2018 | Vol. 4

explore

Research at the University of Missouri-Kansas City

SMARTER DECISIONS

Developing tools to help children make healthier choices

A pre-med student learns about internal organs during a lab.

PHOTO: DAN VIDETICH

explore

2018 | Vol. 4

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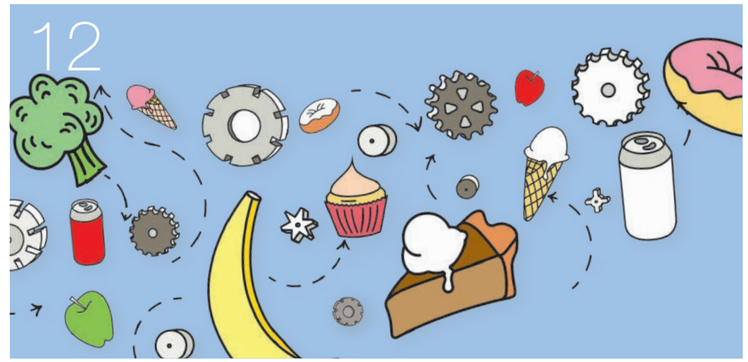
Welcome to explore



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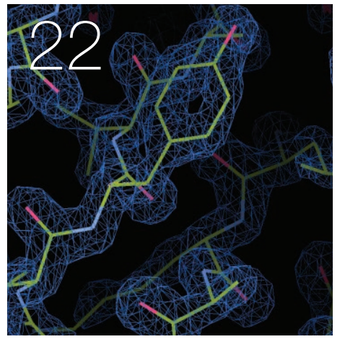

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PHOTO: BRANDON PARIGO

> One of the true joys of my position is interacting with some of the most creative, brilliant and innovative individuals one could ever hope to know.

UMKC is home to some exceptional faculty who are engaged in cutting-edge research and scholarship in a wide variety of areas. If teaching and learning are two of our fundamental core deliverables as a comprehensive urban research university, research — the discovery of new knowledge — is the foundation on which those deliverables stand. Without our engagement in research, we are simply another — one of many — educational institutions that communicates knowledge; and, in the 21st century, when knowledge is but a keystroke away on our ubiquitous hand-held devices, communicating knowledge alone is an inequitable return on investment.

At the foundation of our institution we are a creator — or discoverer — of new knowledge. And, our commitment to our students is that we will teach them, through research training, to become self-reliant learners as well. In this, we perpetuate the cycle by sowing seeds of discovery, learning and knowledge dissemination. This is our value-added proposition for Kansas City, the State of Missouri, and the nation. Not only are we an economic engine for our community and state, we are an engine of discovery and knowledge.

And not unlike the economic engine, the engine of discovery pays dividends in attracting outstanding scholars to Kansas City and Missouri, translating discoveries into innovation, building capital through entrepreneurship, flooding our community and region with healthcare, legal, educational, engineering and business professionals as well as artists, thinkers and learners. And our promise to our stakeholders is that we will deliver on their investment by being the best that we can in building the human capital that will transform our community from the ground up.

From the university's perspective, this transformation process begins with outstanding faculty scholars engaged in cutting-edge research. These individuals are the fabric of our institution, the material upon which all else stands. And so, it is with tremendous pride that I introduce in our fourth volume of Explore, another group of our faculty scholars who are — each in their own very unique way — elevating humanity in our community and state and thus, changing the world for the better.

I hope you enjoy learning about some of our very best scholars as much as I have enjoyed introducing them to you.

Lawrence Dreyfus, Ph.D.
Vice Chancellor for Research
and Economic Development

PHOTO: BRANDON PARIGO

"We bear the awesome responsibility of developing the new knowledge that drives human progress.

UMKC is a public urban research university — it is Kansas City's university. These are mutually reinforcing identities that can, and do, generate powerful synergies.

As a research institution, we bear the awesome responsibility of developing the new knowledge that drives human progress. As Kansas City's university — the lone research institution in the metro area — we bear an equally powerful responsibility to apply our research in service to our community, in pursuit of solutions to our city's and region's most pressing issues and problems.

You can see that synergy at work in our new UMKC Health Sciences District, where researchers work collaboratively with scientists from local agencies and our clinical partner hospitals — and major local companies such as Cerner — to develop new cures and treatments, identify best practices, and bring health care to underserved populations.

You see it in our campus research laboratories, where our scholars develop new knowledge in areas ranging from easing the burden of aging, to safeguarding high-tech communications and transactions, to blunting the threat of terrorism. The reach of our research stretches from the smallest cells in the human body, to the most massive stellar clusters in the deepest reaches of space. Our research also extends beyond the region, with its impact reaching Missouri, the United States and internationally.

You see our commitment to providing unmatched research opportunities to students, as well as our commitment to faculty-student mentorship. That kind of dedication enables UMKC to keep our best and brightest young people close to home while also drawing fresh talent to our community from across the nation and around the world. Such commitment results in passing on the passion and enthusiasm for discovery to future generations.

Our commitment is to create knowledge and then infuse that new knowledge into everything we do. We deliver the discoveries the world needs, with an eye ever-trained on supporting and promoting Kansas City, generating positive energy rippling outward from the heart of America. Read on for a few more examples of how we are helping Kansas City change the world.

Barbara A. Bichelmeyer, Ph.D.
Interim Chancellor and Provost

spotlight

UMKC School of Pharmacy researcher explores new solutions to antibacterial drug resistance

William Gutheil, Ph.D.
Professor, UMKC School of Pharmacy

RESEARCH INTERESTS: bacterial cell wall biosynthesis and related antibacterial agents; biological applications of LC-MS/MS technology

JOINED UMKC: 2000

ACCOMPLISHMENTS: Gutheil established and oversees the UMKC School of Pharmacy mass spectrometer core facility

What are you currently working on?

My current research is on bacterial-cell-wall biosynthesis, which is the target of many of our most effective antibacterial agents — such as penicillin. We study how current cell-wall-targeting antibiotics affect biosynthesis and how bacteria become resistant to antibiotics. Given the well-known health threat posed by antibiotic-resistant bacteria, our research has considerable potential to inform current efforts to address this problem and provide new solutions.

Any important findings?

We have identified and characterized one new antibacterial agent — D-boroAlanine — that has good broad-spectrum antibacterial activity, but not quite good enough for consideration as a clinically useful agent. Some of our mechanistic observations on the regulation of resistance to cell-wall-targeted antibacterial agents suggest strategies to counter antibacterial drug resistance, and we have started discussions with clinical faculty in the UMKC School of Medicine on the possibility of evaluating these strategies.

How do you work research into student learning?

The only way to learn how to research is by doing it. Our pharmacy students have a hands-on opportunity through research to treat various bacteria with antibiotics and observe their response, or lack of response, when resistant. I established and oversee our mass spectrometer core facility. Experience with this tool has helped make our students highly competitive for positions after graduation.

Why is UMKC research important to the region?

Research contributes immensely to our current standard of living and our health. Kansas City is a major hub for agricultural research, which depends on a technically trained workforce. Research at UMKC contributes to both of these needs, and research discoveries often provide the foundation for new enterprises, which enhance the economic development of the region.

How could this research make a big impact?

Drug-resistant bacteria are a huge public health threat. Several bacterial pathogens have now become resistant to nearly every agent available and have become essentially untreatable. It is urgent that we develop new drugs and new drug-use strategies to address this threat. We must also use existing antibiotics more carefully in the future in order to slow resistance to the effective agents we still have left in our arsenal.

— Bridget Koan

explore online
→ **READ GUTHEIL'S FULL INTERVIEW AT** INFO.UMKC.EDU/RESEARCH.

Insects and immunity

Yu's lab discovered a group of at least four proteins, called C-type lectins or immulectins, in the tobacco hornworm (above) that help its blood cells fight off pathogens.

Understanding insect immunology may lead to new ways to decrease the transmission of infectious diseases

by Elaine Adams

Meet the tobacco hornworm. It's a bright green caterpillar striped diagonally with white lines bordered by black dots. It grows up to be a moth, its formal name being manduca sexta.

Now meet Xiao-Qiang (Sean) Yu, professor of molecular biology and biochemistry. At his UMKC lab, Yu works with hundreds of these insects — as well as fruit flies and mosquitoes — to unlock the secrets of immunity.

"We are trying to understand how manipulation of the mosquito immune system can control/decrease transmission of infectious diseases such as malaria, Zika, dengue, West Nile and yellow fever," Yu says. "We are also trying to understand how manipulation of the insect immune system can help control agricultural insect pests."

Yu grew up in rural southern China and initially viewed college as a means of finding a good job away from the countryside. A passion for science came later. Early on, Yu aspired to find a cure for cancer but eventually gravitated to his current research interest. Though unrelated to cancer research, the study of insect immunity could curb the spread of human diseases, which Yu says is still one of his goals.

Humans are protected by two facets of the immune system. One arm of the immune system is our acquired (or adaptive) immunity, familiar to most of us through news reports about AIDS, polio and other diseases. Upon encountering new viruses or bacteria, our bodies "learn" to recognize and destroy them. Vaccines work on this principle. Our innate immunity, by contrast, is with us from birth, does not change during our lifetime and responds to infectious diseases in a nonspecific manner.

Insects lack the antibodies and lymphocytes necessary for acquired immunity, but they are hardly defenseless.

"Insects, although much simpler than humans, possess a highly sophisticated innate immune system that can defend against various pathogens," Yu says. "Knowledge gained from the insect innate immune system can help us better understand the more complicated human innate immune system."

Specifically, Yu is studying how certain proteins affect the insect's immune response. Proteins that thwart immunity could be useful in insect control. Those that boost immunity might help humans. The tobacco hornworm offers a distinct advantage because its large size — up to 4 inches — provides sufficient material for biochemical studies.

Yu's lab has discovered a group of at least four proteins, called C-type lectins or immulectins, in the tobacco hornworm that help its blood cells fight off pathogens. He's now learning more about how these immulectins recognize and latch on to invading microbes.

A recent finding, he says, is that fruit flies possess more than one particular signaling pathway, called Toll pathways, which relay instructional messages and likely are important in defending against pathogens. In this regard, fruit flies are more like humans than previously thought, because we have 10 similar pathways.

This discovery, Yu says, has implications for understanding both human immune systems and the evolution of innate immunity.

Another newer finding is that some proteins in the insect's midgut may play a significant role in the resistance that insects develop to crops that are genetically engineered to kill the pests that eat them. These crops are modified with genes from the soil bacterium bacillus thuringiensis (Bt), which produces insect-killing proteins. A better understanding of resistance, Yu says, could lead to better genetically modified crops.

Yu hopes to take this research in a new direction to understand just how the midgut proteins affect Bt resistance – "particularly in mosquitoes, so we can use Bt to control mosquitoes more effectively."

Because it takes a long time to develop a totally new product, Yu says his goal is to enhance existing ones, particularly those used for pest control.

"You can add something to make a new recipe, and then it can better deter pests," he says.

Insects and Immunity

To the lay person, insect immunity might seem like an arcane field, with little relevance beyond scientists and those extremely fascinated by bugs. Although his findings haven't reached the marketplace yet, Yu knows this research can potentially improve our lives in at least three areas:

Medicine and human immunity:

Both insects and humans possess innate immune systems which, from birth, automatically offer protection from certain invaders. By studying proteins that affect insect immunity, scientists might find new ways to curb insect-borne human diseases, like West Nile and Zika, as well as find new ways to bolster human immunity.

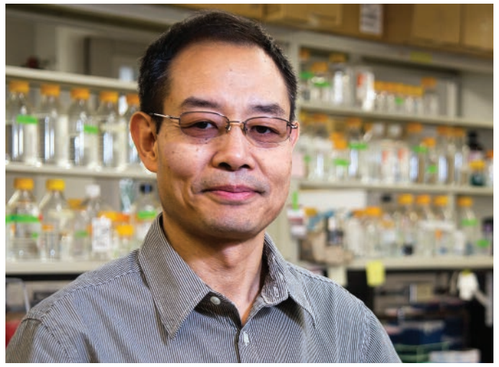
Insect control:

By interfering with their natural immunity, we could better keep insects away from places where they can harm or bother people.

Farming:

Scientists like Yu are learning more about how agricultural pests become resistant to insecticides. Imagine the crops that could be saved if farmers stay a step ahead of plant-eating bugs.

Meet the researcher



Xiao-Qiang (Sean) Yu, Ph.D.
Professor, School of Biological Sciences

RESEARCH INTERESTS: Innate immune responses modulated by plasma proteins and expression of antimicrobial peptides regulated by signal transduction pathways in a model insect, the tobacco hornworm

JOINED UMKC: 2002

ACCOMPLISHMENT: Identification of proteins that influence insect immunity; appointment to the Vector Biology Study Section at the National Institutes of Health

Unlocking the genetics of disease

UMKC researcher works to uncover diagnostic biomarkers and new therapeutic targets for complex human diseases

by Kelly Edwards

In the world of genetics and molecular research, scientists are exploring a phenomenon of gene functions they call the double-edged sword. On the one hand, a particular gene is shown to have a destructive effect, leading to disease in the human body. On the other, that same gene protects the body from other illnesses.

For much of the past 10 years, Shui Qing Ye, M.D., Ph.D., has honed much of his attention as a research scientist on one such double-edged sword, a gene known as Nicotinamide Phosphoribosyltransferase (NAMPT).

"A higher expression of the NAMPT gene is effective in reducing heart ischemic injury, ischemic stroke, drug induced liver toxicity, but individuals expressing high levels of NAMPT are more likely to suffer cancer, arthritis or inflammatory lung disease," said Ye, professor and William R. Brown/Missouri Endowed Chair in Medical Genetics and Molecular Medicine. "A lower expression of the gene reduces the chances of cancer, arthritis, or inflammatory lung disease, but you're more likely to suffer coronary artery disease, stroke, drug induced liver toxicity."

Ye began looking at the effects of the NAMPT gene more than a decade ago while serving as director of the gene expression profiling core at the Center of Translational Respiratory Medicine at John's Hopkins University School of Medicine. Working on a National Institutes of Health-funded project exploring large volumes of data, Ye was able to identify genetic markers, or a "signature," to accurately predict patients with higher susceptibility to acute lung injury. That led to the development of the first commercial antibody for the product of the NAMPT gene, which is now widely used in disease diagnosis.

Now working across the street from the UMKC School of Medicine in his genetics laboratory at Children's Mercy Kansas City, one of the school's partner teaching hospitals, Ye and his team are collaborating with researchers throughout Kansas City and beyond. They are incorporating a variety of state-of-the-art tools, including high-speed DNA sequencing and methods from next-generation DNA sequencing and translational bioinformatics (gene sequence data analytics) to gather and explore big data to pinpoint new diagnostic biomarkers and therapeutic targets for human diseases.

Ye's work has led him to write two acclaimed books. The first, *Bioinformatics — A Practical Approach*, published in 2007, looks at the practical applications of bioinformatics in biological and biomedical data analysis. His most recent book, "Big Data Analysis for Bioinformatics and Biomedical Discoveries," published in 2016, covers topics surrounding big data analysis in biomedicine.

Ye has also developed a gene expression research core, a collection of cutting-edge technologies to explore the roles and relationships of gene expression and gene mutations in human diseases. In turn, he has been able to share information and collaborate with researchers at institutions including UMKC, the University of Kansas Medical Center, Kansas City University of Medicine and Biosciences and others to study and develop therapies for a number of ailments from arthritis to coronary disease.

"We're not doing hypothesis-driven research alone," Ye said. "We're doing data-driven research in combination with hypothesis-driven research. Data-driven research gives you a global insight.

"You need to find out if a particular gene really is the target of a specific therapy. You don't randomly pick one and say it looks like this gene is the key regulator. You look at the whole picture, and we have that luxury now because big data is available. Now you can look and see that this is the gene that is upper-regulated or down-regulated. And the data is not coming from one lab but from a national repository with similar reports from many labs."

By applying translational bioinformatics to big data at his disposal, Ye is at work on several projects that may lead to biological discoveries and ultimately the creation of new diagnostic and therapeutic targets for a wide variety of diseases. Recently, he and collaborator, Dr. Mark Lee at the University of Missouri-Columbia, have developed a modified inhibitor of the NAMPT gene that has the potential to become a novel treatment for osteoporosis.

Also, while working with a Brad Warady, M.D., a well-known pediatric nephrologist at Children's Mercy, to study 450 DNA samples of children with chronic kidney disease, he has been able to identify a number of new and novel genetic markers that indicate severity of the disease. Then, in collaboration with John Spertus, M.D., a leading cardiovascular outcomes researcher at Saint Luke's Mid America Heart Institute, Ye uncovered NAMPT-related genetic variations that serve as predictors of coronary artery disease susceptibility, severity (the number of diseased vessels) and outcome (24-month mortality).

"I enjoy the interdisciplinary collaboration," Ye said. "When you're collaborating with other scientists, you not only relish a collective wisdom but also get a bigger patient sample. The bigger the sample, the better the data."

Meet the researcher

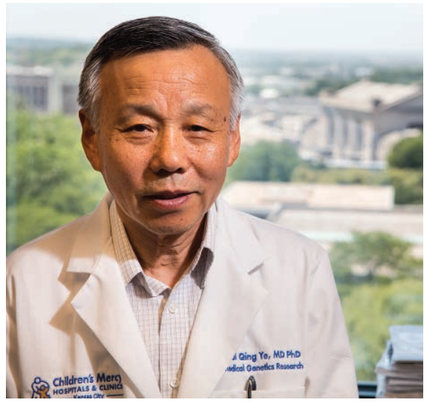


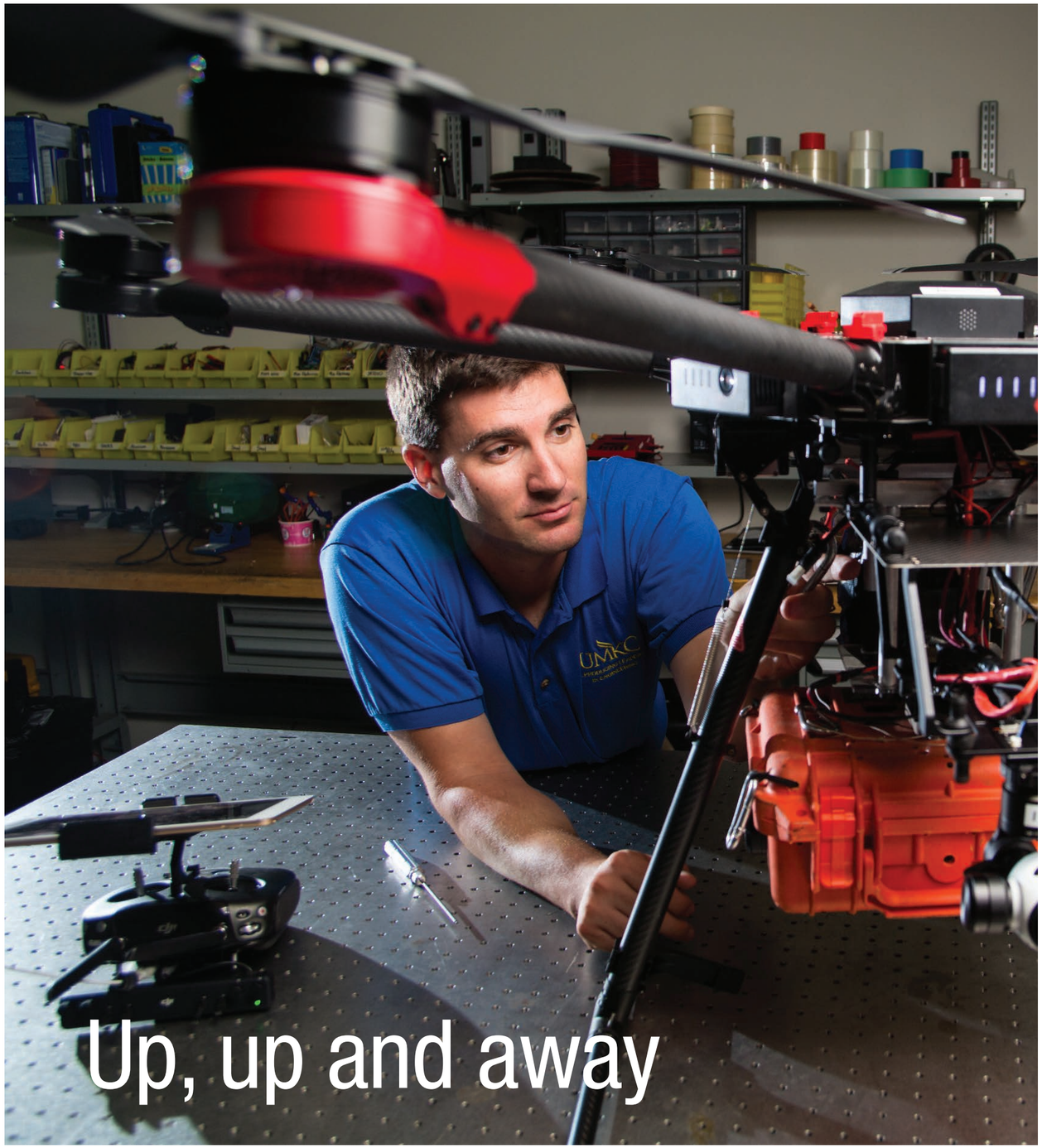
PHOTO: BRANDON PARIGO

Shui Qing Ye, M.D., Ph.D.
William R. Brown/Missouri Endowed Chair in Medical Genetics and Molecular Medicine, Professor, UMKC School of Medicine; Department of Pediatrics and Department of Biomedical and Health Informatics; Director, Division of Experimental and Translational Genetics and Core of Omic Research, Children's Mercy

RESEARCH INTERESTS: Next-generation DNA sequencing; translational bioinformatics and integrative strategy of animal model, biochemical, cellular, molecular and omic approaches to identify new diagnostic biomarkers and novel therapeutic targets to complex human diseases such as acute respiratory distress syndrome, coronary heart disease, chronic kidney disease and drug-induced liver injury

JOINED UMKC: 2010

ACCOMPLISHMENTS: Principle investigator or co-investigator of many National Institutes of Health-funded research studies; served on grant review panels for NIH-National Heart, Lung and Blood Institute, U.S. Department of Defense and the American Heart Association



Up, up and away

Fields works on one of the load-bearing drones in his workshop.

UMKC researcher explores the practicalities and life-saving potential of drone technology.

by Brian Schneweis

For Travis Fields, Ph.D., drones are more than last year's holiday gift craze; they are a way of life. As an assistant professor of mechanical engineering in the School of Computing and Engineering, he is excited to be taking research with drones and unmanned aircraft to new heights.

"I am a private pilot and have always been fascinated by aircraft and aerospace, so finding a unique and interesting area to do research with drones was an easy pick," he says.

Drone technology is growing far beyond personal and commercial use. While large companies like Amazon are turning to drones for innovative package delivery and business solutions, Fields is eager to explore the practical and even life-saving capabilities of this relatively new technology.

"I don't think that Amazon Prime Air will radically change our lives, but drone use for areas such as bridge inspection, search-and-rescue missions and logistical operations like fire fighting and evacuations have the potential to reduce risk to human life, increase efficiencies, reduce costs and improve safety," Fields says.

In 2015, Fields had the opportunity to explore drone capabilities in a groundbreaking way after receiving a FastTrack award from the University of Missouri System Office of Research and Economic Development. The grant provided funding to advance Fields' innovative technology for drone-based bridge inspections. Fields teamed up with a local engineering firm, Shafer, Kline and Warren, Inc., and the Missouri Department of Transportation to use drones to determine the viability of area bridges. The goal of the project was to field test a tethered drone system the team created. This prototype enabled an operator to expand the typical flight time of a drone from 15 minutes to eight hours or more by providing power through the tether with a gas generator and a battery backup.

"We performed two sets of field tests, and our inspection capabilities dramatically increased over the existing technologies offered," Fields says. "Our effort led to the closure of a structurally unsafe bridge, as our video data provided the first clear indications of the full extent of corrosion damage on the substructure of the bridge."

The bridge inspections were lauded as the first documented tests of their kind in the U.S., but that was only the beginning of Fields' work with drones at UMKC.

As the director of the Drone Research and Teaching (DRAT) laboratory, he is leading the charge for RooFly, a new flight service and training program for unmanned aircraft to be used at the university and eventually throughout the community. RooFly currently has six ready-to-fly aircraft with a range of capabilities to perform flight operations for faculty at UMKC. The program is intended to remove burdens related to getting flight certification, learning to fly and acquiring equipment for researchers who simply want to use a drone to perform particular tests and studies.

"RooFly is important to UMKC as we work to expand the capabilities for our researchers in a safe and legal way," he says.

As part of RooFly, Fields began teaching a drone training course during the summer in which students learned the theoretical and practical aspects of unmanned aircraft operations. This prepares them to take the Federal Aviation Administration's Part 107 knowledge exam, which is required to receive a drone license.

While work with drones and RooFly keep him busy, Fields also studies other areas that are taking flight. His current projects include development of a steerable parachute system for precision aerial deliveries and new advancements with 3-D printing sensors and technology. He is also working on adaptive flight control systems for unmanned aircraft that allow microcomputers to learn to fly, which he likens to a baby bird instinctively flying as it leaves its nest.

These experiences were useful when Fields recently served as the advisor for a group of students conducting their senior design project. They collaborated with a team from the University of Southampton in the U.K. to create a tornado-chasing aircraft system.

"The U.K. team built the aircraft and sensor payloads, and our students created the ground robot that drives close to the potential tornado and launches the aircraft," Fields says. "Think of the movie Twister, except it's deployed in the air."

While that project is ongoing, there is also a proposal pending in which Fields' team will take the tethered system concept and expand to a small swarm of tethered drones that will be able to detect and track gas plumes.

Fields has no shortage of projects that involve a real-world application of drones, and looking at where the technology is headed, his work will only become more integral to daily life. In fact, he sees a future in which drones will start to take over tasks normally performed by humans.

"Machine learning and adaptive control techniques enable robots and drones to perform specialized tasks exceptionally well," he says. "Drones are playing an increasingly important role in our lives, and I think that has driven the buzz around them. We have already come so far in the past decade. I think it will be a really exciting time in the next 10 to 20 years."

Meet the researcher

Travis Fields, Ph.D.
Assistant professor of mechanical engineering, School of Computing and Engineering; Director of Parachute and Aerial Vehicle Systems (PAVS) laboratory, Instruments and Measurements Lab (IML), and the Drone Research and Teaching (DRAT) laboratory

RESEARCH INTERESTS: Adaptive flight control systems for unmanned aircraft, steerable parachute systems for precision aerial delivery, 3-D printing sensors and parts

JOINED UMKC: 2013

ACCOMPLISHMENT: Received a FastTrack award from the University of Missouri System Office of Research and Economic Development for drone-based bridge inspections; conducted first documented bridge inspection with use of unmanned aircraft

Smarter decisions

Lark Lim and his collaborators are developing tools that encourage children to make healthier choices.

by Stacy Downs

Should you choose apples or fries?

If you're past the age of 25, you're probably familiar with the three Cs: calories, cholesterol and carbohydrates and what effects they have on the body. So you're more likely to pick apples.

But if you're younger than 25, your dorsolateral prefrontal cortex — also known as your brain's self-control region — hasn't fully developed. You haven't fully processed what seems like nutritional mumbo jumbo. So you might not hesitate before choosing fries.

Brain development is one of the contributing factors to our childhood obesity epidemic, says Lark Lim, associate professor of psychology at the University of Missouri-Kansas City.

"Kids simply don't have the knowledge and cannot fully understand the dietary science of healthy eating," Lim said.

But Lim and his collaborators, using neuroeconomics (see sidebar below), are creating tools to help guide more people to make healthy decisions — to choose apples.

Would my mom like me to eat this?

The ultimate goal for Lim and his team is to prevent childhood obesity by encouraging children to be successful self-controllers who can make their own healthy dietary choices voluntarily.

As children grow, they learn how to make decisions independently. A critical time when children make their own food choices is when they're growing into adolescence, from 9 to 14 years old.

Although this age group's self-control functions haven't developed, Lim's team discovered from their own neuroimaging study that caregivers hold heavy influence on children's decisions. For example, would my mom like me to eat this?

In their study published in 2016 in Nature Communications, Lim and his collaborators determined that this neural internalization of parental regulation serves as an important self-regulator of children's decision-making and can lead to optimal food choices.

Creating collaborative tools

K-12 schools' food and nutrition programs, regulated by the U.S. Department of Agriculture, play a critical role for children's nutrition. But the lunch choices are still up to children who don't have a full understanding of dietary information for their selection.

As a parent to two children in this age group, Lim sees the challenges of helping influence healthy decisions when he's not around.

"I'll ask my daughter what she ate for lunch at school and she'll say 'I don't know' or simply shrug," Lim says.

To develop and create a parent-child tool that aids in this decision making, Lim has applied for a grant from the U.S. Department of Agriculture with research partners from the UMKC School of Computing and Engineering, the Center for Children's Healthy Lifestyles (University of Kansas Medical Center and Children's Mercy) and local elementary and middle schools.

While undergoing neuroimaging sessions, children 9 to 14 years old and their mothers will make real food choices in either independent-decision or shared-decision conditions. Through analyzing the data, Lim and his team will examine computational and neurobiological mechanisms for children's dietary self-control development, which will provide the framework for tools.

What is Neuroeconomics?

Put simply: the science of decision-making. Neuroeconomics combines research methods from neuroscience; experimental and behavioral economics; and cognitive and social psychology. As studies of decision-making behavior become increasingly computational, it also incorporates theoretical biology, computer science and mathematics.

By using tools from various fields, scholars say neuroeconomics offers a more integrative way of understanding how the human brain makes decisions.

One tool is an fMRI (functional magnetic resonance imaging), a test that uses a magnetic field and pulses of radio wave energy to make pictures of structures inside the body.

With MRIs used in medicine, a patient lies still during the procedure. In fMRIs, participants answer questions while blood flows in the brain are scrutinized to see where activity is going on while decisions are made.

Another tool is an EEG (electroencephalogram), a test that detects electrical activity in the brain using small, flat metal discs attached to the scalp.

With these tools, neuroeconomists research people's reasons for trusting one another, charitable behavior, whether to quit smoking, whether to eat apples or fries and much more.

SOURCES: LARK LIM, THE ECONOMIST, THE MAYO CLINIC

TOOL 1

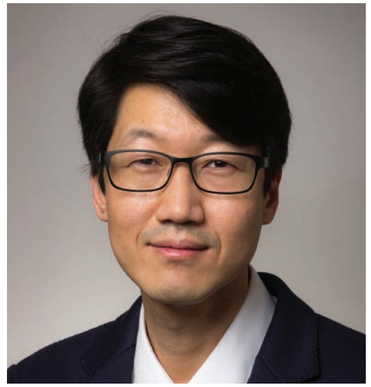
An instructional online platform. "Children and parents will provide their preferences for shared dietary decisions for each week's lunch menu and receive nutritional feedback for their choices from dietitians," Lim said.

TOOL 2

A free mobile app. Through the app, children and their family members will take photos of their meals and snacks, enter their own preferences and share their feedback on each other's food choices. Connected to cloud-based deep-learning artificial intelligence systems, this application will automatically conduct image-pattern classification and healthy-habit analyses to identify real-life risk factor for childhood obesity and provide appropriate health recommendations.

"These proposed tools address preventing childhood obesity in a very novel way, rooted in development and decision neurosciences rather than the usual nutritional sciences," Lim says. "We believe that providing healthy dietary guidelines and environments is undoubtedly important. But it is not sufficient to prevent initial development of childhood obesity or stop additional weight gain in overweight or obese children unless children — by themselves — eventually decide to eat healthy foods rather than unhealthy ones."

Meet the researcher



Lark Lim, Ph.D.

Associate Professor, Department of Psychology, College of Arts and Sciences

RESEARCH INTERESTS: Neuroeconomics, using computational, behavioral and functional neuroimaging techniques to understand the mechanisms of cognitive-affective interactions and decision-making in the brain and the implications for affective-behavioral dysregulation in normal and clinical populations; applications: smoking cessation, drug addiction and eating disorders

JOINED UMKC: 2012

ACCOMPLISHMENT: 2016 UMKC Fast Track Scholar Award and Funding for Excellence Faculty Award

Obesity in children has more than tripled from

1971 → 2011

Childhood Obesity

About one in three American kids and teens is overweight or obese, putting them at a higher risk for physical, social and emotional health difficulties.

The prevalence of obesity in children more than tripled from 1971 to 2011. It is now the No. 1 health concern among parents in the U.S., topping drug abuse and smoking.

Among children today, obesity is causing a broad range of health problems that previously weren't seen until adulthood. These include high blood pressure, type 2 diabetes and elevated blood cholesterol levels. There are also psychological effects: Obese children are more prone to low self-esteem, negative body image and depression.

Excess weight is associated with earlier risk of obesity-related disease and death in adulthood. Former Surgeon General Richard Carmona characterized our childhood obesity epidemic:

"Because of the increasing rates of obesity, unhealthy eating habits and physical inactivity, we may see the first generation that will be less healthy and have a shorter life expectancy than their parents."

SOURCE: AMERICAN HEART ASSOCIATION, 2016

A test of strength

Exploring the relationship between muscle and bone loss

by Sara Kincaid

With more than 25 years dedicated to the study of the molecular genetics of osteoporosis, the work of Mark Johnson, Ph.D., is the foundation for medications — both on the market and in clinical trials — developed to help patients suffering from bone loss.

As professor and chair of the department of Oral and Craniofacial Sciences and director of the UMKC Center of Excellence in the study of dental and musculoskeletal tissues, Johnson says he came to study osteoporosis through the back door.

"From a very young age I've always been interested in human diseases, especially inherited diseases," he says.

His work with osteoporosis changes directions and grows as he continues to make discoveries related to the way the human skeleton creates and regulates bone mass.

Nearly 40 million Americans are at risk for developing osteoporosis, a disease that generally occurs in older adults and is most commonly associated with menopause and estrogen loss. Johnson estimates that of those individuals who suffer from osteoporosis and experience an osteoporotic fracture, such as a hip fracture, nearly half die within a year of the injury.

Johnson's research centers on discovering the keys to turning on bone mass production. Though there are drugs on the market to help with stimulating short-term bone replacement, Johnson hopes to discover the genetic basis for mass development in order to develop new long-term therapeutic strategies to turning on bone development.

Since older female adults experience a loss in estrogen and are the most common population to suffer from osteoporosis, Johnson and his team are researching how hormones affect osteocytes. Osteocytes control osteoblasts — which build bone — and osteoclasts — which remove bone. Their research also focuses on uncovering the role of estrogen and testosterone in regulating the LRP5 pathway, one of five pathways used by the human body to create all of its tissues and cells. Johnson's research on the LRP5 pathway is supported by a significant grant award from the National Institutes of Health. This multi-year award, that is currently being considered for renewal, provides nearly $1.2 million per year.

Johnson hypothesizes that our muscles produce factors that condition the response of bone to mechanical load, and vice versa. Aging affects this crosstalk, leading to the decline of mass in these tissues in older individuals.

"There's a remarkable biochemical coupling [between bone and muscle] that is really quite elegant and essential to the function of each tissue," he says. "The old dogma was that bones provide an attachment site for muscle, which is necessary for locomotion. Muscles contract and apply load to bone, but it was very much a mechanical perspective. Now it looks like there is this molecular component to these two tissues that nobody suspected, and that's really exciting."

Johnson's current work attempts to prove this correlation, though he is still waiting for results from his most recent study.

Further evidence for his hypothesis, and the potential reach of his work, lies in sarcopenia, something of a twin disease to osteoporosis. Sarcopenia, a muscle-wasting disease that causes loss of strength and function, is also associated with the aging process. When people with low bone density are examined, they often have muscle deficits. If Johnson's hypothesis concerning the correlation of bone and muscle plays out, he says there are some exciting benefits to come.

According to Johnson, tens of millions of American are at risk for osteoporosis or sarcopenia each year. As the lifespan of humans extends and the population continues to grow older, Johnson says diseases like osteoporosis and sarcopenia will become an ever-increasing percentage of the U.S. and worldwide population.

"If we can identify the factors that play a role in the biochemical crosstalk between muscle and bone, and if it turns out that the expression of these factors is altered or diminished with aging, then one can envision a pharmaceutical approach in which replacement of one (or both) factors will restore the dynamic balance present at younger ages."

THE CASE FOR MAINTAINING BONE MASS

1/2 of adults age 50+
are at risk of breaking a bone and should be concerned about bone health

3-5%
of muscle mass can be lost each decade after age 30 if physically inactive

Meet the researcher

Mark Johnson, Ph.D.
Professor and Department Chair, Oral and Craniofacial Sciences; Director, UMKC Center of Excellence in the study of dental and musculoskeletal tissues; School of Dentistry

RESEARCH INTERESTS: Molecular basis of human disease, molecular genetics of osteoporosis

JOINED UMKC: 2005

ACCOMPLISHMENT: His lab made a seminal discovery of a human high bone mass mutation that identified a signaling pathway regulating bone mass accrual. Recent studies show biochemical crosstalk between skeletal muscle and bone through this pathway; disruption of which may lead to functional deficits in both tissues with aging.

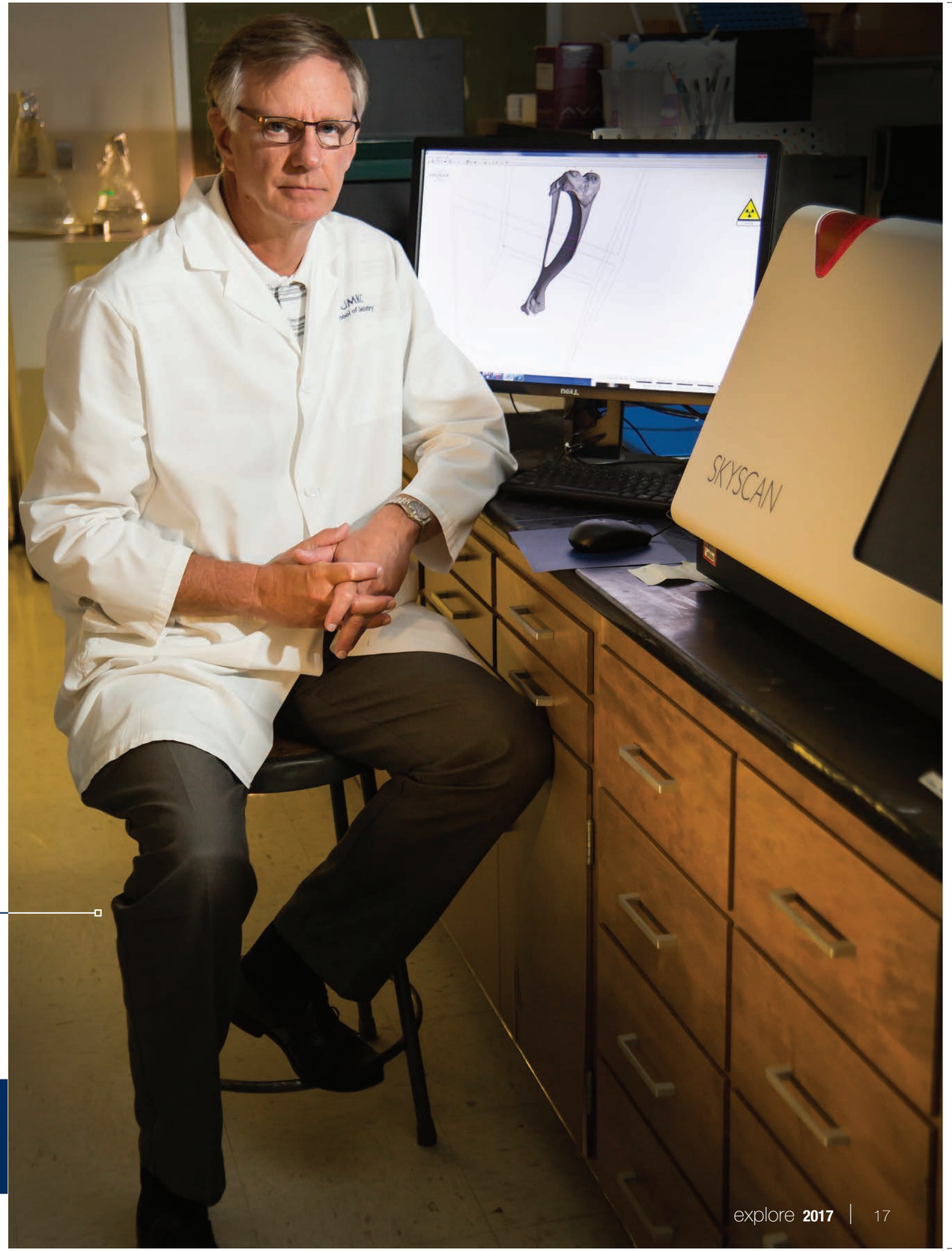


PHOTO: BRANDON PARIGO

One of the many applications to Khan's research is monitoring transisters such as those used in electric or hybrid vehicles.

Evolving technology optimizes battery efficiency

Research leads to device that will maximize efficiency and enhance safety

by Patricia O'Dell

For some of us autonomous cars and electric airplanes are the elements of our childhood cartoons. We wondered about, but could not really imagine the reality of, shooting around like the Jetsons. But as artificial islands and skylines of modern cities like Dubai become a reality, these innovations become more mainstream. While the basic technology of driverless cars and drones are becoming more and more common, researchers are still focused on addressing practical, and ultimately surmountable challenges, that go hand-in-hand with these innovations.

"It's very much like the human body," says UMKC associate professor and researcher Faisal Khan, Ph.D., of the batteries that power these technologies. "They can fail at any time."

For the last six years, Khan has focused his research on monitoring Insulated Gate Bipolar Junction Transistors (IGBJT). These transmitters are an essential component of electric power conversion and are found in self-driving and hybrid cars, locomotives, nuclear ships and electric airplanes. While these transistors are critical to supplying energy at a controlled speed, they do break down. Currently, while every high-powered electronic circuit board needs one, there is no way to monitor the health and longevity of an IGBJT, the failure of which can have critical and costly consequences.

"This technology will allow us to determine when a car battery, for example, is about to run out. This allows you to make sure it doesn't happen while you're driving, but also allows you to get the last drop of use," says Khan.

Khan has been interested in this technology for much of his career.

"I could see there was a void in this area," he says. "Not many people were looking at it."

Dr. Khan and his team recently received a $50,000 UM System Fast Track award to further his research. The Fast Track Awards are given by the University of Missouri Office of Academic Affairs, Research and Economic Development to support the development, testing, construction and analysis of innovative technology with the opportunity for commercial potential.

Khan, an expert in the field of determining the degradation in live power semiconductor aging and degradation, is confident his research will result in this sort of potential.

"For the last four or five years the data said it would work, but we couldn't replicate it in the lab," he says. "This is in the lab now. We are at the last level."

The potential for this product is significant. In 2016, the worldwide IGBJT sales volume was $5.5 billion and has a steady 5-6 percent annual growth. An IGBJT driver will not work without a gate driver module. This gate driver controls the charge to the device from the power source. Often this essential driver can increase the cost of the IGBJT module by 30 percent.

The gate driver market is both essential and competitive. Currently, there is no health monitor available for these modules. Khan believes there is a place in the market for new products, and he is confident that a driver with a health-monitoring unit, such as the one he is developing, would be a market leader.

"The real time health monitoring feature may eliminate system downtime," Khan says.

In addition, he believes it can be incorporated into gate drivers without significant cost increase.

Once the technology, is tested Khan will submit the information to the UMKC Office of Technology Commercialization, and they will begin the process of licensing, selling and producing the technology.

While his research is both valuable and exciting, Khan's satisfaction does not lie only with commercial success.

"My dream is that your electric car will monitor your battery, so there's no surprise in the middle of the highway. What we want to do is save lives."

Technology on the fast track

While researchers are often attracted to their disciplines because they have a passion for increasing knowledge within their fields, there is great value in applying this knowledge to products and systems. Since 2008, the University of Missouri Office of Academic Affairs, Research and Economic Development has awarded $50,000 grants annually to encourage technology transfer from the lab to the private, commercial sector.

"Often, researchers need a technology and business champion," says Eric W. Anderson, director of the Office of Technology Commercialization at UMKC. "We build a network to help identify how emerging technology fits in the business sector and how it applies to commercialization."

Anderson recognizes that a $50,000 grant in areas like biological research does not always catapult researchers to the finish line.

"But in physical science, like Dr. Khan's, researchers can design, fabricate, test and acquire live test data with an award that size, so these funds can be significant," Anderson says.

From that point, the technology commercialization office can facilitate conversations within the industry. Anderson thinks the grants and the relationship that are developed from them are working.

"Sometimes industry can be guarded. We are getting them to pay attention," he says.

Meet the researcher

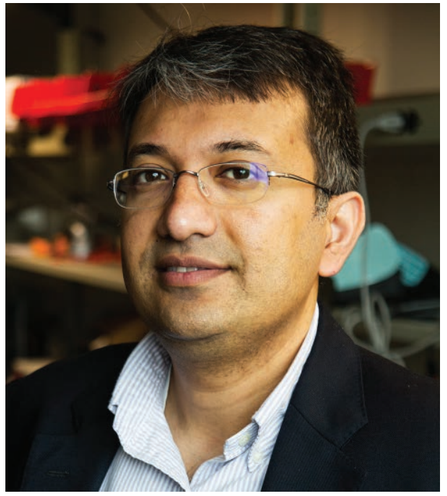


PHOTO: BRANDON PARIGO

Faisal Khan, Ph.D.
Associate Professor, Computer Science and Electrical Engineering

RESEARCH INTERESTS: Power converter reliability and failure analysis, smart modulation for power converters, ultralow-power circuits for implantable electronics

JOINED UMKC: 2015

ACCOMPLISHMENTS: Khan is the primary investigator and co-primary investigator of a total $2.48 million in federal and industry grants.

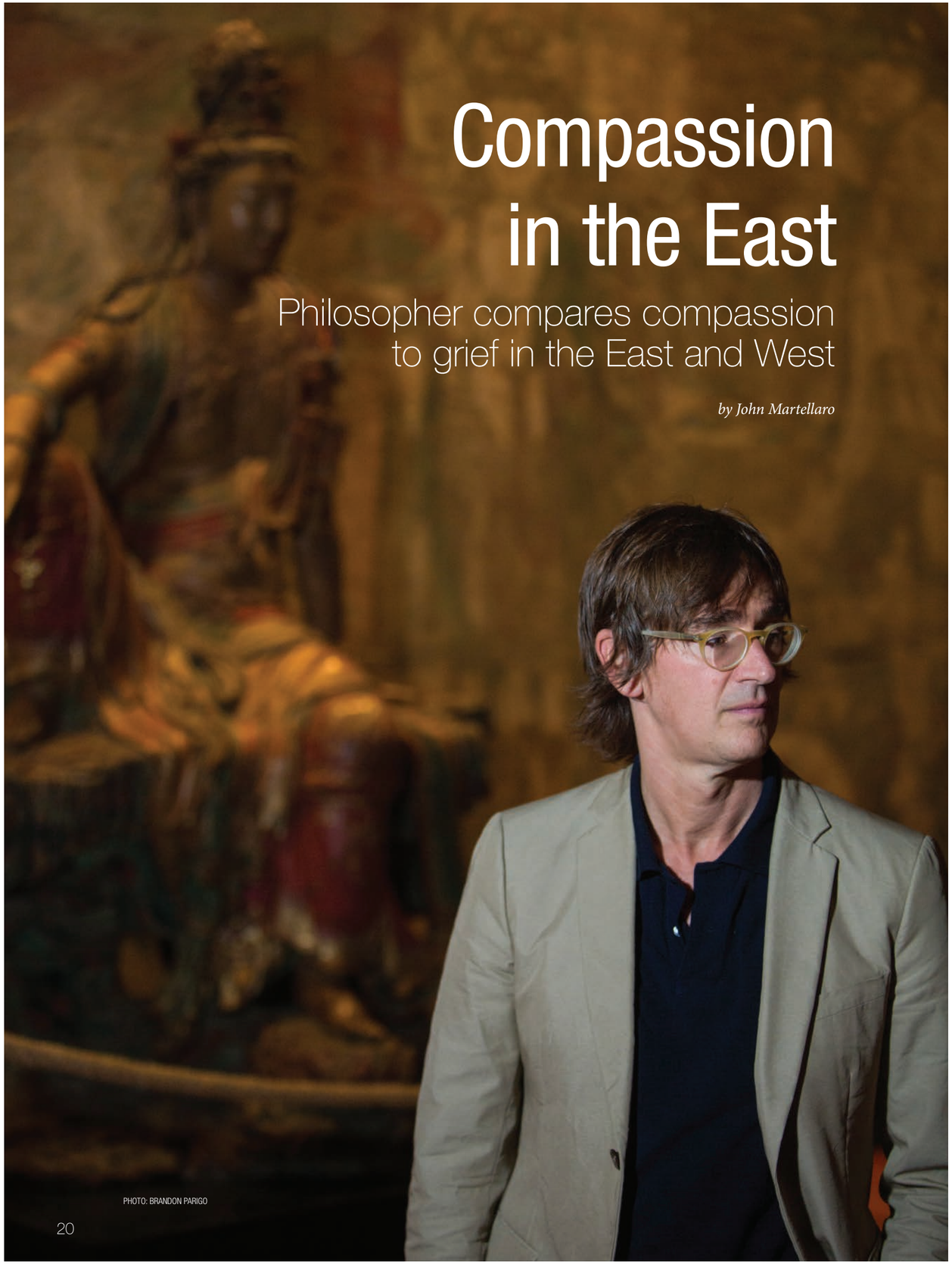


PHOTO: BRANDON PARIGO

Compassion in the East

Philosopher compares compassion to grief in the East and West

by John Martellaro

Death may be the ultimate example of a universal human experience. So, can our thinking about death — the anxiety we experience about our own, the grief we feel about others' — lead us to a universal ethics of compassion for our fellow humans?

That's what Clancy Martin, Ph.D., is exploring in his current research endeavor as a professor of philosophy at UMKC.

"I'm working on a project at the intersection of ethics and the philosophy of mind (two branches of philosophy — see sidebar), and at the intersection of Western philosophy and Eastern philosophy," Martin explains. "The idea — that comes from the work of the eighth-century Buddhist philosopher Shantideva and the nineteenth-century Danish philosopher Soren Kierkegaard, with a bit of help from Jean Paul Sartre — is that part of our experience of consciousness, when we look at it in its most fundamental nature, is the experience of compassion for other consciousnesses."

For a long time, we in the West have ignored the important contributions of Eastern philosophers, to our great loss.

Martin's research involves exploring the relationship between compassion and death — how the mind relates to death, and how we feel about anxiety and suffering. The goal is to give people a reason, and a means, to think and act more compassionately.

"It would be nice if we could make this work," Martin says. "We're always looking for a grounding principle to support whatever moral system we might postulate."

In addition to working in the philosophy department at the College of Arts and Sciences, Martin is also a professor of business ethics at the Henry W. Bloch School of Management. A 2011-12 Guggenheim Fellow, Martin has authored, coauthored and edited a variety of books in philosophy, including *Love and Lies*, *Honest Work* with Robert Solomon and Joanne Ciulla, and *The Philosophy of Deception*. His work has been translated into more than 20 languages.

How does one conduct academic research into such topics? It doesn't involve test tubes or computer modeling, but it is far more rigorous than mere deep thinking in a quiet room.

Martin says he begins by reviewing "how great minds of the past looked at these issues. Then you check that against your own intuition about the issue, and against contemporary debate on the issue" by philosophers in forums and published works.

The next step is to construct a hypothetical conversation with one of the great thinkers of the past about the contemporary concerns relating to the issue. That leads to a draft manuscript.

"You then pass that around to people you respect, to get their feedback and their concerns," he says.

Some of those reviewers are other academics in philosophy. And some are not. Among those from whom Martin regularly seeks insight and reactions are a photojournalist at National Geographic, an economist at MIT, a novelist and a jeweler.

"I try to involve as many different thinkers from as many different disciplines as possible," he says.

For this particular research effort, he has expanded his circle of discussion partners to include people who work professionally with death and dying, including hospice workers and physicians.

"I'm reading works written by people who are dying and writing about their experiences, and people who are writing from the perspective of grief over losing a loved one," Martin says.

In his reading of the works of his two primary sources, Martin says he has been struck by how remarkably similar he has found the thoughts about death put forward by Shantideva and Kierkegaard, who lived centuries and continents apart.

"For a long time, we in the West have ignored the important contributions of Eastern philosophers, to our great loss," Martin says, adding that Eastern academics have similarly ignored the West. "I am hoping to make more progress than I otherwise might, by drawing on these two great traditions.

"It's a fun project, in part, because many of the best Buddhist scholars and working philosophers are in India, and, in addition to working together over email, I travel to monasteries and other religious centers in the Himalayas, India and Nepal, to study with them," Martin says. "It's resulted in various papers and essays and is slowly maturing into a book."

Intersecting Branches

Martin's current research involves aspects of two branches of philosophy: **Ethics** and **Philosophy of Mind**. The field has many other branches, including Epistemology, Logic, Philosophy of Science and Philosophy of Language.

Philosophy of Mind is the branch of philosophy that studies the nature of the mind and its relationship to the physical body.

Ethics is a branch of philosophy that involves systematizing, defending, and recommending concepts of right and wrong conduct.

Meet the researcher

Clancy Martin, Ph.D.
Professor, Department of Philosophy, College of Arts and Sciences

RESEARCH INTERESTS: Existentialism, Buddhist philosophy, philosophy and literature, philosophy of mind, cognitive science, death, truthfulness

JOINED UMKC: 2003

ACCOMPLISHMENTS: Guggenheim Fellow, DAAD Fellow, Pushcart Prizewinner; published more than a dozen books and 200 articles, essays and reviews, including pieces in *The New Yorker*, *The New York Times*, *Harper's Magazine*, *The Wall Street Journal* and *The Atlantic*

Small connections, big implications

Exploring new ways to treat cancer and other diseases

by Greg Hack

In most research, there's no such thing as "minor details" or "the small stuff." This is especially true for Xiaolan Yao, Ph.D. Her research team makes and uses three-dimensional models of proteins, and for those models to be accurate, every atom counts.

She and her team — currently two graduate students and two undergraduates — work with relatively large protein molecules, or macromolecules. These molecules are still far too small to be "seen" by conventional methods, but their three-dimensional structure — how the atoms in a macromolecule are arranged — can be determined by techniques such as X-ray crystallography or magnetic resonance spectroscopy, tools that Yao and her team use routinely to "visualize" the proteins they study.

Yao, an associate professor in the Division of Molecular Biology and Biochemistry in the School of Biological Sciences, is investigating the structure and function of lipid transfer carriers, proteins that are essential to many processes inside every human cell. Despite the tiny scale of her research, its implications are huge, for everything from cancer and diabetes to how people age.

"These proteins move greasy lipid molecules from one part of the cell to another," says Yao, who also teaches undergraduate and graduate biochemistry classes. "I tell my students they can think of a cell as a society, and these proteins as the workers, or as the different kinds of machines needed to do different jobs."

Yao, whose research is funded by a grant from the National Institutes of Health, says many lipid transfer proteins also appear to have regulatory functions, turning certain cellular processes on and off.

Yao's research focuses on just one protein, known as CERT, short for ceramide transfer protein. Ceramide is a group of waxy molecules that are important components of the cellular membranes and regulators of a variety of cellular processes. Discoveries regarding how CERT works would most likely apply to other lipid transfer proteins, too. And gaining a better understanding of how CERT works could help combat several diseases.

"For example, there is evidence that CERT is hijacked by pathogens such as Hepatitis C virus for its replication inside the host cell," she says. "That's also true with chlamydia, a sexually transmitted, intracellular bacterium."

It also appears that certain cancer cells make a lot more CERT protein than normal cells to evade chemotherapeutic drugs.

"If we can find an effective way to inhibit CERT, we could develop more effective cancer therapies," Yao says.

She also says such applications would be up to other research teams "down the road." But to a biochemist like her, she is completely satisfied with the basic research of gaining a better understanding and appreciation of the beauty and elegance of the molecules themselves. Her work studying the protein's atomic structure and how that allows it to communicate with other molecules has its own challenges and rewards — and will enable and underpin later-applied research.

Yao, who grew up in China's Henan Province, earned her bachelor's and master's degrees in chemistry at Zhengzhou University. Her father, Qiming Yao, was a chemistry professor there and always pushed her to do her best.

After earning her bachelor's and master's degrees in China, where more industrial technician positions rather than research jobs were available, she applied to U.S. graduate schools, and was accepted to a doctoral program at Iowa State University. There she was inspired by the work of Mei Hong, Ph.D., an assistant professor who became her Ph.D. advisor.

Hong got Yao interested in using nuclear magnetic resonance spectroscopy to determine how atoms were arranged in proteins to form elaborate three-dimensional structures. Yao said she also benefited tremendously from her postdoctoral training in the lab of Mike Rosen, Ph.D., at the University of Texas Southwestern Medical Center in Dallas.

She came to UMKC in September 2010, in part, she says, "because the atmosphere seemed so collegial and helpful, and that has been true. I have many wonderful colleagues." Yao credits UMKC faculty members Samuel Bouyain, Marilyn Yoder and Brian Geisbrecht, who is now at Kansas State University, with helping her advance her use of X-ray crystallography.

It's also clear, watching her display and explain her 3-D molecular models, that she finds her quest for greater fundamental knowledge and understanding of protein structures and cell functions exciting. And she enjoys sharing her enthusiasm with her students and colleagues.

"Why do any of us do what we do?" she says. "It should be because it is fun!"

Meet the researcher

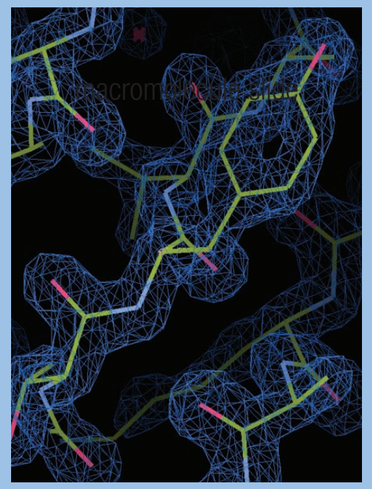
Xiaolan Yao, Ph.D.
Associate professor of molecular biology and biochemistry, School of Biological Sciences

RESEARCH INTERESTS: Using X-ray and magnetic resonance techniques to understand lipid protein macromolecules vital to many cell functions and regulation

JOINED UMKC: 2010

ACCOMPLISHMENT: Secured nearly $400,000 in grants for research involving cellular processes; 2016 UMKC Trustees' Faculty Scholar Award

PHOTO: BRANDON PARIGO



"Seeing" atom by atom

Xiaolan Yao's work involves large molecules, known as macromolecules. Yao uses advanced techniques such as X-ray crystallography and nuclear magnetic resonance spectroscopy to detect how the atoms in a macromolecule fit together. Here are descriptions of two of those techniques:

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

Nuclear magnetic resonance spectroscopy, commonly known as NMR spectroscopy, uses the magnetic properties of some atomic nuclei to determine the physical and chemical properties of atoms or the molecules that contain them. The atoms, when put in a magnetic field, will absorb and re-emit electromagnetic radiation in a way that can be measured and interpreted to figure out its structure. (NMR is also used in medicine for MRI, magnetic resonance imaging.)

X-RAY CRYSTALLOGRAPHY

X-ray crystallography shoots a focused X-ray beam at a crystal at a specific angle and then measures the angles and intensities at which the X-rays are deflected or "diffracted." The data from the diffractions indicate the atomic structure of the crystal. Also known as X-ray diffraction or XRD analysis.

data points

MORE THAN NUMBERS

UMKC IS A RESEARCH UNIVERSITY ON THE MOVE.

UMKC plays a major role in the Kansas City metropolitan area as an educator, employer and research leader. The following data are more than just numbers — they reflect the excellence of UMKC faculty, whose creative endeavors set us apart as a research university and economic engine in the heart of Kansas City.

$150.7 million
Total of proposed projects

222
Number of extramural awards received by UMKC faculty in FY 2017

14
Patent applications filed

415
Number of proposals submitted in FY 2017

$31.8 million
Total research expenditures

$32.1 million
Amount awarded to UMKC research and related projects in FY 2017

57%
Percentage of total dollars coming from the federal government

53.5%
Yield on awarded projects

34
Number of invention disclosures filed in FY 2017

Jeffrey Price, Ph.D., conducts research using fruit flies because their sleep-wake cycle — circadian rhythm — is synchronized by daylight, similar to that of humans. PHOTO: BRANDON PARIGO

Nobel Prize-winning research

by Stacy Downs

Jeffrey Price, Ph.D., associate professor at the UMKC School of Biological Sciences, is an author of two of the seven key publications on circadian rhythms that led up to this year's Nobel Prize in Medicine.

Research in this field contributes to better understanding of the human biological clock, translating into potential therapies to help people who work night shifts which disrupt the body's natural sleep cycle and can alter hormonal and metabolic balance. Studies have associated shift work with high blood pressure, increases in illnesses and injury, mental and emotional strain, and diseases such as diabetes and cancer.

"The biological clock is a powerful force," says Price, who examines fruit flies, which have 24-hour sleep-wake cycles. "Our research may be applicable also, for example, to patients undergoing chemotherapy. Those experienced with chemotherapy have noticed that drugs have more effect during certain times of day."

The Nobel committee awarded the prize to Jeffrey C. Hall, retired from Brandeis University in Waltham, Mass.; Michael Rosbash, Brandeis University; and Michael W. Young, Rockefeller University in New York for their discoveries on the molecular mechanisms that control circadian rhythms. Price worked with Young before he joined UMKC in 1999.

Here are the two publications Price co-authored:

- Price is the primary author on a 1998 paper published in Cell. The paper mentions Price and Young's analysis of DBT, the brain chemical that helps trigger the sleep mechanism that is still the focus of Price's current research. Price and Young worked together for six years from 1989 to 1995 at Rockefeller University.
- Price is second author on another cited paper from 1994, published in Science, about a protein found in the eyes and brain that's blocked by a chromosome mutation that stops circadian rhythms.

"Dr. Price was a very important part of the research that led to these Nobel Prizes," says Theodore White, Ph.D., dean of the School of Biological Sciences. "We are proud to have him and his laboratory as an area of active research in the School of Biological Sciences."

The school recently hired Stephane Dissel, Ph.D., assistant professor, who investigates the circadian clock and stress. Other UMKC faculty in other schools also study circadian rhythms.

"Circadian rhythms are a growing and important research area for UMKC," White says.

International attention

A five-person crew from a television network in Japan filmed a UMKC researcher as part of an eight-episode documentary on the human body.

The crew interviewed Sarah Dallas, Ph.D., the Lee M. and William Lefkowitz Endowed Professor at the UMKC School of Dentistry for its episode on bone. Dallas is a pioneer in the imaging of osteocytes, specialized cells embedded in the bone. Dallas is a key member on UMKC's research team that is exploring osteocytes and how they degenerate as aging occurs.

The documentary will feature experts in their fields from around the world. It is scheduled to be aired in December on NHK, the Japanese public television equivalent of America's PBS and Britain's BBC.

Dallas explains her research to the film crew.

PHOTO: JIM THOMAS

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