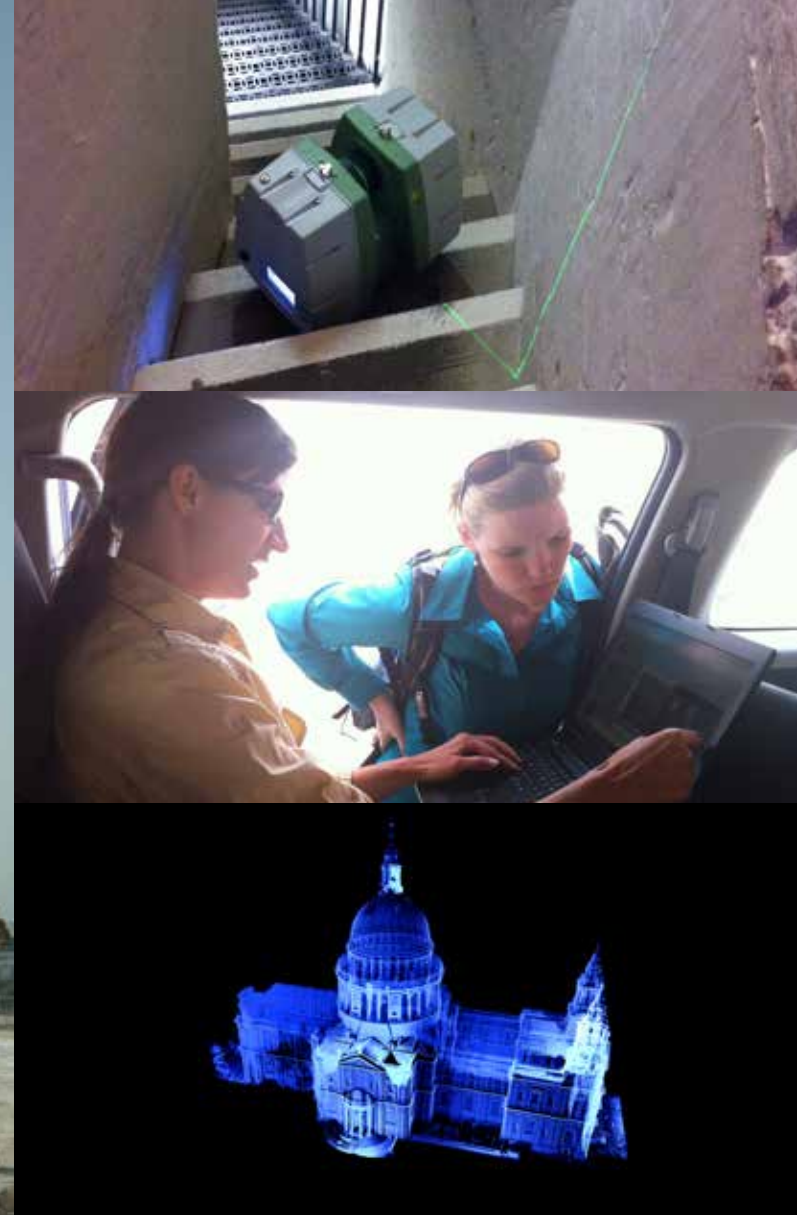
Eileen Ernenwein (left) uses ground-penetrating radar to image the subsurface in front of the Monastery at Petra, Jordan. Caitlin Stevens (above), a CAST researcher, prepares to scan the burial chamber at the Pyramid of Meidun in Egypt. Courtesy Atlantic Productions.

Courtesy of Atlantic Productions





Clockwise from right: A Leica ScanStation C10 laser scanner scans a staircase near the top of the dome at St. Paul's Cathedral in London, Katie Simon (left), a research assistant at CAST, and Eileen Ernenwein discuss data location in Petra, Jordan; a 3-D point cloud of St. Paul's Cathedral; CAST researcher Malcolm Williamson prepares to scan the Great Pyramid of Giza in Egypt.



(Top right) Adam Barnes, other photos courtesy of Atlantic Productions

## Working Non-destructively

After working for several years in cultural resource management in the western United States — which included conducting archaeological surveys and site excavations — Katie Simon became interested in methods that allow for the study of archaeological sites without damaging them.

Today, she is a research associate at the university's Center for Advanced Spatial Technologies, which uses remote sensing to measure or acquire information about an object without direct contact, such as by laser scanning, satellite imaging, aerial photography or radar.

"The most important thing about remote sensing is that it is non-destructive," Simon said. "Archaeology traditionally has been a destructive endeavor. You are destroying everything as you are digging through it. It is also incredibly expensive to excavate, and excavation is politically sensitive, as well.

"Archaeology is a pretty politically sticky field to be involved in and this is a more respectful and productive way to do research," she said.

Jackson Cothren, director of CAST, agrees.

"You are digging and you can't put it back the way it was," Cothren said. "You want to minimize that damage as much as possible. What geospatial imaging gives you is the ability to focus your destructive activities in the areas where it will most likely benefit your study. You don't have to dig up the entire site."

In 2013, CAST and the Archaeo-Imaging Laboratory at the university launched Spatial Archaeometry Research Collaborations — or SPARC — with a \$250,000 grant from the National Science Foundation. SPARC promotes the use of 3-D measurement, geospatial analysis and remote sensing technologies in archaeological research around the world.

Scientists who use remote sensing must be cautious with the data they gather, Cothren said. In the history of Western colonialism, artifacts were removed from archaeological sites in such places as Africa and the Middle East and used to populate museums in the Western world, he said.

"The repatriation of those artifacts is underway in varying degrees," Cothren said. "That's a well-understood and appreciated fact in the archaeological and museum community. In the information age, an analog has developed and the term 'digital colonialism' has been coined. That is the idea of going to those countries, filming or capturing digital data in some form and exploiting it — using it to make money — without repatriating any of those funds to the host country.

"It's really no different than taking the artifact itself," he said. "We don't want to contribute to that by not giving credit to the agencies or societies that hosted us. We make sure that if there is any revenue that we get from the data, some of it goes back to that country for preserving the site or helping the community."

A few minutes later, the scanner begins a slow sweep from left to right as a rapidly spinning mirror reflects the green laser beam on to every surface — most prominently the walls, chairs, desks and computer equipment. About thirty seconds later the scanning is finished and Williamson begins poking the screen again to see the resulting images.

The whole setup, which took about 15 minutes, has become routine for Williamson, who has been at CAST for 21 years and has used this particular scanner for the past four years. But prior to last year, he had never been asked to do it in front of a camera in front of one of the seven wonders of the ancient world.

That's because in January 2013, a London-based television producer cold-called CAST. She was interested in hiring a technical expert for a new documentary series on ancient structures.

Soon, researchers from CAST were traveling to historic locations around the world, including the pyramids in Egypt, St. Paul's Cathedral in London and the ancient desert city of Petra in Jordan. They were filmed doing what they do best, using their advanced remote sensing technology to collect and analyze billions of measurements to form point clouds, which provided

3-D perspectives of these sites. The series, *Time Scanners*, aired overseas on National Geographic International this past spring and in the United States on PBS during the summer.

Williamson was one of six current or former CAST researchers who appeared in the series. Jackson Cothren, director of CAST since 2008, described the center's participation in *Time Scanners* as "a once-in-a-lifetime experience."

"We were recognized as one of the preeminent organizations that could do this," Cothren said. "We were pleased with the approach that the producers took; they didn't hype the technology or the findings behind the technology, but presented a very realistic result of what we do. We also learned a lot about what we are capable of doing, and how quickly we could capture — to the accuracy that we expect — very large and complex structures."

In Egypt, the scanning technology was used to show the evolution of the engineering behind the ancient pyramids. At St. Paul's, the scans confirmed that a German bomb during the blitz of London detonated on the main floor of the cathedral and not in the crypt as was previously believed. In Petra, a 3-D point cloud of the structure known as the Monastery uncovered markings that

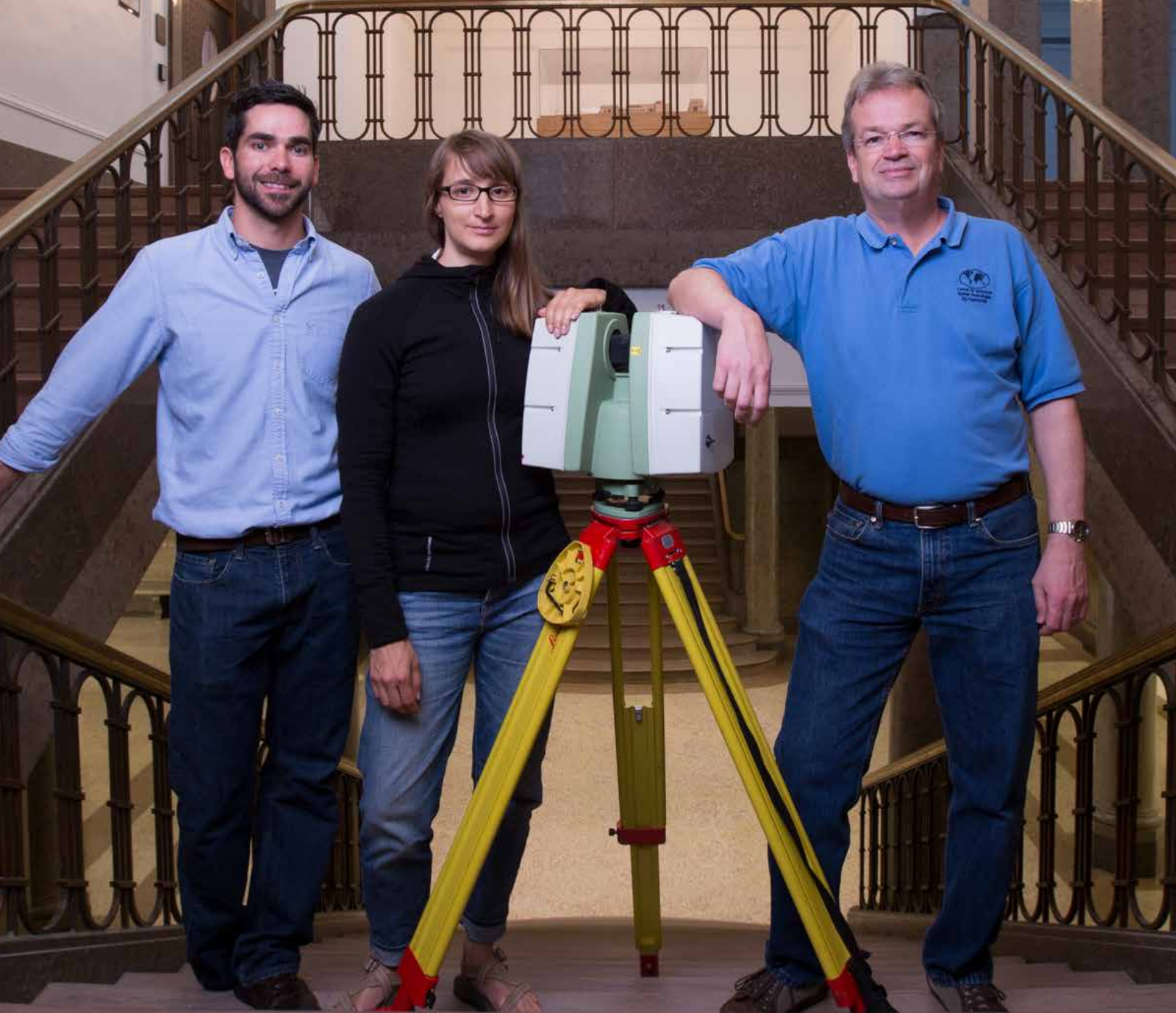
led experts to believe that more than 2,000 years ago, Nabatean stonemasons used a staircase to carve the building out of a mountainside.

Steve Burrows, executive vice president of WSP, a global engineering and design consulting firm, was the featured expert in *Time Scanners*. He said, "The laser scanning technology meant that we could analyze the ancient structures in a way that no one ever has before, and some of the things we found were incredible."

Cothren said, "We have received numerous contacts from this. We do a lot of outreach locally and internationally and we are pretty good at it, but we could never create a marketing tool as good as *Time Scanners*. We now can say, if you want to know more about what we do, go watch the series."

### Diversity of Experience

*Time Scanners* capped a long period of growth for CAST, which was established in the J. William Fulbright College of Arts and Sciences in 1991. The center began in a single room in the



CAST researchers Adam Barnes (from left), Katie Simon and Malcolm Williamson all participated in the documentary TV series *Time Scanners*.

Photo by Russell Cothren

basement of Ozark Hall and now encompasses 11,000 square feet of office space and computer labs in the J.B. Hunt Transport Services Inc. Center for Academic Excellence.

Now employing nearly 20 full-time staff members, CAST is dedicated to research and applications in geospatial analysis and modeling, remote sensing and digital photogrammetry. Remote sensing is the measurement or acquisition of information about an object without direct contact, such as by satellite imaging, radar or aerial photography. Photogrammetry is the science of recording, measuring and interpreting photographic images or other two-dimensional, remotely sensed data.

“Just as photography became a standard as soon as it was introduced in archaeology and architecture, 3-D imaging is simply the next step forward in recordation and measurement,” Williamson said. “With a photograph you frequently don’t realize what you can’t see. When you start working with a 3-D model, you very quickly become aware of just how complex most locations and structures are.”

Cothren is the only faculty member in the center, but two-dozen professors from the University of Arkansas frequently collaborate with CAST, in disciplines ranging from anthropology to geosciences to wildlife ecology. The center also partners with

faculty at other universities and scientists at NASA and the U.S. Army, among others.

CAST researchers, working with collaborators, are involved in the application of remote sensing technologies in current projects around Arkansas, the United States and abroad, including Machu Picchu in Peru, the ruins of the ancient port city Ostia in Italy and Tiwanaku, a pre-Columbian archaeological site in Bolivia.

One of CAST’s defining qualities — perhaps its most notable feature — is its variety of researchers. There are anthropologists, archaeologists, computer engineers and landscape architects.

“We can speak to an archaeologist or a classicist but we can also speak to a scientist,” said Adam Barnes, a geomatics specialist at CAST. “There is a marriage between disciplines. We speak all of those languages.”

Indeed, Cothren credits the assortment of specialists at CAST for pulling off the technical expertise needed for *Time Scanners*. In each of the six episodes that were filmed, the researchers had to produce intricate 3-D point clouds in only a few days — a process that usually takes several weeks.

The work was extremely challenging, said CAST’s Katie Simon, who specializes in 3-D scanning applications in archaeology. Not only were the researchers asked to perform at 10 times the normal speed, they were constantly interrupted by the film crew with requests to start over with another angle for the camera.

### Prepared for Precision

CAST has a reputation for its methodical preparation, Simon said.

“We’re constantly trying to do everything we can to minimize the errors that might occur,” she said. “A lot of people whom I’ve

been working with notice that we are very particular about getting our geo-referencing properly done, or that our data collection stations are precise. It is really time-consuming and some people think it’s not worth the time.

“Sometimes they will be correct when they say it doesn’t need to be that precise for their current application, but what we constantly keep in mind is that all of this data is archived and we like to make it available as much as possible,” she said. “So if you make a research argument in the future for some conclusion you’ve come to, based on this data, it is important to know the level of precision and accuracy. We’ve been trained that error accumulates at every link in this process, and at the end all that error accumulates in your final product.”

The attention to detail starts with Cothren, who holds a doctorate and a master’s degree in geodetic science and surveying — a branch of mathematics and earth sciences that deals with the measurement and representation of the Earth. What lies behind the science of geodesy, Cothren notes, is the ability to track down errors and to apply statistics so one can understand how one can better deploy instruments in order to capture errors and mitigate them.

“We use the same procedures that an engineering team would use in order to get very accurate measurements,” he said. “Your instrument set-ups, the way you take your measurements, the redundancy that you build into the scans, is all there to contribute to minimizing error and identifying error when you have it and correct it. A lot of scans that are done for visualization purposes, they don’t care about error accumulation. It just has to look good from a distance. A lot of geospatial groups get all the colors right and the scan looks beautiful, but it is not an engineering-quality survey. We like to think ours are. We are confident that they really mean something.” ■



**Jackson Cothren**, Associate Professor  
Geosciences and Director, Center for  
Advanced Spatial Technologies (CAST)



**Malcolm Williamson**, Geospatial  
Applications and Education Manager  
CAST



**Katie Simon**, Archeological Remote-  
Sensing Specialist  
CAST



**Adam Barnes**, Geomatics Specialist  
CAST



Photo by Russell Cobren

# Teaching Students with Autism to Solve Mathematical Word Problems

By Leah Markum

Behavior analysts working in public schools in the 1990s did not hear as much about autism as they do today. They would enter classrooms to work with children who usually were experiencing difficulty with behavior, but also demonstrated limited academic achievement. The analysts needed to figure out the best approach to educating these children.

Peggy Schaefer Whitby was one of those behavior analysts. She worked with children in the public school system who had significant behavioral challenges. She found that it worked to implement the principles of Applied Behavior Analysis to address the behavioral and communication skills of the children. Over the years, she applied them to more and more children, most of whom had been diagnosed with autism spectrum disorder.

“I loved teaching this group of kids because the strategies that I used worked so well,” she explained. “Then I realized there were no academic interventions out there.”

In early elementary school, children with high-functioning autism may be high performers. Once they arrive in middle school, though, they often hit a wall. In middle school, teachers expect more self-direction from students. The course work becomes more applied and abstract, particularly in mathematics. Children with autism often struggle in these modes of learning.

“We have an ‘I do, we do, you do’ approach.”

Schaefer Whitby is one of the few researchers investigating evidence-based strategies for teaching mathematics to children

with autism. Most other research focuses on communication and social skills.

“There is a myth that children with autism are savants in mathematics,” Schaefer Whitby said. “Certainly there are people with autism who have savant-type skills, but these kids also struggle with mathematical learning. We have children who can count and memorize math facts, but struggle with application. Problem-solving also involves reading comprehension issues.”

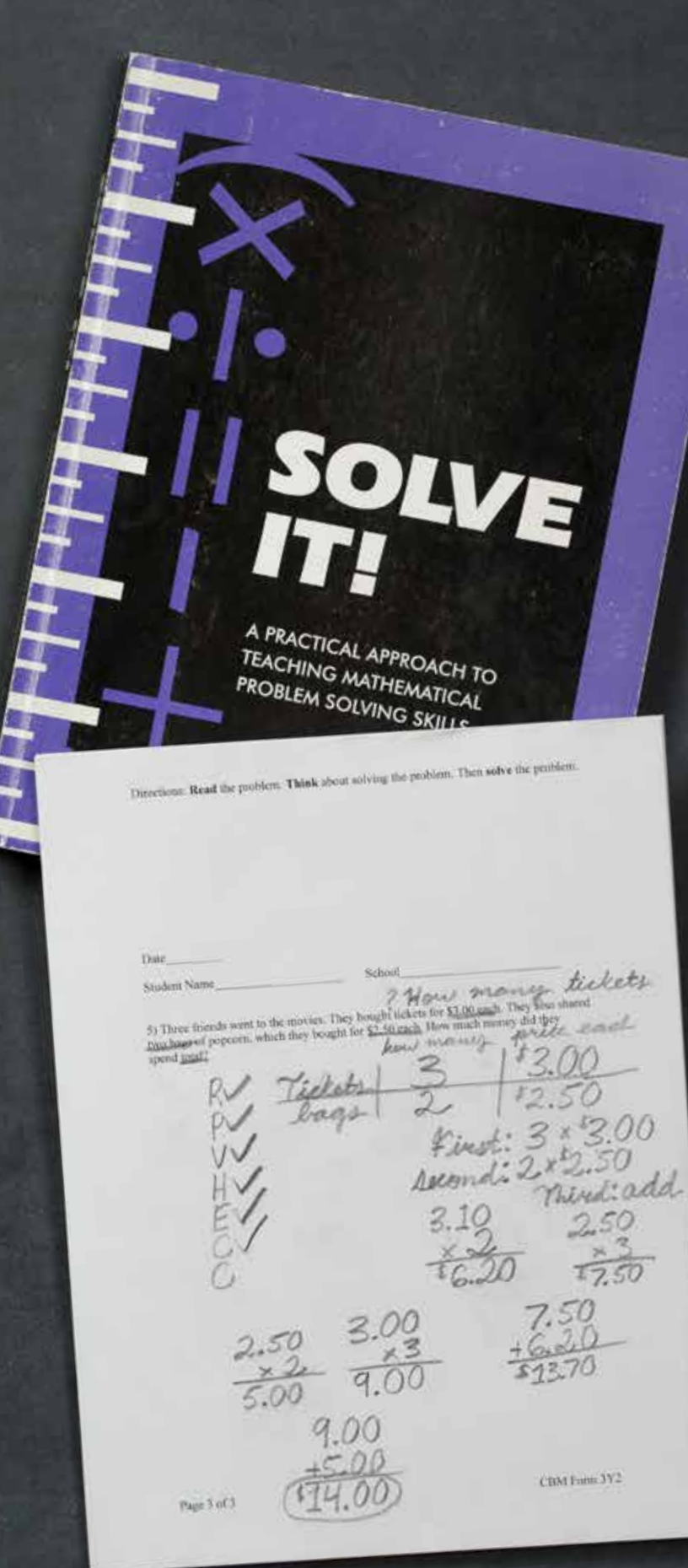
Children can learn techniques for solving math problems. Some children experience minimal difficulty organizing the information in their minds and creating a strategy for a particular problem.

“We know that people with autism develop strategies,” Schaefer Whitby said. “They may not always develop the most effective strategies.”

Many teachers have used *Solve It!* to develop effective strategies for adolescent students with learning disabilities. *Solve It!* is a set of cognitive strategies for word-problem solving based on methods used by the best problem solvers. Schaefer Whitby applied it to students with autism.



**Peggy Schaefer Whitby**, Associate Professor of Special Education  
College of Education and Health Professions.



One of Schaefer Whitby's students learned to solve a math word problem using a Solve It! worksheet.

*Solve It!* uses seven cognitive strategies, combined with metacognitive strategies, that essentially place the learner in the right mindset, or schema, to solve a problem. The seven cognitive strategies are: read, paraphrase, visualize, hypothesize, estimate, compute and check. Students memorize these steps using the mnemonic R.P.V.H.E.C.C. At each step the student uses metacognitive strategies of self-management, self-checking and self-evaluation.

To teach students with autism how to develop a useful approach to solving word problems, Schaefer Whitby had them watch how she solved a problem. As they “caught on” to her approach, they would solve a problem with her and, eventually, solve a problem independently.

“I embedded a rule — because kids with autism tend to like rules and will follow them — that they had to do each step,” Schaefer Whitby said.

Soon they solved problems using the new strategies without someone telling them how. After 10 days they consistently solved the problems correctly. In three weeks they applied the strategies to the general education setting. “I could see on their classroom papers where they wrote R.P.V.H.E.C.C. and checked off as they went along,” she said.

“We look at how these kids visualize and use schema.”

Students with high-functioning autism tend to read — and see the world — in a very literal and concrete manner. One of the word problems in Schaefer Whitby’s study described a person baking cookies. In this example, a student with good schema may visualize the cookies ordered on a pan, whereas a person without a good schema may draw a picture of Mom baking the cookies.

“There’s a lot of extraneous information in a word problem,” Schaefer Whitby said. “Our children have difficulty focusing on the relevant pieces.”

*Solve It!* requires paraphrasing to help the students identify the important facts in a word problem.

“We taught them to underline the important part of the questions, and they were able to do that,” Schaefer Whitby said. “However, many of them struggled with putting the word problem into their own words. They wanted to repeat it exactly as it was read.”

Children with autism may have poor schema that prevents them from visualizing what they need to solve the problem. This can occur in a simple multiplication problem. A student with good schema represents two times three as two sets of three. A student who does not have good schema may visualize two objects in one set and three in the other.

All of the study’s participants assumed, no matter the type of problem, that the order in which they entered numbers into a calculator did not matter. They followed rules and used strategies they were taught in elementary school that did not apply to higher-level mathematics.



Photo by Russell Cathren

Peggy Schaefer Whitby helps a student develop strategies for learning.

“It is important for teachers to understand that we teach kids strategies when they are young that don’t really hold true as they get into more advanced mathematics,” Schaefer Whitby said. “We have to be careful telling kids with autism these rules because they will hold onto them and continue to use them.”

Schaefer Whitby, other researchers and autism specialists do not necessarily need to instruct students directly or continue instruction to ensure students maintain the strategies. There is another method that enables students to excel academically, even students who do not participate in research projects.

“If the child does not maintain the strategies, we look at procedural facilitation,” Schaefer Whitby explained. “I use a video model to teach the kids how to use the strategy and have it in the classroom so a teacher does not have to be there. You can use it as a video model in priming where the students watch it before they solve the problem. You can also use it as a video prompt where the students stop at each step to see how they solve the problem. My next research studies will be looking at that.”

“The research has implications for teachers and practitioners.”

More and more children are diagnosed with autism. Of all such children, around 30 percent are considered high functioning. They can attend school with the general populace, but many need cognitive strategy intervention like other students with learning disabilities.

“One of the young men that I worked with was brilliant,” Schaefer Whitby said. “He loved computers, but he only loved non-proprietary software because he can go in and change the code. So I had a 13-year-old who could do his own programming on non-proprietary software but who could not pass mathematics. What is the future for this child? If he cannot pass mathematics, he can’t get a regular high school diploma. Yet he could be the next Bill Gates.” ■



Profile of the Laboratory of Vaccine and Immunotherapy Delivery:

# It Takes a Lab to Orchestrate a Vaccine

By Matt McGowan

**Bhanu Koppolu** Postdoctoral Fellow, Biomedical Engineering  
Laboratory for Vaccine and Immunotherapy Delivery  
College of Engineering.

Photo by Matt Reynolds

Minutes after his boss drills him with questions about results from recent experiments, Bhanu Koppolu is back at the bench, pulling on black latex gloves and checking on millions of T cells taken from a small incubator inside a whiter-than-white lab room at the Engineering Research Center in south Fayetteville. (Also called “killer cells,” T cells help the immune system fight viruses and bacteria; they are the body’s first line of defense against disease.)

Between the bench and microscope on one side of the room and a hooded, sterile cabinet on the other, Koppolu moves effortlessly, almost gracefully, like an experienced chef in a well-organized kitchen. Everything is where it belongs, and his body knows what to do. It’s almost as if he doesn’t have to think. There are no missteps or wasted energy. He moves back and forth, opening doors, adjusting the microscope, spraying and rubbing ethanol disinfectant on his hands, filling vials with a syringe, inserting the vials into a centrifuge, making slides from red liquid that contains the cell clusters.

After earning his doctorate in biomedical engineering earlier this year, Koppolu now works as a postdoctoral fellow in the Laboratory of Vaccine and Immunotherapy Delivery. Investigators in this “translational” lab — in addition to Bhanu, three graduate students and about a dozen undergraduates work in the lab — focus on developing cancer immunotherapies that will have a strong and immediate clinical impact. The lab’s multi-disciplinary approach uses aspects of engineering, chemistry, physics, biology, immunology and nanotechnology.

Today Koppolu is developing proteins, coating them onto the T cells and testing, trying to see how the cells will behave when they come into contact with the proteins. If they work, if the proteins activate the T cells, Koppolu may use them, along with other biomaterials, to design a molecule or drug that will elicit a desired immune response.

“And this is important,” he says, “because these cells are sensitive to IL-12.”

Ultimately, that’s what he wants to know. How will healthy human tissue respond to Interleukin 12 (IL-12), a cytokine that stimulates the body’s immune system to attack a range of cancerous tumors?

Most of Koppolu’s experiments deal with this powerful substance, which once held great promise as a therapy for cancer until it was shelved in the 1990s because of high toxicities. Then, about 15 years after it was shelved, a young scientist working as a postdoctoral fellow at the Laboratory of Tumor Immunology and Biology at the National Cancer Institute made an important discovery and resurrected IL-12 for cancer treatment.

Koppolu’s boss is David Zaharoff, director of the vaccine and immunotherapy lab. Zaharoff was that young scientist who made

the discovery about IL-12 at the National Cancer Institute. While there, he combined IL-12 with chitosan, a polysaccharide derived from the shells of crustaceans. With this co-formulation, he discovered a method of delivering the cytokine directly to a tumor while avoiding systemic toxicity. In 2009, Zaharoff set up shop at the University of Arkansas and quickly demonstrated the power of the chitosan/IL-12 combination when experiments eradicated bladder tumors in mice.

Koppolu says it will take at least a few years before the product is ready to turn over to a pharmaceutical company, which will have to buy licensing rights for intellectual property from the university, if that’s the direction Zaharoff chooses.

“But first,” Zaharoff said, “Bhanu must modify and

improve the molecule, so that it has the same capabilities and essentially the same properties as the original discovery but is more proprietary and thus ready for commercialization.”

Meanwhile, Koppolu will plug away at the core tasks that define one’s life in the lab: buying equipment and specimens, setting up and conducting experiments, analyzing data, writing and publishing papers. ■

*“If you can get the patient to develop an immune response against cancer, I don’t think you need chemotherapy anymore.”*

— David Zaharoff



**David Zaharoff**, Assistant Professor of Biomedical Engineering and holder of the Twenty-first Century Professorship in Biomedical Engineering

College of Engineering

Funding: National Cancer Institute of the National Institutes of Health

Since coming to the University of Arkansas in 2009, Zaharoff has received more than \$3

million in competitive state and federal grants for research in the Laboratory of Vaccine and Immunotherapy Delivery. In 2014, the National Cancer Institute awarded two grants, \$416,897 for his work at continuing to develop a new therapy for bladder cancer — doctoral candidate Sean Smith is working on this project — and \$1.5 million to advance the molecule and pharmaceuticals project spearheaded by Koppolu.

There are two other significant projects. To glean a better understanding of how IL-12 works and thus make it as safe as possible, Khue Nguyen, another doctoral student, explores the effect the cytokine has on different strains of mice. And Sruthi Ravindranathan, also a doctoral candidate, is working on a post-surgical vaccine to prevent the recurrence of breast cancer. Zaharoff says the ultimate goal of this project is to develop a personalized treatment, because the vaccine would consist of cancer cells taken from the patient’s excised tumor. These cells would be isolated and inactivated before being reintroduced into the patient along with the delivery of other immune stimulating material.

# Can Pie Crust and Chocolate Cut Cholesterol?

By Kendall Curlee

Imagine reaching for a piping hot biscuit or taking a forkful of crisp, flaky piecrust, knowing that each delicious bite will lower your bad cholesterol, raise your good cholesterol and maybe boost your metabolism to burn more calories. Sound too good to be true? It gets better: how about savoring a chocolate bar that promotes heart health and combats fat?

Sarah Mayfield, an Honors College student in food science, is working with Andrew Proctor in food science to make this dream a reality.

She has spent more than five months making shortening and, more recently, chocolate bars and chocolate paste using a new soy oil that Proctor produced, an oil containing conjugated linoleic acid (CLA). This new soy oil provides the recommended daily allowance of CLA in just one-half ounce, and besides being cholesterol-free and low in saturated fat, it has anti-obesity, anti-carcinogenic, anti-diabetic, and anti-arthritis properties.

Proctor's research team has already produced a CLA-rich margarine that delivers 3.2 grams of CLA in just 185 calories. In a recent study by University of Arkansas System Division of Agriculture researchers, obese rats ate CLA-enriched feed, resulting in demonstrated health benefits. In 30 days, total serum cholesterol and LDL ("bad") cholesterol were reduced by 50 percent, and a fat-burning gene was activated.

Given today's obesity problems and the economic potential — soybeans are a \$2-billion-a-year-crop in Arkansas — the search is on at the university to produce more CLA-rich food products with soy oil. And that's where Sarah Mayfield comes in.

One spring day in the lab, Mayfield assembles the ingredients for her latest batch of shortening. The formulation is simple: melt together the fats, which include regular and CLA-enriched soy oils, then allow them to cool slowly while stirring. The combination of cooling and stirring causes the fats to crystallize and form a semi-solid substance that looks exactly like the shortening in your kitchen pantry. Unlike with traditional solid shortening, "crystalline structure, rather than a high concentration of saturated fats, is responsible for the texture," Mayfield explains.

Nearby, a tray is filled with more than 70 shortening samples in plastic containers, each marked with different percentages of CLA-enriched and regular soy oils. Later in the afternoon Mayfield will ship them to the food science department at the University of Ghent in Belgium, where she will spend the summer subjecting the samples to a battery of tests.

"We'll be looking at viscosity, hardness, color, and we'll use X-ray crystallography to look at the crystal structure," Mayfield said. "We'll also use the DSC — differential scanning calorimetry — to see how much solid fat is in there. You don't want it to be too low, or it would melt at room temperature."

In addition to testing her shortening samples, Mayfield will work in the University of Ghent's Cacaolab, where researchers are partnering with industry to create innovative chocolate products, improve chocolate-making processes, and stimulate the export potential of Belgian chocolate, renowned worldwide for its quality. There she plans to develop chocolate bars and a chocolate paste that use a combination of CLA-enriched soy oil and the customary palm oil to provide the fat.

Chocolate promises to be a bit trickier to work with than the shortening. Normal chocolate melts at body temperature, a unique property of its cocoa butter, a solid fat.

"With chocolate, it's important to hit the sweet spot for the melting point," Mayfield said. "When you put it in your mouth, you want it to melt right then. We'll have to see if adding CLA changes that property — hopefully, it won't."



**Sarah Mayfield** is an honors food science senior with a second major in biochemistry. The new Honors College International Research Grant helped fund her work at the University of Ghent in Belgium; she also received a State Undergraduate Research Fellowship and funds from Bumpers College and the University of Ghent.



Sarah Mayfield, left, works with Andrew Proctor, above upper, to develop new uses for a healthier shortening. In the lower photo above, samples of soybean oil shortening enriched with conjugated linoleic acid await testing.

Photos by Russell Cothran

She will use the same battery of tests on the chocolate bars that she used for the shortening, in addition to testing for fracture force — the point, when bending, that the bar breaks — and for bloom, a film that develops on older or lower quality chocolate.

Once Mayfield returned to campus in fall 2014, she studied the oxidative stability of the shortening and chocolate over time. Fats go bad because they oxidize, which leads to rancidity and off odors and flavors. Unsaturated fats oxidize faster than saturated fats, so this test will be an important final step.

Mayfield also plans to start baking with the CLA-enriched shortening and conventional solid vegetable shortening and then compare the baked goods for crispiness and hardness. She'll start with something simple, like pie crusts, which are easy to analyze.

It's a good bet that when Mayfield is ready to taste test her baked goods and chocolates, she'll have no problem finding volunteers. ■



**Andrew Proctor** is a University Professor in the department of food science. His research in the University of Arkansas Division of Agriculture is supported by the Arkansas Soybean Promotion Board, the Arkansas Biosciences Institute and Riceland Foods.



# FALLING BARNNS

## in an Evolving World

By Matt McGowan

In their presentation “Falling Barns: Registers of Social and Economic Evolution in the Arkansas Ozarks,” Frank Jacobus and Phoebe Lickwar remind us that we cannot separate the history of the social life of a place from the things made by and for the people who inhabited that place. Which probably explains why so many of us feel punched in the gut when we see a barn set back from the highway, tucked away in a grove of black locusts or cowering under the wrath of the sun, crumbling or collapsed into a heap of rusted nails and weathered boards.

Why? What is it about barns that conjure complex feelings, even — and very often, especially — for people whose families never farmed, or if they did, left the occupation generations ago?

### Painful Evolution

“These barns — most of which will be gone in the next 20 years or so — are emblematic of something that’s painful for many of us to consider,” says architect Jacobus. “Not only are they material evidence of a way of life that no longer exists, the loss of work and life and the spirit of new settlement, but they also represent the massive cultural change we’ve gone through over the past 150 years.”

This social evolution, brought about by rapid urbanization, technological change and economic growth, force us to ask tough questions, Jacobus says. Who are we? How have we evolved? How are we acting in the world? Are we moving in the right direction?

For the past year, Jacobus and Lickwar, a photographer and landscape architect, have collaborated on the barn project, documenting these crumbling structures in Northwest Arkansas, gleaning as much as possible about the settlers who built them and, as creative professionals, trying understand their historical contribution to the vernacular. It is an ideal collaboration, Lickwar says, because barns are nearly the perfect convergence of the two disciplines that she and Jacobus represent.

In fall 2013, they created “Barn Again,” an exhibit of their work featuring 20 elegiac photographs by Lickwar and four informational “totems” by Jacobus that described the history of barns and the cultural and economic factors that contributed to their disuse and eventual demise. The centerpiece of the exhibit was an installation piece — a small barn, 8 feet tall, 8 feet wide and 16 feet long — designed and built with materials salvaged from an old barn by Marc Manack and current and former architecture students.

### Vernacular Vision

What barns were used for was simple. Subsistence farmers built them to store hay and protect livestock. Because the purpose of the barns was purely functional and utilitarian, their design was vernacular, meaning they were based on the needs of the owners, reflecting local traditions and made with local materials. Although many people consider the barns to be attractive, as vernacular structures, they weren’t adorned with ornaments or other stylistic or aesthetic elements.

Photo by Matt Reynolds

What hasn’t been simple is uncovering the early history of the structures and the people who built them. Initially Lickwar and Jacobus wanted to compile oral histories about each structure they documented, but it has been proven impossible to identify or find information about the early settlers who built and used the barns.

Their efforts have been fruitful in other ways. Lickwar hopes their work will generate a greater awareness of the cultural significance of barns. Ideally, she would like to see the structures preserved or repurposed, as much as possible, although she knows that will be impossible for most of the barns.

Short of saving the structures, Lickwar and Jacobus will continue to use the knowledge they’ve acquired to drive their creative design of structures and landscapes. They’ve forged a professional relationship with a Johnson man whom Lickwar met one day while taking photographs of a crumbling barn on the man’s property. After several conversations about the structure, which could not be saved, the parties agreed that Manack would design a home for the property, and Lickwar would design the site. They will design features that match the spirit and historical purpose of the property, while providing a vision of its future adaptation.

“We are trying to be sensitive to the site, in both its current state and regarding its historical use,” Lickwar says. ■

*Lickwar and Jacobus presented their research at the Council of Educators in Landscape Architecture conference in 2013 and will present this year at the meeting of the Southeast Society of Architectural Historians.*



**Frank Jacobus**, Assistant Professor of Architecture  
Fay Jones School of Architecture



**Phoebe Lickwar**, Photographer and Assistant Professor of Landscape Architecture  
Fay Jones School of Architecture



**Marc Manack**, Assistant Professor of Architecture  
Fay Jones School of Architecture



# A prudent regard to our own good

By Andy Albertson

Five weeks before the U.S. Supreme Court decided the fate of the Patient Protection and Affordable Care Act, University of Arkansas Law Professor Mark Killenbeck addressed the issue at the heart of the Affordable Care Act debate — the Commerce Clause. This in and of itself is not news — Killenbeck is a constitutional law expert often called on to explain the issues of the day. But this was no ordinary lecture: Killenbeck presented in the Court Chamber of the United States Supreme Court. One Supreme Court Associate Justice, the Honorable Sonia Sotomayor, was the host for the event and introduced Killenbeck and the lecture. Another, the Honorable Ruth Bader Ginsburg, was in the audience.



**Mark Killenbeck**, Wylie H. Davis Distinguished Professor of Law  
University of Arkansas School of Law  
Publication: *Journal of Supreme Court History*

Library of Congress image





Justice Sonia Sotomayor

*The Commerce Clause — and how Congress and the United States Supreme Court interpret it — has helped define our republic.*

The event, part of the 2012 Leon Silverman Lecture Series sponsored by the Supreme Court Historical Society, presented both an opportunity and a challenge. The invitation to deliver the lecture had been extended the previous October, well before the Court accepted the Affordable Care Act case for review. By the time the lecture was given, on May 23, 2012, the case had been argued, but not decided. This prompted Killenbeck to exercise extreme care, speaking as he was at the Court and before members of the Court about an issue currently pending before it and them. He accordingly focused carefully on the history of the Commerce Clause and its treatment over time by the Supreme Court, without regard to the arguments for and against the Act itself.

Killenbeck's lecture was well received and became the lead article in a recent issue of the *Journal of Supreme Court History*. Killenbeck's "A Prudent Regard to Our Own Good? The Commerce Clause, in Nation and States" summarizes and analyzes the history of the Commerce Clause, which has been at the center of centuries of debate between the states and the federal government. From civil rights to navigable waters, from the New Deal down through the Patient Protection and Affordable Care Act, the Commerce Clause — and how Congress and the United States Supreme Court interpret it — has helped define our republic.

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The Commerce Clause is the enumerated power in the Constitution that gives Congress the authority "To regulate Commerce with foreign Nations, and among the several States, and with the Indian Tribes." Killenbeck illustrates that the powers granted to Congress by the Commerce Clause, and the definition of "commerce" itself, have expanded and retracted largely through the interpretations of the Clause handed down by the Supreme Court.



Justice Ruth Bader Ginsburg

Killenbeck argues that to understand the Commerce Clause and its role, one must pay "close attention to three things:

- insights gleaned from the writings of the individual aptly characterized as the Father of the Constitution [James Madison];
- the manner in which the powers conferred and limitations imposed by Article I, section 8, clause 3 [the Commerce Clause] have been interpreted and applied; and
- the need to be "practically wise," in particular to shape and apply rules in Commerce Clause matters that reflect "wisdom applied to practice."

The Commerce Clause arose, as did the Constitution itself, from what Madison called "the mortal diseases of the current constitution," which described what Killenbeck calls "two serious, interrelated problems: a dearth of authority at the national level, and overindulgence of authority at the state level."

The newly created United States were proving anything but united. States imposed tariffs and restrictions on one another, and some states refused to pay taxes to the nation. And, under the Articles of Confederation, the national government had no authority to do anything about it. The individuals who framed and ratified the Constitution wanted to cure these ills. Their goal was to create an effective, empowered federal government, and save a nation from dying in its infancy.

Though it numbers but 16 words, the Commerce Clause has proven to be one of the most pivotal passages in the Constitution. To better understand it, Killenbeck argues one must turn to Madison — his thoughts and writings — whose influence is found everywhere in the Constitution and Clause.

**A Want of Concert**

In 1787, Madison wrote the essay *Vices of the Political System of the United States*. Though the essay has been largely overlooked in the subsequent centuries, there is no denying its echoes can be heard in the Constitution. In it, Madison argues that the citizens

of the United States must exercise "a prudent regard to their own good as involved in the general and permanent good of the Community." Madison makes the case for addressing both the shortage of federal authority and the excess of state authority.

In particular, commerce and commercial interests are examined in *Vices* including "Trespasses of the States on the rights of each other" and, in particular, "A 'want of concert in matters where the common interest requires it,' a flaw 'strongly illustrated in the state of our commercial affairs,' to the point that 'the national dignity, interest, and revenue [have] suffered from this cause.'"

*Vices* provides a valuable lead-in to the more commonly discussed *The Federalist*, the series of 85 essays written by Madison, John Jay, and Alexander Hamilton to build support for the ratification of the Constitution. In *Federalist 42*, Madison addresses commerce directly:

"The defect of power in the existing confederacy, to regulate the commerce between its several members, is in the number of those which have clearly been pointed out by experience. To the proofs and remarks which former papers have brought into view on this subject, it may be added, that without this supplemental provision, the great and essential power of regulating foreign commerce, would have been incomplete, and ineffectual."

Killenbeck follows by writing that "Article I, section 8, clause 3 lies accordingly at the heart of the attempt to form a 'more perfect union.' That government would look outward, by design leaving most internal matters to the states. But it could do so only if it could bring order to its internal commercial affairs."

**Interpretation and Application**

Killenbeck's article moves on to consider "the process of interpretation and application" of the Commerce Clause by Congress and the Supreme Court. In a number of bills, early Congresses demonstrated that they "viewed the Commerce Clause as having a large regulatory scope." For instance, 1790's *An Act*



Images are from the Collection of the Supreme Court

for the government and regulation of Seamen in the merchants service “functioned as the early equivalent of a code of labor relations, mandating ‘an agreement in writing or in print, with every seaman or mariner on board’ a ship ‘bound from a port in one state to a port in any other than an adjoining state.’”

Killenbeck argues that this and other acts show that the widely accepted view that our founding fathers took a narrow interpretation of the Commerce Clause should at least be questioned, if not rejected. As he writes, “I am suggesting that a post-Convention congressional process of liquidating and ascertaining the meaning of the text offers compelling evidence of a broader and more nuanced reading of the Commerce Clause than one might expect.”

An overview of the Supreme Court decisions follows. Killenbeck touches on the decisions chronologically “to illustrate what [he believes] have been the three historic trends: exposition, dispute, and resolution.”

The exposition section begins with consideration of *Gibbons v. Ogden*, notable not only for being the first case in which the Supreme Court wrestled with the Commerce Clause but because “we can actually find virtually everything we need to determine both original understandings and most aspects of modern Commerce Clause doctrine in *Gibbons*, properly read and understood.”

The *Gibbons* court considered three important questions: what exactly is “commerce”; what is, or should be, the fate of state measures that purport to deal with such matters; and, in a closely

related vein, is the federal power to regulate commerce exclusive or concurrent?

In answering those questions, Chief Justice John Marshall embraced a broad view of the positive federal power to regulate commerce, one that simultaneously respected concurrent state authority to regulate for the health, welfare, and safety of its citizens but also emphasized the power of the federal government to address and deal with “those internal concerns which affect the States generally.” This means, Killenbeck argues, that it is simply not correct that the Supreme Court made an ill-advised turn from the interpretations of *Gibbons* during the New Deal. Rather, Killenbeck believes, that the “wrong turn” happened much earlier, “when the principles espoused by Madison and Marshall were forgotten and the foundations laid by Marshall in *Gibbons* were abandoned.”

The substantial majority of the decisions issued in the wake of *Gibbons* tended to favor the authority of states and call into question the ability of Congress to act. As such, they represent what Killenbeck has labeled as the second phase of Court treatment of the dormant and positive commerce clauses: a process of dispute, by which he means the development of an approach to the Commerce Clause by a Court that is much more attuned to and sympathetic to issues of state sovereignty than was the case under Marshall.

The third historic trend, resolution, refers to the interpretations of more recent years that, Killenbeck writes, have “brought us back to a close approximation of what I think Madison in particular had in mind as he surveyed matters prior to the Constitutional Convention and then worked diligently to fashion, ratify, and implement a Constitution that would help secure ‘a more perfect union.’”

The Constitution was written as an outline meant to guide and be interpreted by subsequent generations, a point on which Madison and Marshall agreed. As Killenbeck points out, the danger is two-fold and familiar: “the corrosive influence of looking to local or individual needs, rather than those of the nation” and “the temptation to cut corners.” Though the Court has historically

taken a deferential role in relation to Congress, it nevertheless is a safeguard “in a political and legal regime within which the Court has the final say on matters of constitutional interpretation.”

### Practical and Wise

In this way Killenbeck brings the reader full circle to Madison and his appeal for a “prudent regard for our own common good.”

Madison believed that “the fundamental principle of republican Government [is] that the majority who rule in such Governments, are the safest Guardians of both public Good and of private rights.”...[W]e can do no better than to keep in mind the central lessons of Madison’s Vices; lessons that instruct both as to the reason for granting federal powers and the ends toward which they are properly directed. Which is another way of saying that it is incumbent on all of us to exercise ‘a prudent regard to [our] own [collective] good as involved in the general and permanent good of the Community.’ To be, as Madison expected of us, both practical and wise.

As is always the case, the arguments Killenbeck makes are just that: positions he embraces based on his reading of the historical record. The importance of the issues makes these matters deeply contested, residing as they do at the heart of what former Justice Sandra Day O’Connor characterized as “our oldest question of constitutional law,” the relationships and allocations of power between and among the people, the federal government and the states. It is accordingly hardly surprising that the debate continues, with Killenbeck deeply involved. Indeed, he returned to the Supreme Court on October 9, 2014, once again at the invitation of the Supreme Court Historical Society, to present the historical overview for a reenactment of *M’Culloch v. Maryland*, decided in 1819 and considered by many to be the most important case in the history of the Supreme Court. A case, it should be noted, about which Killenbeck has written extensively in both articles and in the first book ever published devoted exclusively to it, *M’Culloch v. Maryland: Securing a Nation*. ■



Justice Sandra Day O’Connor

*The importance of the issues makes these matters deeply contested, residing as they do at the heart of what former Justice Sandra Day O’Connor characterized as “our oldest question of constitutional law,” the relationships and allocations of power between and among the people, the federal government and the states.*

*The Constitution was written as an outline meant to guide and be interpreted by subsequent generations.*



**Patrick Wolf**, Distinguished Professor of Education Policy - *The School Choice Journey: School Vouchers and the Empowerment of Urban Families* - Palgrave Macmillan

In Wolf's studies, the experiences of urban families using vouchers to send their children to private schools shed light on the significance of school choice in the context of urban poverty and education reform. Many parents became informed education consumers and citizen-activists.



**Peter Ungar**, Distinguished Professor of Anthropology - *Teeth: A Very Short Introduction* - Oxford University Press

"It's a perpetual death match in the mouth, with plants and animals developing tough or hard tissues for protection, and teeth evolving ways to sharpen or strength themselves to overcome those defenses," Ungar writes in this natural history of teeth written for a mainstream audience.



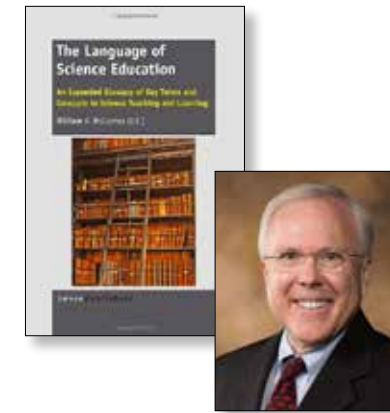
**Eric Funkhouser**, Associate Professor of Philosophy - *The Logical Structure of Kinds* - Oxford University Press

Funkhouser uncovers a logical structure that is common to many, if not all taxonomies. Conceptual schemes—including the sciences, mathematics, and ethics—classify things into kinds. This book focuses on classification by kind-terms like "mass," "shape," or "belief." Scarlet, for example, is a specific kind of red.



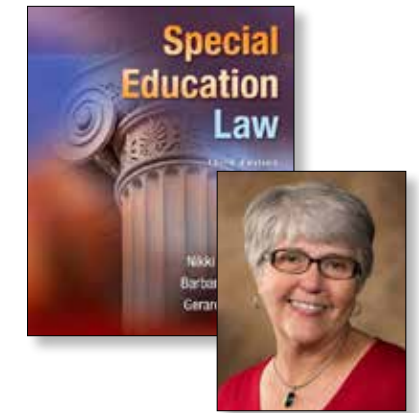
**M. Keith Booker**, ed., James E. and Ellen Wadley Roper Professorship in English - *Comics Through Time: A History of Icons, Idols, and Ideas* (4 vol.) - ABC CLIO Greenwood.

Comics were popular throughout the 20th century despite the restrictions of the Comics Code in place from the 1950s through 1970s. *Comics Through Time* is a one-stop resource for researching topics, genres, works, and artists of comic books, comic strips, and graphic novels.



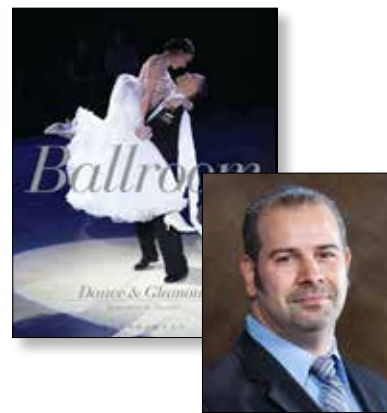
**W. F. McComas**, Parks Professor of Science Education - *The Language of Science Education: An Expanded Glossary of Terms Related to Science Teaching and Learning* - Boston: Sense Publishing Company

Science education uses a vocabulary sometimes at odds with commonly used terms in education. Understanding the specific way terms are used within science education is vital for students and professionals. McComas offers a useful reference.



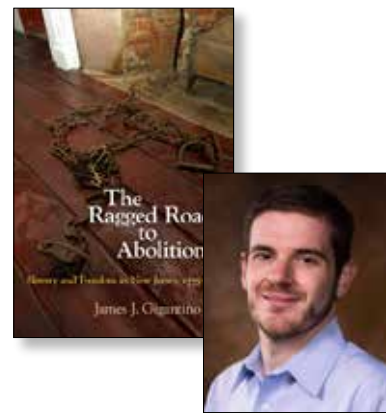
**N. L. Murdick**; **B. C. Gartin**, University Professor of Special Education; G. Fowler - *Special Education Law* (3rd Ed.) - Pearson Education

*Special Education Law* examines the history and evolving nature of special education legislation and interpretation by case law. It examines issues of public education, nondiscriminatory evaluation, least restrictive environment, due process, and parental participation.



**Jonathan Saul Marion**, Assistant Professor of Anthropology - *Ballroom Dance & Glamour* - Bloomsbury Publishing

As the success of *Dancing with the Stars* reveals, ballroom dancing remains popular world wide. Marion's book offers a window into the global phenomenon of competitive dance. Including photographs and commentary, this book showcases the dancers and elegance of the sport.



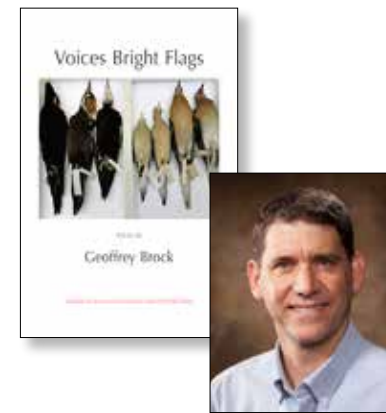
**Jim Gigantino II**, Assistant Professor of History - *The Ragged Road to Abolition: Slavery and Freedom in New Jersey, 1775-1865* - University of Pennsylvania Press

Gigantino chronicles the experiences of slaves, free blacks, abolitionists and slaveholders during slavery's slow death. Slavery persisted in New Jersey because the law required children born to enslaved mothers to serve their mother's master for more than two decades.



*Architects of Little Rock*  
*Of the Soil: Photographs of Vernacular and Architecture and Stories of Changing Times in Arkansas* - University of Arkansas Press and the Fay Jones School of Architecture

In *Architects*, Charles Witsell and Gordon Wittenberg compiled stories of the architects of Little Rock's important buildings from 1833 to 1950. *Of the Soil* features photographs that Geoff Wittingham took in the 1980s with architecture professor Cyrus Sutherland.



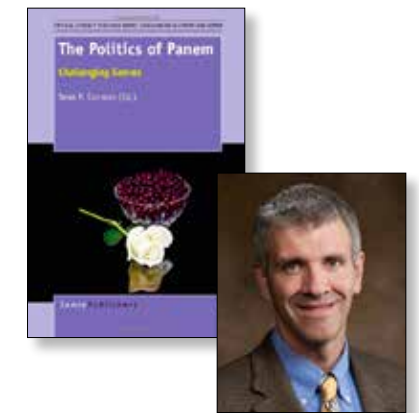
**Geoffrey Brock**, Professor of Creative Writing and Translation - *Voices Bright Flags* - Waywiser Press

Brock's poems approach America from a range of perspectives and in a range of styles and voices, each implying its own America. In the foreword, Heather McHugh writes, "It is a book of and for the old-fashioned reader, the one who will appreciate the precise prosodic dados and dove-tailings of the poet's craft."



**Joe Schriver**, Professor of Social Work - *Human Behavior and the Social Environment: Shifting Paradigms in Essential Knowledge for Social Work Practice* (6th ed.) - Boston: Pearson Allyn and Bacon

Schriver explores traditional and non-traditional models of human behavior and the social environment. He reveals the range of social systems in which people live and the ways these systems promote or deter people in their health and wellbeing.



**Sean P. Connors**, ed., Assistant Professor of Curriculum and Instruction - *The Politics of Panem: Challenging Genres* - Sense Publishers

As young adult dystopian fiction, what can *The Hunger Games* tell us about being human in the world? Scholars in literacy education and the humanities consider how the trilogy functions as a narrative and what questions it raises that can lead to critical exploration in the classroom.

# National Institutes of Health (NIH) Awards, FY14

## Yuchun Du

Biological Sciences  
Pilot Studies in Pancreatic Cancer

The objective of this project is to use a genetically defined isogenic cell model and a novel quantitative proteomic method to identify the proteins that may confer radioresistance in pancreatic cancer cells, and then use molecular/cell biology methods to validate the functions of the identified proteins. The results from the proposed work are expected to contribute to designing new strategies to improve the cure rate of pancreatic cancer. - [http://bit.ly/Yuchun\\_Du](http://bit.ly/Yuchun_Du)

**\$141,840**

## Courtney Dutton

Psychology – doctoral student  
Test of social conflict on PTSD and alcohol cravings

This study is designed to understand the effects of social conflict on posttraumatic stress symptoms and biases toward approaching alcohol. The associated training plan is designed to advance my expertise in clinical science to prepare me for a career aimed at improving treatments for this population. - [http://bit.ly/Courtney\\_Dutton](http://bit.ly/Courtney_Dutton)

**\$32,104**

## Ashley Knapp

Psychology – doctoral student  
A Test of an Adolescent Anxiety Sensitivity Amelioration Program

This study aims to address an important gap by conducting an experimental test, among adolescents, of the impact of a brief intervention to reduce a cognitive vulnerability factor shown to impact the development of panic and other anxiety psychopathology in adult research. - [http://bit.ly/Ashley\\_Knapp](http://bit.ly/Ashley_Knapp)

**\$32,105**

## Frank Millett

Chemistry & Biochemistry  
COBRE Center for Protein Structure and Function

The research projects supported by our COBRE Center or Protein Structure and Function are directed toward obtaining a detailed molecular-level understanding of the structure and function of proteins that could lead to improved treatments for human disease. - [http://bit.ly/Frank\\_Millett](http://bit.ly/Frank_Millett)

**\$1,080,700**

## Timothy Muldoon

Biomedical Engineering  
Diffuse illumination in fiber bundle microendoscopy for deep tissue imaging

Microendoscopy is a promising imaging technique capable of presenting high-resolution images of tissue at the point-of-care; to help clinicians better target surgical biopsies to improve the early detection of cancer in suspicious lesions. This project aims to develop a microendoscope based on diffuse reflectance imaging, which can detect absorption in tissue at greater depths, and take advantage of emerging molecular-specific functionalized gold nanoparticle-based exogenous contrast agents. - [http://bit.ly/Timothy\\_Muldoon](http://bit.ly/Timothy_Muldoon)

**\$68,140**

## Nathan Parks

Psychology  
Short-Term Plasticity in the Human Visual System: The Role of Cortical Feedback

This project will investigate neural mechanisms of short-term visual adaptations in the human visual system following a loss of patterned visual input from the retina. - [http://bit.ly/Nathan\\_Parks](http://bit.ly/Nathan_Parks)

**\$256,508**

## Xuan Shi

Geosciences  
Reducing Physician Distribution Uncertainty in Spatial Accessibility Research

In the wake of landmark health reform, there is widespread concern about the adequacy and distribution of our nation's health workforce. The goal of this project is to explore potential solutions to reduce the uncertainty and understand the probable patterns of physician distribution. - [http://bit.ly/Xuan\\_Shi](http://bit.ly/Xuan_Shi)

**\$38,336**

## Julie Stenken

Chemistry & Biochemistry  
Modulating and Monitoring the Foreign Body Response to Implants

All implanted materials elicit an immune response that leads to the foreign body reaction and measuring the complex chemical signals produced during wound healing will provide important information for reducing the immune response to any implant. - [http://bit.ly/Julie\\_Stenken](http://bit.ly/Julie_Stenken)

**\$321,121**

## Jeff Wolchok

Biomedical Engineering  
Engineering A Muscle Mimetic Biomaterial

A recognized risk factor for tendon re-rupture following rotator cuff surgery is shoulder muscle atrophy. We suggest that a readily available "off the shelf" biomaterial that provides the appropriate regenerative cues by mimicking the properties of native skeletal muscle extracellular matrix could be used to regenerate damaged muscle tissue. - [http://bit.ly/Jeff\\_Wolchok](http://bit.ly/Jeff_Wolchok)

**\$437,248**

## David Zaharoff

Biomedical Engineering  
Intravesical Chitosan/IL-12 Immunotherapy for Bladder Carcinoma

Bladder cancer, the sixth most common non-skin cancer diagnosis in the U.S., is a highly recurrent disease that would benefit from a new therapy capable of inducing durable tumor regression. A novel immune-based therapy, comprised of a mixture of chitosan, a polysaccharide, with interleukin-12, an immune stimulating cytokine, is under development. - [http://bit.ly/David\\_Zaharoff](http://bit.ly/David_Zaharoff)

**\$416,897**

## David Zaharoff

Biomedical Engineering  
Biopolymer-based strategies for local delivery of cytokine therapeutics

The administration of pro-inflammatory cytokines has demonstrated remarkable antitumor activity in numerous preclinical studies. Unfortunately, these cytokines have not been widely effective in humans due to the lack of effective delivery strategies which maximize appropriate cytokine levels in tumors while minimizing toxicities associated with their systemic spread. This project will overcome these limitations by developing and evaluating a novel delivery strategy, based on linking cytokines with the biodegradable polysaccharide chitosan for the local, sustained delivery of pro-inflammatory and T cell activating cytokines to the tumor microenvironment. - [http://bit.ly/D\\_Zaharoff](http://bit.ly/D_Zaharoff)

**\$301,389**