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DISCOVER

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RESEARCH | SCHOLARSHIP | INNOVATION



A MATTER OF TRUST

New social robots are coming to our homes, ready to be our household assistants and companions. Dr. Despoina Perouli is studying them to help ensure we don't give away our privacy and security when we let them in.

DISCOVER 2018

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A striking breadth of research and innovation

Welcome to the 2018 edition of *Discover* magazine! Each February I look forward to reviewing the *Discover* proofs, seeing the story ideas that were discussed last fall come to life on the draft pages of the magazine. This year I was especially struck by the breadth of the highlighted research and scholarship. We feature, for example, faculty leading a range of impressive work: leveraging fundamental research on shock forces for wide-ranging applications; exploring privacy concerns created by the emergence of social robots and electronic assistants in our homes; finding modern relevance in both well-known and neglected Enlightenment texts; understanding how opioids impact brain functioning and so much more. And this represents just a selection of the vibrant scholarly work that is so central to the mission of Marquette University — more can be found at marquette.edu/research.

Another important role of academic research is to provide opportunities for our students at all levels to engage in scholarly exploration and applied research in close collaboration with faculty mentors. Graduate students are deeply involved in scholarly work across campus and this year we feature three of our outstanding doctoral students who have received prestigious fellowships to support their research. More stories of graduate student research can be found online on the Graduate School website: marquette.edu/grad/student-success.php.

Three years ago, we launched *Discover*'s "Spark" section to highlight how innovation and entrepreneurship synergize with our research and scholarly endeavors. Last year we featured the opening of the 707 Hub, a major project supported by the university's Strategic Innovation Fund. The hub is now a thriving collaborative entrepreneurial incubator space for students interested in developing new business ventures and novel ideas. This year's "Spark" features innovative work on campus that connects our faculty and students with a wide variety of external communities. We also continue to learn from our campus efforts to create a culture of innovation and develop specifically targeted entrepreneurship support. The Strategic Innovation Fund has been revised into two separate challenge tracks, the Explorer Challenge and the President's Challenge. The Dorm Fund continues to support early-stage entrepreneurial ideas from undergraduate students and the Enterprise Seed Fund, which supported 13 campus-initiated start-up companies, is currently under revision in order to better meet the needs of our entrepreneurs. For further updates, see marquette.edu/innovation.

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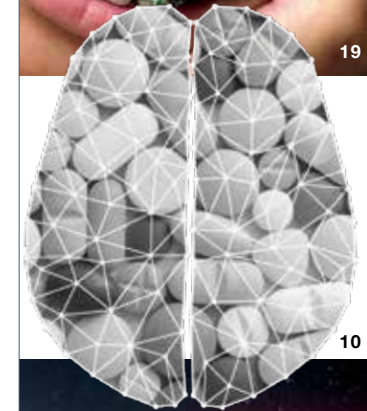
Editor's note:
Faculty titles in this issue of *Discover* are current as of its March 2018 publication, but some featured

faculty members may be promoted to new positions effective fall 2018.

We appreciate your feedback on *Discover*. Please send all comments to the editor at stephen.filmanowicz@marquette.edu.



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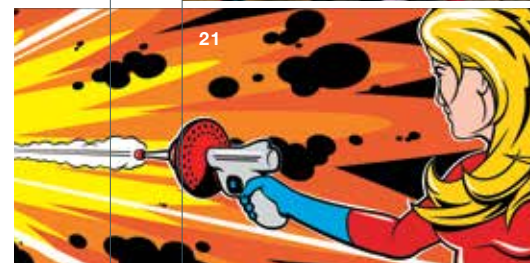
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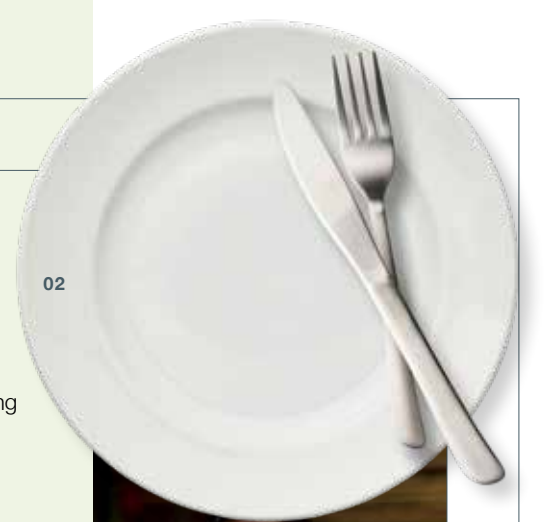
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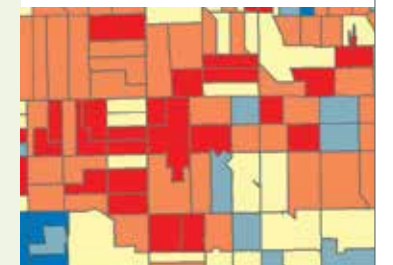
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The main course

Dr. Ryan Patrick Hanley has a knack for making underappreciated Enlightenment texts resonate anew, as he showed by test-driving Kant's rules for the dinner party as a model of civil discourse.



By Matt Hrodey

The Adventures of Telemachus may be the best-read book you've never heard of. Written by French Archbishop Francois Fénelon of Cambrai, it sold more copies in France in the 18th century than any book but the Bible and spawned more than 10 English prose and poetry versions. But in recent decades, it's largely been overlooked, making it a good candidate for rediscovery by Dr. Ryan Patrick Hanley, Mellon Distinguished Professor of Political Science.

Hanley's current Fénelon project — encompassing both translation and a monograph, and supported by a prestigious National Endowment for the Humanities fellowship — fits a pattern for a scholar with a pronounced knack for finding neglected texts, shining a bright analytical light on them and plumbing them for contemporary relevance.

After all, it was Hanley, a political theorist and accomplished scholar of 18th-century philosophy, who used an obscure find to put to practical use the ideas of Immanuel Kant, one of the most influential philosophers of the Enlightenment and beyond. Guiding a group of students through an undergraduate seminar on Kant, who is known as a challenging read, Hanley remembered little-known rules the philosopher had created for making the dinner party a forum for edifying discussion between people with different viewpoints and beliefs.

Before long, Hanley had secured a private room at the now-closed Karl Ratzsch in downtown Milwaukee, ordered shareable plates of traditional German fare, and had his excited seminar students on board to test out Kant's rules. Since the group must not split off into side conversations, participation is limited to three to nine people, and a decorum of respect and benevolence is mandatory. Plus, secrecy is the rule. What is said at a Kantian dinner generally stays there, encouraging people to be more open.

So Hanley can't repeat what was discussed during the first event. But it went well, he says. "It turned into a very interesting way to bring Kant's philosophy to life." Interesting enough to prompt a series of six similar dinners — open for public sign-up — at two local restaurants in 2016, with funding from the Wisconsin Humanities Council. Again, Kant's rules were validated. "We live in a culture where everything is mediated by the screen," Hanley says, "For all the good they bring, they do make our opponents anonymous to us."

With his interest in Enlightenment political theory and the historical events that shaped those ideas, Hanley

is a well-known expert on Adam Smith, the 18th-century thinker whose *The Wealth of Nations* is often considered the first major work of modern economics. While Hanley hasn't unearthed any lost texts by Smith — he's a heavily discussed and written-about figure, after all — the Marquette professor has drawn attention to Smith's neglected religious philosophy, which prefigured important work by Kant and other thinkers. With support from an earlier NEH fellowship, Hanley did this in his 2009 book on Smith, *Adam Smith and the Character of Virtue*, which he followed with the collection, *Adam Smith: His Life, Thought, and Legacy*, in 2016, which he edited.

Smith was the most important early theorist on free markets and coined the term "invisible hand," as it applied to the movements of markets — and not of God, then a more common usage. At the same time, Hanley has argued, Smith was one of the earliest formulators of Enlightenment-influenced religion, arguing that morals should trump ceremony, and religion exists, in part, to reinforce our natural sense of duty.

Did *Telemachus*, as a deep exploration of morality, influence Smith? Hanley says it's possible but not yet known for sure. For his current project, the professor has translated selections of the text himself from French into English and written an analytical monograph on the book, which follows the story of Ulysses' son, as he goes on his own journey accompanied by a figure named Mentor (possibly the origin of the English word) who advises him. For a scholar like Hanley, there are philosophical riches along the way, including what he sees as a fascinating early and innovative perspective on economic justice. Upon encountering a city with a self-obsessed, Louis XIV-style ruler, Mentor declares that there must be a philosophical revolution, of sorts, an overhaul of the city's manners, tastes and laws.

Fénelon's ideal government, led by a wise but also practical philosopher king, addresses the problem of poverty and of extreme economic inequality but throws the port open to free trade, a controversial policy at the time. The French church official sought a way to weave virtues and morality and practicality together, and this very nuanced approach is part of what excites Hanley about Fénelon, another historic figure he sees as wildly understudied.



Mellon Distinguished Professor, Political Science

Dr. Ryan Patrick Hanley

RESEARCHER

a career on fire

Dr. John Borg leverages vast expertise in shock forces to answer critical engineering questions and maybe even point the way toward stronger airplane wings. But first he had to listen to his mother.



By Erik Gunn

Dr. John Borg grew up taking everything apart, fiddling with his Erector Set and shooting off model rockets fueled by black powder extracted from shotgun shells. His mother ordered him to quit the pyrotechnics, then called him in from outside one day: “Were you messing with explosives again?” she demanded with a stern look.

Amazed at her psychic power, he asked how she knew. “Your shoelace is on fire,” she replied.

His mother had him pegged to become an engineer. And although Borg initially declared a finance major in college, he took only engineering classes. In his junior year his finance faculty adviser transferred his file to the engineering department. From there, he built a career of true distinction in mechanical engineering, one influenced in its own way by his backyard experiments with explosives. “He has established an international reputation in the area of the dynamic behavior of materials undergoing impact and shock processes,” said Marquette President Michael R. Lovell, an accomplished mechanical engineer himself, when presenting Borg with the Lawrence G. Haggerty Faculty Award for Research Excellence, Marquette’s highest research honor, in April 2017.

Borg, professor and chair of mechanical engineering, describes his core research subject as sand — how it and other earth materials “behave in the extreme.” He translates: “I’m interested in things that when they smash into each other, they start to melt.” Current projects include two funded by the U.S. Department of Defense, both of them “pure research” with wide-ranging applications, Borg says.

One leverages his knowledge of the effects of shock forces on materials to study new ways to make stronger, lighter “engineered microstructures.” To combine two or more substances into something stronger, a standard approach is to mix them in powdered form and bake under enormously high pressure. The problem: The powder melts together, then cools into a denser mass, defeating the goal of “stronger and lighter.”

Supported by a \$402,440 federal defense grant, Borg and a graduate-student team replace the heat with

shock waves. “A shock wave, as it passes over, can heat and cool in microseconds,” he explains. That way, the grains melt and fuse only at their surfaces, preserving the finer-grained nanostructure. If successful, the technology could open the door to better ways of making strong, light and flexible products — such as aircraft wings.

The second project, supported by a \$270,000 defense grant, takes place entirely in virtual space, as Borg runs computer simulations to test how countless variations in design and material specifications for virtual cylinders change the outcome when they are “exploded,” also virtually.

“The exploding cylinder problem” is a long-standing materials science tool that helps produce real-world answers about everything from fuel tank explosions to designs for auto bodies, bumpers or airbags. Crashworthy cars aren’t designed to come out of a wreck unscathed, Borg points out: “You want your car to fall apart around you and absorb that energy, and you’re left sitting in the road untouched.” Exploding cylinder calculations inform designs that make that outcome possible.

The simulation he’s running looks at how countless small changes in cylinder dimensions, materials and other factors affect the results. But rather than seeking new answers to the cylinder problem, his real aim is to test the accuracy of the computer simulation itself.

Borg’s wide-ranging work, and the regard of his colleagues, contributed to the 2017 Haggerty award. “I was very surprised and flattered,” he says. “It was something I wasn’t expecting.”

The award also clearly reflects a drive to advance science and a non-stop curiosity that’s led him to study topics as far afield as the motion characteristics of the knuckleball (see sidebar) and to value collaboration across a wide array of disciplines. “I don’t want just mechanical engineers,” he says. “I want physicists. I want chemists. I want materials scientists. Get them all in a room, and you can really do something.”



Understanding the knuckleball


Dr. John Borg’s research has taken him down many paths, but just one project got the attention of 60 Minutes.

Nearly a decade ago, Borg and then mechanical engineering graduate student, Mike Morrissey, Grad ’09, put aside ballpark rivalries (Borg rooting for the Brewers, Morrissey for the Cubs) for a joint project studying the physics of the knuckleball.

Thrown in a way that minimizes spin and boosts turbulence, the knuckleball is storied for its erratic motion beading toward the plate. And in those days, pitcher R.A. Dickey, then a Brewers minor leaguer, was causing a stir by throwing not the usual “four-seam” but instead a “two-seam” knuckleball — so-called based on what’s seen from the side as the ball hurtles forward.

Borg and Morrissey interviewed Dickey by phone and then used the university’s wind tunnel to research why the two styles acted so differently. Both pitches are disrupted by distortions in air pressure at the seams, albeit each differently. The four-seam pitch looks like “more of a butterfly dancing,” says Borg. The two-seam style has “one big break” — typically downward, ideally just before crossing the plate, almost guaranteeing a whiff. It’s also “a little less predictable,” says Morrissey.

The project had perfect timing. “Our research came out when Dickey (by then a New York Met) won the Cy Young Award,” says Borg, which led to the 60 Minutes spot and calls from the Discovery Channel and Popular Mechanics. And the pitch is no longer an oddball variant, says Borg. “Now everybody’s throwing two-seams.”

A portrait of David DeFilippis, a young man with dark hair and a slight smile, wearing a dark blue V-neck shirt. He has a large, detailed tattoo on his left arm. The background is dark and out of focus.

FAST OUT OF THE BLOCKS

ARMED WITH PRESTIGIOUS FELLOWSHIPS, THESE RESEARCHERS ARE RUSHING TO HELP THE WORLD BETTER UNDERSTAND FERTILITY RISKS, CHANGING RAIN FORESTS AND HOW TO TRAIN MUSCLES. OH, AND THEY HAPPEN TO BE GRADUATE STUDENTS.

By Jennifer Anderson

DAVID DEFILIPPIS

David DeFilippis has always been a handy guy to have around. Before college, he worked as a diesel mechanic, a welder and a woodwind instrument repairer, always enjoying the mental challenge of solving mechanical problems. When a freshwater sciences professor during his undergraduate years at the University of Wisconsin–Milwaukee complained about having to take water samples by hand, DeFilippis built him a machine that did it automatically.

So it's not too surprising that DeFilippis has turned inventor again, now that he's studying for his doctorate in biological sciences at Marquette and engaged in an ambitious research effort studying competition between woody vines, or lianas, and indigenous trees in Panamanian rain forests. His latest invention — an electronic dendrometer — automates another laborious task: hand-measuring daily changes in the growth of these vines and trees, much to the appreciation of his team members.

Supported by the Graduate Research Fellowships Program of the National Science Foundation, DeFilippis focuses on the research project he's conducting in collaboration with Dr. Stefan Schnitzer, Mellon Distinguished Professor of Biological Sciences, who has led research in Panama for decades. Vines are integral to maintaining a diverse community of wildlife in the rain forest, says DeFilippis, acting as interwoven

highways for insects and animals to move between trees. But the lianas are often detrimental to the trees, stealing sunlight and water while simultaneously crowding them out for space. As tree cover thins, forests suffer in their capacity to act as "carbon sinks" that offset emissions caused by burning fossil fuels.

Wrapping around tree trunks and vine stems like a rubber band, DeFilippis' devices measure daily changes in circumference, as influenced by water supply, a process known as diurnal fluctuation. Equipped with the inexpensive wireless technology found in garage door openers, they upload measurement data to a cloud server. As he's worked on welding and gluing dozens of dendrometers for deployment this spring, DeFilippis has also developed a program that will synthesize the data and convert it into graphs. These visualizations will improve his team's ability to envision what's in store for the rain forest, comparing how trees and vines tolerate extended dry seasons and understanding the broader environmental impact of vines spreading at the expense of trees.

"Marquette has been extremely supportive about accommodating my research," says DeFilippis. "This project has been an amazing combination of technology development, environmental studies and biology. I can't imagine being able to do this anywhere else."



TERESA HARDY

Theresa Hardy was in the thick of working on her doctorate in the College of Nursing when she visited her sister, who was studying for her own doctorate in Scotland. While there, and almost on a whim, she reached out to a professor at the Queen's Medical Research Institute whose work had loomed large in her own research, reproductive endocrinologist Dr. Richard Anderson. He agreed to meet with her for a half hour at his out-of-the-way Edinburgh office.

Although they'd never spoken before, this brief meeting was the start of a fruitful collaboration. Hardy's doctoral program focus is on how stress can affect women's fertility, and Anderson had written some seminal papers on female reproductive potential. In addition, he had something researchers in the field treasure: a ready population of women who were already part of a long-term fertility study. Anderson was so intrigued by Hardy's research that he invited her on the spot to return for a longer stay in Scotland working alongside his team.

With the invitation from Anderson and support from her adviser at Marquette, Dr. Donna McCarthy, professor of nursing, Hardy applied for and received a prestigious National Research Service Award from the National Institutes of Health. The grant enabled her to spend a year in Scotland and Ireland, both working with Anderson

investigating results from the women in his study and teaching at University College Dublin's nursing school. A grant from the Oncology Nursing Society Foundation also supports her work.

Hardy's work examines how elevated levels of cortisol, the main hormone released by the adrenal gland in response to stress, can impact women's reproductive potential over time. Using cutting-edge techniques that gauge cortisol levels in saliva and hair, she can determine whether the subject has experienced chronic stress. Hardy then homes in on a protein hormone secreted by follicles in the ovaries — the Anti-Müllerian Hormone or AMH — which is a molecular biomarker of reproductive potential because it reflects the size of women's egg supply, or "ovarian reserve." (Since all of the women in Anderson's longitudinal study are cancer survivors, cancer treatments are one potential source of chronic stress in their lives.)

Aiming to better identify which women may be at the highest risk for infertility, Hardy also wants to understand what can be done to reduce that risk. "Infertility affects 15 percent of women in the United States, but we still don't really understand what causes it. Ultimately, if we can predict the risks of infertility, we can tailor treatment protocols to reduce them."



CHRISTOPHER SUNDBERG

As a tight end for the University of Wyoming Cowboys, **Christopher Sundberg** was already playing at a Division I level, but the question of how he could become a better football player still consumed him. "My passion for biomedical research originated in that initial desire to improve my performance on the field," says Sundberg. "We know exercise is one of the best things we can do for ourselves, but we don't really understand why."

Sundberg is set to earn his doctorate in clinical and translational rehabilitation health sciences later this spring, and he is spending his remaining months studying the mechanisms of neuromuscular fatigue in health, disease and aging. As a recipient of a National Research Service Award from the National Institutes of Health, he's able to focus exclusively on his goal of identifying how age-related loss of muscle mass and increased fatigability result in a reduced ability to perform everyday activities, a loss of balance and a decreased quality of life for the elderly.

"Something seems to happen to people around the age of 70; they lose muscle mass and fatigue much more rapidly than before," explains Sundberg. "I want to understand why that is and how to prevent it."

His hypothesis is that older-adult muscles are less efficient and more sensitive than young-adult muscles to the

depressive effects of fatiguing metabolites that collect in the fibers. The accumulation of these metabolites makes the dynamic muscle contractions necessary for everyday living more difficult. Sundberg is testing this theory in two ways: first, by studying fatigue at the level of the single muscle fiber through muscle biopsies, and second by using magnetic stimulation to measure whether the amount and origin of fatigue differs with age or gender during dynamic muscle contractions.

Sundberg's research benefits from the rare opportunity to work with two professors from different disciplines: Dr. Sandra Hunter, professor of exercise science, and Dr. Robert Fitts, professor emeritus of biological sciences. Examining cellular muscle biology with Fitts and neuromuscular physiology with Hunter, Sundberg is able to employ a translational approach of studying fatigue at both the single fiber level and within the entire neuromuscular system. He is optimistic that these studies will eventually translate into the design and testing of novel exercise interventions for adults as they age.

"Marquette is the ideal location for my training," explains Sundberg. "It provides the rare opportunity to be trained concurrently in techniques at the forefront of the fields of cellular muscle biology and whole-body neuromuscular physiology."

Rewired Circuits

Dr. Matthew Hearing finds his alma mater the ideal place to investigate how opioid addictions change the brain.

By Jesse Lee

Nearly 15 years ago, Dr. David Baker, professor and associate chair of biomedical sciences, spotted unique drive and scientific curiosity in Matthew Hearing, then an undergraduate running experiments in Baker's lab on the neurobiology of cocaine addiction. With Baker's guidance, Hearing went on to study at the Medical University of South Carolina — the "addiction science hub of the country," Hearing says — where he received his doctorate in 2010.

Hearing, H Sci '03, eventually returned to Marquette to join Baker's department, where he is an assistant professor and a fellow addiction researcher. But first, he made a couple of timely observations that would help him specialize in a type of addiction that was about to explode into a staggering public health crisis.

While at the University of Minnesota for a postdoctoral fellowship, Hearing saw opioid abuse skyrocketing and addiction researchers struggling to find theories to explain why. "I saw an obvious need to fill gaps in opioid research," he says. "I recognized that we categorized addiction generally, across multiple classes of drugs, in just one basket.

"There was also almost nothing out there from a research standpoint in the area that I wanted to look at, which is neuroplasticity." So Hearing saw his opening to conduct much-needed research.

Simply put, neuroplasticity is the idea that the brain is always changing based on environmental factors and behaviors. From changes involving individual neurons to larger

remappings of neural pathways, neuroplasticity allows the brain to compensate after injury, for example.

But the brain can also be altered through actions like drug use, and not all drugs have the same effect. "Generally, there is some degree of overlap in neuroplasticity across all addictive drugs. The same circuits, those responsible for controlling decision-making and behavior, are the circuits that are affected," Hearing says.

"However, we have seen in the lab with opioids, when given in the same regimen as a drug like cocaine, the plasticity does seem to be stronger and to involve more neuronal pathways. This could be one explanation as to why opioids seem to have more of a hold over people who are addicted compared to other drugs."

Genetic and environmental predispositions also lead people to start using drugs in the first place, says Hearing, which then makes addictions more likely. "People used to write it off as a decision the person made to become addicted, but we know better than that now," he says. "Addiction is ultimately a brain disease."

With a predisposition toward addiction and the neuroplasticity that occurs as an addiction forms, a person's brain undergoes often irreversible changes.

"My concern is that opioid users don't understand the permanent effect they're having," he says. "People think if they are able to stop using, everything should reset. We know now that is absolutely not true, which is what ultimately leads to relapse."

Working alongside several Marquette neuroscientists at the forefront of opioid addiction research, Hearing focuses on how neuroplasticity contributes to the development and persistence of addicted behavior. Supported by a \$1 million grant from the National Institute on Drug Abuse, his plan is to build from the basics: how opioids affect plasticity in the nucleus accumbens (the brain's reward system) and the prefrontal cortex (important for decision-making).

Hearing uses technology such as optogenetics, which allows him to manipulate animal neurons in real-time using light, in order to identify

changes in the brain at the level of a single cell. His goal is to develop a new treatment for people with opioid addiction, which could include neuromodulation of affected areas, or basically using the brain's own predisposition toward plasticity to help it heal. "Ultimately we want to discover what adaptations occur during use that lead to physical dependence and withdrawal," Hearing says. Given the extreme physical and mental withdrawal symptoms affecting those who abruptly stop pain medications after long periods of use, "we need to find ways to counteract the changes in the brain that are causing those symptoms."

Once a mentor and now a colleague, Baker calls understanding the biological basis of opioid addiction a paramount priority of modern biomedical science and says, "Matt and his research group are establishing a leading program that will meaningfully contribute to the understanding and treatment of addiction."

"My concern is that opioid users don't understand the permanent effect they're having. People think if they are able to stop using, everything should reset. ... That is absolutely not true."

Assistant Professor, Biomedical Sciences

Dr. Matthew Hearing



RESEARCHER



A MATTER OF TRUST

New social robots are coming to our homes, ready to be our household assistants and companions. Dr. Despoina Perouli is studying them to help ensure we don't give away our privacy and security when we let them in.

By Dan Simmons



Kuri resembles a robotic penguin and can be programmed to play hide-and-seek and read stories to the kids. Olly looks like a technicolor doughnut and can look into your eyes and read your current mood. JD, all arms and legs, can dance and do push-ups. These future-is-now robots are three examples of what are being called electronic home assistants, part of a fast-moving and explosively growing industry that could make such social robots as ubiquitous as smartphones in the next decade.

But do they have a dark side? Could their cameras, sensors and artificial-intelligence capabilities turn them into horror-movie Santas, who see you when you're sleeping and know when you're away? Could hackers or criminals co-opt the networks on which the devices operate, gaining access to bank accounts and capturing video of intimate moments at home?

These questions inspired Dr. Despoina Perouli, assistant professor of mathematics, statistics and computer science who focuses on cyber security, to put the technology to the test. She has been awarded a two-year \$175,000 grant from the National Science Foundation to conduct research in four main areas related to the security and privacy of users of social robots. "This is really a new era, and a new area of research," she says, as she embarks on work to poke and prod the devices' cloud-based data network systems, deputizing a wide array of testers, from high schoolers to seniors in assisted living centers.

Perouli took interest in the topic in past collaborations with Dr. Andrew Williams, who directed the former Humanoid Engineering and Intelligent Robotics Lab at Marquette before taking a position at the University of Kansas. Williams has researched the potential of these new devices to serve human needs in education, health and other areas. Seeing how they work — typically operating over Wi-Fi

systems and sharing data collected by sensors, cameras and microphones with a cloud-based hub hosted by the company that makes them — got Perouli thinking. "The idea came to mind: How secure are they?" she says. In digging into the question, she found comparatively little research exists on how to keep users safe and their data secure.

A cyber security expert, Perouli was hired at Marquette in part to help open and run its growing Center for Cyber Security Awareness and Cyber Defense. It represents one big piece of the university's move to establish itself as a

"THE SOCIAL ROBOTS DIFFER FROM MORE TRADITIONAL COMPUTING DEVICES ... RELYING ON CURRENT SECURITY PRACTICES IS NOT GOING TO NECESSARILY SOLVE ALL IMPORTANT PROBLEMS."

national leader in the growing field of data sciences. The university wants to be ahead of the curve not only in researching what's-now technology, but also what's next. And for Perouli, market indicators clearly point to our world — at home, work and in public — going robotic.

"The social robots differ from more traditional computing devices, such as laptops and smartphones, on several aspects: Mobility, sensors, use and computing power are some of them," Perouli says. "Therefore, relying on current security practices

is not going to necessarily solve all important problems."

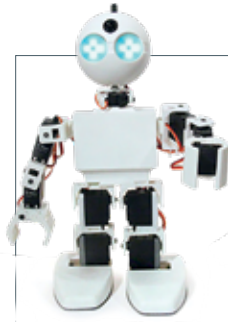
With smartphones, for example, their portability means they are with us as we move about, constantly transmitting our location data to service providers, although controls for how that information can be used are fairly strict and well-established. Social robots raise unique new issues, such as what happens to the words they record as they wait passively to hear their "wake up" word. Or how much does their role as helpful or even intentionally "cute" anthropomorphic partners lead users to trust them with sensitive information, without thinking where that information may end up?

Perouli's research will play out both in the laboratory and in public. A major lab component has already been completed,



Dr. Despoina Perouli, Assistant Professor, Mathematics, Statistics and Computer Science

RESEARCHER



which Perouli describes as testing and identifying how the devices compare with tablets and smartphones in security vulnerabilities and threats. She's not able to share how that research was conducted or results, as it's currently in the process of being considered for publication. One aim is eventually to develop algorithms to help robots detect and self-police when they overstep their roles and violate users' security and privacy. What happens, for example, when cameras or microphones are left on when they're not intended to be on?

"From a security perspective, these are very interesting interactions," she says.

Perouli will be field-testing the devices by putting a group of people in a room with a wide range of home robotic

devices — JiBo, Kuri, JD, Amazon Echo Show, Google Home — and essentially saying, "Go!"

After the interactions, testers will be surveyed on how comfortable they felt around the devices, what security alarms went off and whether they'd consider sharing sensitive information, such as credit card numbers. It will be repeated at assisted living facilities, where social robots could become always-on-call helping hands for caregivers.

"We want to hear from real people of all ages," Perouli says. With the feedback they give her, Perouli will evaluate whether humans and their futuristic hard-plastic assistants can develop the ingredient crucial to sustain any relationship: trust. Without it, the relationships will continue, but with that dreaded status: It's complicated.

Digital Detective

Dr. Aleksandra Snowden looks at the map of Milwaukee on her laptop screen. As little blocks representing census tracts change color or shape depending on which factors she selects — type of crime, time of day — she thinks of old-time crime shows, the ones where deputies gathered by a wall map dotted with pushpins.



"We no longer have to push pins into walls," she says with a laugh. "Things are more efficient. But the questions are still the same. Where are the crime hot spots? What can we do about them?"

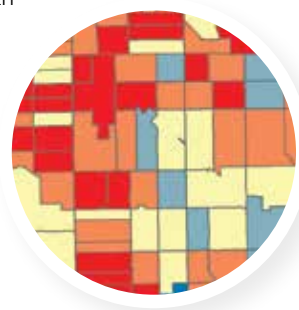
Snowden, a criminologist and recently hired assistant professor in social and cultural sciences, focuses her research not just on where crime occurs, but what other neighborhood dynamics correlate with crime — namely, alcohol availability at taverns or liquor stores. "When we don't look at alcohol availability, we are less able to explain the crime patterns," she says.

Examining 2014 crime data in Milwaukee, she discovered that about half of police calls related to violent crime occurred in just six of the city's 190 neighborhoods. "We can investigate what's going on there," she says. "What are some of the dynamics and factors?"

As a sophomore at Indiana University, Snowden took a class on urban crime patterns that inspired her to follow her chosen path as a researcher. Getting hired at Marquette has "provided a perfect opportunity to apply what I learned as a student." One reason: Milwaukee's unusually high crime rate. Another reason: Milwaukee's unusually strong commitment to GIS (or geographic information systems), with an elaborate research-friendly infrastructure and reams of data, especially as it relates to crime, publicly available online.

"As a researcher, I think that violence matters," she says. "We can work together to try to figure out how to solve it."

Snowden will expand her research this year, working with the Frank Zeidler Center for Public Discussion to interview mothers in Milwaukee's most violent neighborhoods. Marquette's Office of Community Engagement will fund the project, and Zeidler staff will facilitate the interviews using questions developed by Snowden based on her research. "Having the information from community members is going to be incredibly valuable," she says. Putting faces and stories to the dots on her maps can only help her understand — and move toward reducing — the problems. **DAN SIMMONS**



RESEARCH IN BRIEF



A REGION GETS ITS CLOSE-UP

MAP examines Milwaukee with an unprecedented level of polling and demographic analysis.

Marquette University Law School launched an ambitious project in 2012. Thanks to the work of Dr. Charles Franklin, a nationally respected pollster and professor of law and public policy, the Marquette Law School Poll has become the largest public opinion polling effort ever undertaken in Wisconsin, a state consistently found in the middle of national politics.

But the poll is just one aspect of a wide-ranging, 11-year-old public policy initiative, now supported by a \$7 million endowment, that regularly opens the doors of Eckstein Hall to the community for discussions on the biggest issues of the day. In October, the Law School unveiled its latest big-picture public policy undertaking: the Milwaukee Area Project, a comprehensive look at what's happening, and why, within the region Marquette calls home.

And if you don't think any of this seems like the kind of programming that would fit into a typical law school, you're right: Marquette isn't your typical law school.

Under Dean Joseph D. Kearney, the Law School has reached well beyond its primary role of legal education to serve as a modern-day public square for the community. A recent \$5.5 million gift to the Law School from Milwaukee philanthropists Sheldon and Marianne Lubar supports this commitment, adding to a previous gift of \$1.5 million from the couple and establishing the Law School's Lubar Center for Public Policy Research and Civic Education. The Milwaukee Area Project is the Lubar Center's first major initiative.

"While polling is often focused on the 'horse-race' questions of which candidate is ahead, the Marquette Law School Poll has always devoted more than three-quarters of our questions to public policy issues and topics about people's personal situations," says Franklin, a long-time member of ABC News' national election night team and a frequent source of analysis for local and national media. "The Milwaukee Area Project is a step further, focusing entirely on how people live their lives and what they think of the present and future of the Milwaukee area. We ask about work, commuting, opinions of neighborhoods, schools and policy decisions in the region. These opinion data are then joined by economic and demographic data to paint a rich portrait of the entire region."

Setting a baseline for future polling, the first Milwaukee Area Project poll found residents sometimes divided, but also concerned about the well-being of the region as a whole. Asked about economic conditions in their community, 9 percent rated them excellent, 42 percent good, 33 percent fair and 14 percent poor; and on race relations in their community, 18 percent described them as very good, 45 somewhat good, 20 percent somewhat bad and 14 percent very bad.

CHRIS JENKINS

Find MAP's latest polling results at law.marquette.edu/poll.



Dr. Charles Franklin
Professor, Law and Public Policy

RESEARCHER



HARD TIME, MODEL EMPLOYMENT

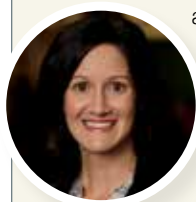
A unique study of a prison workplace shows how much respect means to workers in challenging situations.

To better understand the concept of respect in the workplace, Dr. Kristie Rogers needed a setting that allowed her to explore this “significant phenomenon under rare or extreme circumstances.”

She chose a women’s prison.

The assistant professor of management has been interested in and studying workplace respect since she was a doctoral student at Arizona State University. For her, the existing research was troubling.

“More than half of people don’t feel respected at work, yet the research also shows that — to an overwhelming majority of people — respect is more important than money or advancement,” she says. “It just didn’t add up for me.”



Setting out to build a new theory, Rogers went behind bars to study Televerde, a company that employs inmates at a state prison to perform professional business-to-business marketing services. Prisons, she says, are environments where lack of respect is most apparent.

“My goal was not to understand how an average employer gives or withholds respect cues,” Rogers points out, “but to find a company that does this exceptionally well and examine respect dynamics in their purest form.”

In her study, “Seeing More Than Orange: Organizational Respect and Positive Identity Transformation in a Prison Context,”

published in 2017 in *Administrative Science Quarterly*, Rogers and her co-authors linked respect to important employee outcomes such as job performance, personal well-being and identity change. While respect is universally desired, the authors found it is especially highly prized when employees feel some threat to their identity, reputation or status.

“The prison is a great example of this,” Rogers says. “But there are other situations that would prompt an intensified desire for respect in traditional organizations, such as newcomers seeking to prove themselves, those working in low-status occupations, employees of a company with a reputation that suffers publicly, or those working for a company that is acquired and are feeling unsure about how valued they will be.”

For the prisoner-workers Rogers studied, she says feeling respected at work gave them a safe way to transition into something better. “Feeling they add value gave them the freedom to reconstruct the way they thought of themselves,” she says, adding that Televerde got it right by consistently encouraging positive identity changes in their workers. After all, how employees see themselves drives their behavior at work and in other areas of their lives.

Further research bears that out: As of 2015, the average recidivism rate among prisoners was around 45 percent; for Televerde employees, it was 8.7 percent.

CHRISTOPHER STOLARSKI

Assistant Professor, Management

Dr. Kristie Rogers

RESEARCHER

DEBRIEFING FOR BETTER NURSING

The inventor of the gold standard for drawing meaning from student nursing simulations trains her research lens on a new challenge.

Because the time nursing students get in hospitals for their rounds and clinicals is highly restricted, they benefit from a major advance in nursing education: well-equipped facilities like Marquette’s Wheaton Franciscan Center for Clinical Simulation where they engage in real-time clinical scenarios ranging from surgical recovery to emergency cardiac care, all under the watchful eye of experienced faculty members.

But it took a post-scenario debriefing method developed by Dr. Kristina Thomas Dreifuerst, associate professor of nursing, to ensure that students translate these simulation experiences into nursing knowledge and clinical reasoning. Dreifuerst’s Debriefing for Meaningful Learning model provides a structured method for nursing professors and students to discuss a simulation using the Socratic method of dialogue. It’s proved so influential since its debut less than a decade ago that it’s now in use at more than 300 nursing schools worldwide.

And not surprisingly, as a recognized international authority on debriefing techniques, Dreifuerst continues to set the pace in this field. On the research front, Dreifuerst is undertaking her second major project for the National Council of State Boards of Nursing, after serving as consultant for the organization’s National Simulation Study, published four years ago when she was on the faculty at Indiana University–Purdue University Indianapolis.

While that original study looked at the use of simulation in pre-licensure nursing programs, a new study — supported by a \$300,000 grant from the NCSBN — takes a similar gauge of clinical experiences in U.S. family nurse practitioner programs. The grant is Marquette’s first from the prestigious oversight organization.

“We chose the family nurse practitioner program to study because of all the nurse practitioner programs, it has the widest scope of practice,” Dreifuerst explains. “These practitioners see patients from birth to death — and it is the largest type of NP program. It has the greatest impact on overall quality of care,” Dreifuerst explains.

Tapping social media and other marketing techniques to recruit participants, Dreifuerst and her co-principal investigators at George Washington University and Widener University are on track to reach their aim of surveying 1,000 faculty and 4,000 current or just-graduated students from these programs, asking online questions about patient care during their clinical experience to identify what experiences are missing. Anticipating the publishing of findings in spring 2019, Dreifuerst says, “Once we can pinpoint the gaps, we can target specific, well-designed interventions that may include simulations.”



A post-scenario debriefing method to ensure that students translate simulation experiences into nursing knowledge and clinical reasoning, Dreifuerst’s model has proved so influential that it’s now in use at more than 300 nursing schools worldwide.



Dreifuerst leads students in a debriefing, a critical reflection that’s as important as the clinical simulation that precedes it.

Associate Professor, Nursing

Dr. Kristina Thomas Dreifuerst

RESEARCHER



RHYME WITH REASON

Children's poetry can be fun and cute, but for Dr. Angela Sorby, it's also a serious subject that just may be essential to our survival as a species.

According to Dr. Angela Sorby, professor and interim chair of English, it's no accident that children are some of the world's most avid consumers of poetry. Although they tend to "experience poetic pyrotechnics as play," rhyme and repetition are essential tools for language acquisition and literacy. As they delight over nursery rhymes, or staples such as Dr. Seuss' *Green Eggs and Ham* or Shel Silverstein's *Where the Sidewalk Ends*, they're actually taking crucial steps in their development.

Since first growing interested with the association of childhood and poetry in graduate school, Sorby has conducted research that advances children's poetry as a subject worthy of academic scrutiny. Her first book, *Schoolroom Poets*, is oft-cited in poetry circles, and by invitation she wrote the children's poetry chapter of the *Cambridge History of American Poetry*, the inclusion of which is a sure sign of progress, she says.

As part of her work, Sorby is also interested in the overlooked but meaningful use of cuteness in literature. Often seen as a trivial aesthetic, cuteness is important, she believes, because it triggers forms of adult engagement that ensures the survival of individual babies and ultimately of the species. "When a verbal or visual artifact

strikes a cute pose, it is demanding, 'Notice me, play with me, nurture me,'" she says. Through a study of 19th-century American poets, Sorby is documenting the use of cuteness as a serious literary tool. In her forthcoming article, "A Dimple in the Tomb" in the literary journal *ESQ*, she writes: "The many cute tropes and images in Emily Dickinson's tiny, deliberately awkward verses have long been noted and dismissed as embarrassing lapses. I argue that Dickinson uses cuteness sparingly but seriously and strategically to demand attention, invite playfulness, and to stage power relationships."

Sorby's scholarship isn't all child's play, of course, or is it? With Sandra Kleppe of Hedmark University of Applied Sciences in Norway, she is co-editing a book on poetry and pedagogy to which she will also contribute a chapter analyzing how literary data is like and unlike chemical data to discover the point where poetry and chemistry overlap. And she's teamed up with a Chinese scholar to tackle a paper about children's poetry in mid-20th-century China and the United States.

"Interestingly," she reports, "we've found that children immersed in these two very different literary traditions delight in the same things: patterns, surprises, formal turns, rhyme and meter."

GUY FIORITA



Dr. Angela Sorby
Professor and Interim Chair, English

RESEARCHER

ALIGNMENT ACCELERATOR?

Testing whether orthodontic laser treatments are really a faster route to a straighter smile.

What orthodontics patient wouldn't smile at the idea of faster treatment? Along with the cosmetic concerns and discomfort of wearing braces, there is research linking lengthy orthodontic treatment with increased risk of cavities and gum recession.

Clinical devices that promise to hasten tooth movement are on the market, some harnessing laser technology's stimulatory effect on bone regeneration. But Dr. Ghada Nimeri, D.D.S., assistant professor of orthodontics in the Marquette University School of Dentistry, says studies on the effectiveness of lasers are inconclusive, and their mechanisms of action in periodontal tissue are poorly understood.

Some findings show that low-level laser therapy irradiation, or LLLT, accelerates initial-stage tooth movement by two to three times, but Nimeri says inconsistent therapeutic dosages across studies has yielded "contradictory results and weak evidence" to support these claims.

Her proposal for a more consistent approach was awarded a \$20,000 grant from the American Association of Orthodontists Foundation in 2017. Nimeri's goal is to pinpoint optimal wavelengths, intensity and duration of LLLT irradiation, in pursuit of more effective clinical applications. She's particularly interested in learning more about the cellular- and molecular-level biological response to LLLT exposure in periodontal ligaments, the connective fibers that help anchor teeth to bones.

"We want to understand what really happens in the cells," what laser exposure activates to catalyze faster or slower tooth movement, says Nimeri, who earned her dental degree and a doctorate in biointerface science and biomaterials in her native Sweden, and joined the School of Dentistry in 2016 after an orthodontics residency at the University of Alabama at Birmingham. To do so, she is cataloging the effect of laser treatments on cell-proliferation rates, collagen production and level of gum inflammation.

Studies supporting a potential role for LLLT in reducing orthodontics pain and preventing relapse after treatment have also applied the therapy inconsistently, leading to inconclusive evidence, Nimeri notes. She says her work at the molecular level can help clarify the therapy's potential in these areas. "We always look at new technology and want to see the effects and what it can help us with," Nimeri says. "Laser has been used now in a lot of medical fields. I want to see if laser can be a real benefit for (orthodontics) in the future."

PAULA WHEELER



With inconsistencies plaguing claims that laser irradiation accelerates tooth movement, Nimeri aims to pinpoint optimal wavelengths and dosages in pursuit of improved treatments.



Dr. Ghada Nimeri, D.D.S.
Assistant Professor, Dentistry

RESEARCHER

NURTURING THE LIFE OF THE MIND AND SOUL

A scholar goes inside the design of today's student residential communities.

It is a centuries-old idea staging a strong comeback: College students living in intentionally designed communities that transcend standard residence halls. Encouraging the sharing of classes, meals, extracurricular activities and study, these settings have roots in the "residential colleges" of Oxford and Cambridge, a model overlooked in this country during the 20th century in favor of designs that had students holed up in dorm rooms, interacting only intermittently with hall mates.

But a rediscovery of these living learning communities that began in the 1980s has gained steam as studies point to their advantages. In concise terms, they "promote academic and social integration, ultimately deepening students' learning," says Dr. Jody Jessup-Anger, associate professor of educational policy and leadership.

Jessup-Anger, who was named one of five emerging scholars by the American College Personnel Association in 2010, reached this conclusion through a research journey that began with her doctoral dissertation on how these communities enhance students' proclivity for learning. In an extensive scholarship review published in the *Review of Higher Education* in 2012, she examined how residential colleges "inspire the life of the mind." And next is a book advancing a "research-based model for design, delivery and assessment" of these communities, due out this year.

It is this larger project that inspired an unusual new direction in Jessup-Anger's research — a fall 2017 sabbatical at a Milwaukee architecture firm, Workshop Architects, that plans and designs living learning communities around the country including the Rev. Robert A. Wild, S.J., Commons, currently under construction at Marquette. Jessup-Anger was given an office at Workshop and direct involvement with the staff — observing a working-learning environment, as it were. The sabbatical has, practically speaking, given her a "more keen understanding of how to promote collaboration," she says, thanks to Workshop's open space design and flexible work spaces that enable teams to work side by side.

In addition to yielding new insights into the physical demands of the modern student environment, Jessup-Anger's Workshop sojourn has helped this Marquette scholar see the Ignatian concept of *cura personalis*, the care of individuals as unique and whole people, in a new light. "Given the dimensions LLCs bring to the life of the mind in students, it's a natural extension to think of how they can nurture the life of the soul."

ANN CHRISTENSON, CJPA '90

ANN CHRISTENSON, CJPA '90



Encouraging the sharing of classes, meals, extracurricular activities and study, these settings have roots in the "residential colleges" of Oxford and Cambridge, a model overlooked in this country during the 20th century.



Jessup-Anger's sabbatical included a residency at Workshop Architects, a specialist in student residential communities.

Associate Professor, Educational Policy and Leadership
Dr. Jody Jessup-Anger

RESEARCHER



GO FORTH AND PROSPER

In Dr. Amanda Keeler's research, science fiction reveals models for what could be a better future.

In the genre of science fiction, strange worlds force the audience to think about what could happen in their own future, perhaps pointing the way toward either a utopian society or post-apocalyptic tragedy.

In her research, Dr. Amanda Keeler examines how these different science fiction scenarios reflect our current world and how their imagined futures may help model a better future. "It's an art form that helps us learn about our world," says Keeler, assistant professor of digital media and performing arts. "I think at this point, viewers have expectations that ... this is a forward-thinking media that thinks outside of contemporary parameters."

Her office environment reflects her passions, surrounding her with posters from TV shows like *The Twilight Zone* and *The X-Files*, old movie cameras, film reels and other analog movie-making equipment. Two vintage radios indicate an additional interest that yielded published papers in the last couple of years exploring early radio's educational aspirations and current efforts to preserve early broadcasts.

Growing up, Keeler soaked up all of the *Star Trek* franchise, including the original series, the movies, and as many *Star Trek: The Next Generation* reruns as she could catch after class when she was in high school. Today, she turns a critical eye to modern science fiction and television, such as the new *Star Trek: Discovery*.

Keeler is currently at work on an article examining what happens when women drive the narrative action and are central figures of power within the *Star Trek* structure. "When people see themselves in those characters, it can give them a path they maybe didn't think about before," she observes. "It's about what it means when women are at the center of the narrative ... the constant fight to have that visibility."

This article contrasts the newest *Star Trek* series with the original, which was lauded for forward-thinking storytelling, featuring women and people of color, albeit in characters who were never in command or given much development. It fits a pattern that Keeler is looking at — whether science fiction writers are transcending expectations with their narratives, "taking risks with that storytelling and breaking out of the contemporary moment."

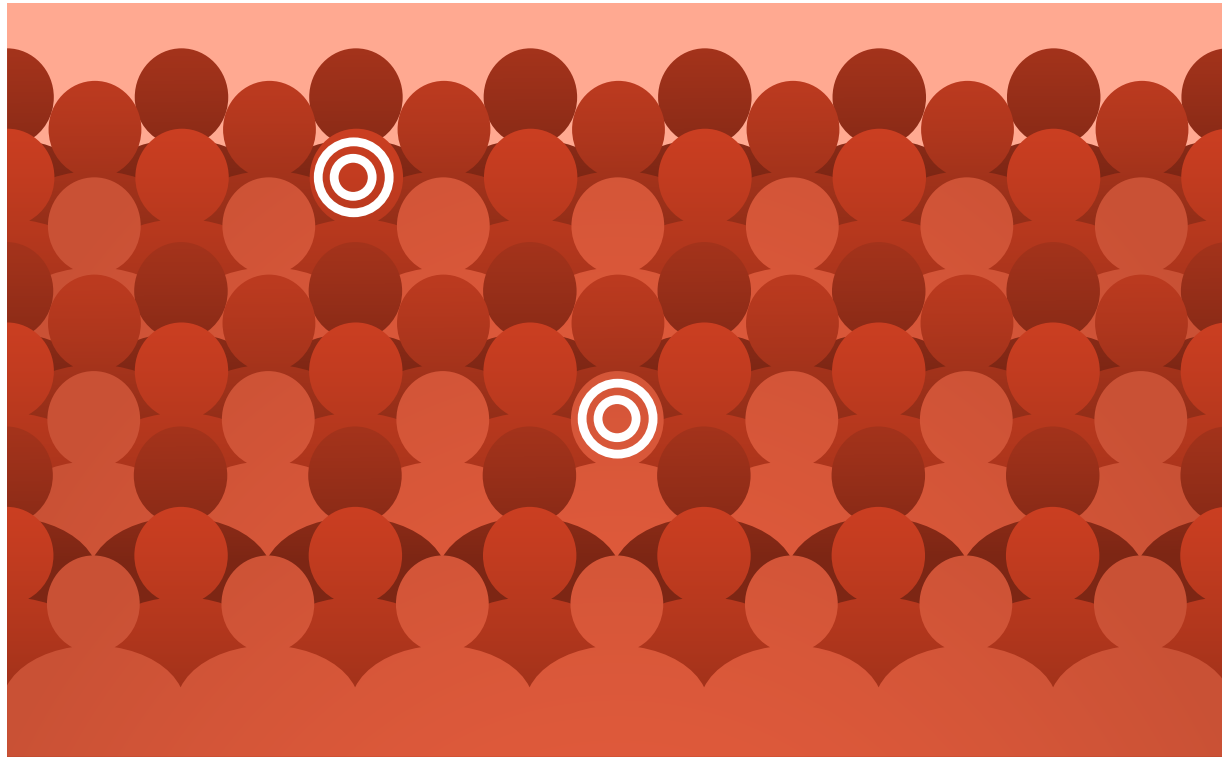
Ultimately, Keeler believes that science fiction taps into a human desire to discover the possibilities of a different world, which forces us into a closer examination of what we think we know about everything. "We're at a Jesuit institution, and some here are very involved in their faith," Keeler says. "And I know there's always that eternal human search for something bigger than themselves."

TIM CIGELSKE, COMM '04



Assistant Professor, Digital Media and Performing Arts
Dr. Amanda Keeler

RESEARCHER



DETECTING THE PATTERN

Could a hard-to-treat childhood speech disorder be better understood as a procedural learning problem?

At one to two cases per thousand, childhood apraxia of speech, or CAS, is classified as a rare disorder. But at that rate, it wouldn't be unusual for a large elementary school to have a case or two, notes Dr. Jenya luzzini-Seigel, assistant professor of speech pathology and audiology. "If you think about it, one to two kids per thousand isn't that uncommon. We need to find ways to accurately identify and treat children with this disorder."

CAS presents with a variety of speech symptoms that can be difficult to diagnose. Children in this population also tend to have language impairments and difficulty with fine and gross motor skills. And since symptoms can vary by child, CAS is often diagnosed belatedly or missed altogether.

luzzini-Seigel believes a common thread may connect children with CAS, however, and could make the disorder better understood and more identifiable. "Procedural learning is the implicit learning of patterns, and we use this process to learn speech, motor skills and grammatical patterns" she says. "I believe a procedural learning problem affects these children and drives these varying symptoms. Without the ability to learn sequences, they're not picking up motor skills, speech or language."

A grant from the Childhood Apraxia of Speech Association of North America is enabling luzzini-Seigel to study this hypothesis, and her preliminary findings are positive. Conducting a straightforward test, her team asks children to touch a puppy that appears in one of four squares on a touchscreen, first in a randomized order and then in a predictable sequence.

While children with typical development become faster at finding the puppy over the course of the test, children with apraxia require many more trials to learn the sequence. "We're seeing that the children with apraxia do have more difficulty with procedural learning," she says.

Given more trials, children with apraxia in her test ultimately do learn the sequence and get faster in identifying it, suggesting there is hope in treatment, albeit more intensive treatment than that of other speech disorders. luzzini-Seigel's goal is to find standardized types of treatments that are effective. "There are few evidence-based treatments for kids with apraxia," she says. "Right now we're exposing as many kids as possible to our treatment protocol to see if it works for a variety of children with this disorder, and so far, it's working for a lot of them. It's a great start."

JESSE LEE



Dr. Jenya luzzini-Seigel, Assistant Professor, Speech Pathology and Audiology

RESEARCHER



SURVIVORS' MENTALITY

Research center puts emphasis on stroke rehabilitation.

With boosted support for stroke prevention and treatment research from the National Institutes of Health, survival rates continue rising. Yet research into stroke survivors' rehabilitative needs lags behind.

That's a shortcoming the Stroke Rehabilitation Center of Southeastern Wisconsin, a partnership of Marquette University and the Medical College of Wisconsin, tackles directly as one of the few stroke centers in the country specializing in interdisciplinary research and clinical programs to improve the long-term functioning of these patients.

As the 2-year-old center pursues advanced investigatory strategies — such as using brain imaging to guide rehabilitation and developing therapeutic interventions for movement control — it leverages impressive combined institutional resources. Images from a 3-Tesla MRI scanner at MCW's Center for Imaging Research, for example, are analyzed using the high-performance computing clusters of Marquette's Integrative Neural Engineering and Rehabilitation Laboratory (and other campus labs), which model the work of billions of brain connections.

Still such innovations are just part of the center's holistic approach. "The SRC is a comprehensive center in which education, clinical services and community outreach are integral to the mission," says Dr. Brian Schmit, Eng '88, professor of biomedical engineering and center co-founder. "We have an active community-academic advisory board, educational programs that place physician fellows and residents in Marquette research laboratories, and a new specialty clinic in stroke rehabilitation at Froedtert Hospital."

FUND THE NEXT GREAT EXPLORATION.

Marquette has always fostered spirited dreamers and dedicated problem solvers — those with the passion for discovery. We are, after all, named for an explorer. Here, researchers pursue answers to seemingly unanswerable questions, tackle new challenges, and work to find solutions to problems yet to fully surface. A gift in support of research and innovation may inspire something remarkable. Join the exploration; your support can Be The Difference.

To support research and innovation at Marquette, contact Kelley McCaskill at kelley.mccaskill@marquette.edu or 414.288.1590.



**MARQUETTE
UNIVERSITY**

BE THE DIFFERENCE.

SPARK

Stories of the Marquette community igniting innovation and entrepreneurial spirit.

Faculty, staff and students at Marquette are on a quest for new knowledge, new tools and new ways to reduce health and educational inequities.

1 Digitizing Scholarship

Data and technology become the ally of scholarship in the Raynor Memorial Libraries' digital lab.

2 South Pole Scientist

Subatomic neutrinos are best observed at the South Pole, where Dr. Karen Andeen does her work.

3 Across the Data Divide

Faculty members help ease a computer science teacher shortage in Milwaukee schools.

4 Power Assist

A powerlifting professor helps Central American women lift their way to empowerment.

5 Team Equity

As Marquette takes a collective look at health inequities, this guide tracks faculty-driven partnerships.



Using historical maps, databases and digital displays, students involved in the Near West Side History Project made Mary Faye Brown, Nurs '29, the guide of a detailed tour of the neighborhood around Marquette during the 1920s.

DIGITIZING SCHOLARSHIP

In a library lab, students put technology to use making history and other subjects come alive.

1 It's 1923, and senior nursing student Mary Faye Brown's parents are in town and want to check out the bustling neighborhood around Marquette. She's taking them on a tour of the Near West Side, and thanks to new tools at the expanded Raynor Memorial Libraries' Digital Scholarship Lab, we're able to join them as they visit Albert Heath and learn how he quickly transformed a small grocery store on 20th and Wells into one of the largest delicatessens in the city.

As part of a larger Near West Side History Project, undergraduate students created the block-by-block tour, using sources such as city directories and Sanborn fire insurance maps. With their professor, **Dr. James Marten**, chair of the History Department, students met librarians from the Digital Scholarship Lab, who helped them use electronic tools such as the Omeka web publishing platform and CartoDB mapping software. The outcome was student-driven scholarship that innovates in how it creates, shares and stores information, says Marten.

Open since June 2016 in lower-level space made available by the shrinking footprint of increasingly digitized periodicals and microforms, the lab aims to combine access to important

digital tools with "friendly expertise, creative spaces and an energizing, supportive environment," says **Janice Welburn**, dean of libraries. While equipment in the lab includes a stunning interactive touchscreen monitor that dwarfs students, many powerful tools — such as Microsoft's Power BI business analytics program or the Tableau data visualization app — can be accessed from computers anywhere.

What's really needed is expert help navigating this technology, and that's where **Elizabeth Gibes**, digital scholarship librarian, and her team enter the picture. This wasn't exactly the job she trained for as a graduate student in library and information studies, but it's definitely the future of scholarship, says Gibes, as seen in recent student projects such as a map plotting the spreading of the polio epidemic in New York City in 1916, and "Marching On," a senior journalism capstone project that looks back at 200 days of marching for open housing in Milwaukee in the late '60s. "The students come in with the ideas and a laptop," says Gibes, "and we help them learn how to be savvy consumers of knowledge and creators of digital projects."

EDGAR MENDEZ, GRAD '14

2 At the South Pole, with temperatures hovering near minus 100 degrees Fahrenheit in the winter months, the sun rises and sets just once a year. At an altitude of 10,000 feet, the 100 scientists and support staff working there can experience altitude sickness and trouble breathing. Twenty pounds of clothing and gear weigh down those who venture outside. Despite these harsh conditions, working at the IceCube Neutrino Observatory is seen as a golden opportunity.

Scientists are considered lucky to go once; **Dr. Karen Andeen** has been twice. Andeen, an assistant professor of physics now in her third year at Marquette, has been involved with IceCube since her days as a graduate student at the University of Wisconsin–Madison. There, she helped build some of the observatory’s 5,160 digital optical modules, which she later tested and deployed into polar ice. Together the modules form the world’s largest neutrino detector, stretching 2.5 kilometers below the South Pole’s surface.

A collaboration involving 300 scientists in 12 different countries, the project is designed to observe particles called neutrinos, a nearly massless, subatomic particle thought to be produced by powerful cosmic events like a black hole or an exploding star. No one has been able to observe high-energy astrophysical neutrinos before; they hardly ever interact with anything and have no electric charge. When they do interact, they create a cone of blue glowing light, called the Cherenkov effect. In the ice, the index of refraction is higher than in the air, making ice-based experiments more likely to detect this light. “With the clearest ice in the world, the South Pole is the ideal location for the detector,” explains Andeen. Operating in its completed configuration since 2011, IceCube is now in a data-collecting phase. Andeen and her students help analyze some of the 100 gigabytes of data transmitted via satellite every day from IceCube (with vastly more carried out by hand at the end of the season). In Marquette’s Wehr Physics Building, she is also building and testing prototype detector panels for future deployment. With no graduate students in the department, undergraduate students are heavily involved in testing and analyzing data from the prototypes.



Being able to focus on teaching is one of the reasons Andeen and her husband **Dr. Tim Tharp**, also an assistant professor of physics, chose to settle at Marquette. “We wanted to be able to research but also be able to focus on teaching

undergrads, so Marquette is a really perfect fit,” she says. After meeting at UW–Madison, the couple spent a few years in Geneva, Switzerland, where both worked on separate projects at the CERN particle physics laboratory. Now back in their native Midwest, the couple can be close to family while remaining connected to their scientific passions — Tharp’s continued antimatter research in Geneva and Andeen’s research a hemisphere away at the South Pole.

MARTINA IBÁÑEZ-BALDOR, COMM '15

SUBATOMIC SCIENCE AT THE SOUTH POLE

Dr. Karen Andeen’s quest to understand elusive neutrinos takes her deep into the polar ice.

Ice Cube

BY THE NUMBERS

- 100 scientists and support staff on site during peak season
- 100 average temperature (Fahrenheit) during winter months
- 20 pounds of clothing and gear needed to venture outdoors



ACROSS THE INFORMATION DIVIDE

Training enough computer science teachers to have one in every Milwaukee public school.



A Marquette training course helped teacher Michelle Young bring computer science instruction to her school.

3 Michelle Young teaches science and computer science to eighth graders at Rufus King International Middle School in Milwaukee. But growing up, she actually disliked science.

She's hardly alone. Women and people of color, like Young, have long been under-represented among those taking computer science courses, says **Dr. Dennis Brylow**, associate professor of mathematics, statistics and computer science at Marquette. That's why he and colleagues are working to change the perception that opportunities in this promising and lucrative field are primarily for white, suburban boys.

To do that, Brylow and Dr. Marta Magiera, associate professor of mathematics, statistics and computer science, have partnered with Milwaukee Public Schools to help build a corps of new elementary and middle school computer science teachers in the district. Supported by a \$1 million grant from the National Science Foundation, this three-year partnership begun in 2017 is on its way to preparing 200 teachers in computer science instruction. That's enough to train one teacher for every elementary, middle and high school in the district, Brylow says.

This new MPS-focused effort extends an ambitious effort more broadly targeting the shortage of computer science instruction in elementary and secondary schools. It's an alarming nationwide problem that hasn't spared Wisconsin, where 80 percent of primary and secondary schools don't have even one computer science teacher. So over the last seven years, programs launched by Brylow and Magiera have enrolled over 1,000 teachers

from around the state, including Milwaukee, in a short course preparing them to teach computer science.

As part of the new effort, Young joined fellow teachers from MPS last summer for a five-day training course at Marquette that immersed them in coding, developing algorithms, creating apps and other tasks. Four Saturday workshops followed so teachers could share classroom experiences and advice.

For her students to become future coders and programmers, it's important they see someone who looks like them at the head of the class, says Young. "It's a matter of exposure," she says.

That outcome fits the sense of mission Brylow now feels around expanding computer science education. Through the work of teachers such as Young, he says, "We could help give access to tens of thousands of students in the state to computer science education and have a real impact."

GEORGIA PABST

Nurturing STEM

Marquette faculty members are leading two other high-powered efforts to improve science, technology and engineering education in grades one through 12.

- Supported by a \$1.5 million NSF grant, *Biomedical and Mechanical Engineering Associate Professor Barbara Silver-Thorn and colleagues are creating a 14-month master's program through which current college graduates will become licensed STEM teachers, with scholarships underwriting much of their graduate study. College of Education faculty members Drs. Ellen Eckman, Leigh van den Kieboom and Jill Birren are co-principal investigators on the project.*
- Magiera, associate professor of mathematics, statistics and computer science, is researching knowledge of mathematical reasoning and communicating mathematical ideas in middle school teachers, and testing ways to improve these reasoning and communication methods for future teachers. A prestigious, \$792,000 NSF CAREER grant supports this five-year project.



After powerlifting showed Dr. Noelle Brigden (left) a path through chronic pain and the emotional demands of researching violence against Central American migrants, she started a program to share her passion with Salvadoran women seeking personal empowerment. She also placed third in a San Salvador competition, behind Guadalupe Cabrera Baires (center) and Veronica Reyes (right).

POWER ASSIST

A professor and champion powerlifter starts a Salvadoran strength-training program to empower women working to transcend violence and poverty.

4 It's not unusual for faculty members to win awards, but **Dr. Noelle Brigden**, assistant professor of political science, added a unique notch in her belt with two winning powerlifts — a 275-pound deadlift and a 150-pound bench press — at the 2017 Wisconsin State Fair.

The sport is more than a recreational sideline for her. Brigden picked up powerlifting both as a remedy for chronic pain from an earlier spinal cord injury and as a balm for emotionally demanding research. Brigden studies borders, violence and human security, and began lifting after conducting two years of in-person doctoral research on violence against Central American migrants during their passage across Mexico. Weight training served as a metaphor, she says, "for what I could carry, in terms of the stories that people had trusted me with during my research." To give back to the region she continues to study, she recently created a three-week powerlifting program for women in El Salvador.

Reluctant to leave their children unattended in cities that rank among the world's most violent, Salvadoran women often provide for their families by turning to entrepreneurship. Economic status, gender inequality and machismo, however, are just a few of the obstacles in their way. Brigden's partner organization, the nonprofit Programa Velasco in San Ramón, supports these women on their journey to become financially independent entrepreneurs, offering resources such as mentoring, workshops and family support.

Debuting in December, Brigden's powerlifting program was a hit, with a grandmother in her 60s claiming the title of star student among the 14 women who participated. The professor is returning to lead another three-week course this spring, encouraging more Salvadoran women to find sources of self-esteem and strength within themselves and continuing Brigden's mission promoting the "revaluing the female body as a source of strength, and not just beauty."

KALEY ROHLINGER, COMMUNICATION STUDENT

TEAM EQUITY

Get to know several of the Marquette faculty members working to create more equitable health outcomes.

The Marquette community is taking a deep dive this year on the difficult drive to achieve health equity. Leading the way, this year's Marquette Forum is hosting lectures, discussions and other events around the theme of "Fractured: Health and Equity." Faculty members (many of them forum participants) are also tackling health disparities and social determinants of health through their community-engaged research and engagement. Here's a guide to a few leading efforts:

Empowering patients with health literacy

In 20 years as a health care provider, educator and volunteer in local hospitals and community clinics, Josh Knox, Grad '11, associate clinical professor of physician assistant studies, saw the unfortunate consequences of "patients not understanding how to access the health system, being confused about utilizing medications for acute and chronic disease management, and being unable to institute preventive self-care."

So a spirit of "if not me, then who?" drives his work with colleague Dr. Abiola Keller, assistant professor of nursing and a fellow physician assistant, to increase health literacy in Milwaukee's underserved communities. With Amy Vuyk, Grad

'95, the pair are bringing an evidence-based health literacy curriculum, the HEAL Program, to two urban medical clinics, Bread of Healing and Repairers of the Breach.

Originally developed by Literacy for Life, an innovative adult literacy organization in Williamsburg, Virginia, HEAL trains providers and volunteers to lead patients in discussing topics such as managing medicines, caring for upper respiratory infections and identifying the difference between the common cold and

the flu. With support from the nocPA Health Foundation and the Mal and Jill Hepburn Foundation, this curriculum is now being adapted for Milwaukee clinics serving local low-income and homeless adults.

"Health inequities rob people of educational, economic and social opportunities,"

says Keller, H Sci '01. "Literacy skills are one of the strongest predictors of health status. Addressing low health literacy provides a unique opportunity to eliminate a key barrier to high quality and equitable health care."

Promoting equity in dental health

Disparities in dental health can result from issues as basic as lacking transportation to a dental office, prioritizing other health care needs over dental care, lacking insurance or having difficulty navigating government assistance programs, says Dr. Christopher Okunseri,

Grad '10, professor of dentistry. So following his recent study of access to dental sealant treatments among low-income and minority children,

he is working on two projects: studying access to dental care in Wisconsin through a \$84,815 grant from Delta



Dental Insurance, and examining immigrant children's oral health and disparities with funding from the National Institutes of Health. "You have to be healthy to be successful, to be able to make a meaningful impact on society," says Okunseri in discussing the long-term aims of his research.

Addressing equity on the neighborhood level

Aware that healthier neighborhoods create healthier residents, Dr. Angelique Harris, an associate professor in the Department of Social and Cultural Sciences, has worked on multiple initiatives that spur greater health in local communities including an intervention program that helped

community members make healthier lifestyle choices and another focusing on challenges and contributing factors as-



When the **Youth Empowered to Succeed** program began offering mentoring and athletic training in swimming, biking and running five years ago, only a few of the middle-school-age participants were physically active, and none could swim or bike. Last summer, the same students competed in USA Triathlon's Youth National Championship in Cleveland, Ohio. A partnership with Milwaukee's United Community Center and its Bruce-Guadalupe School funded by a \$1.05 million federal grant, the program comprehensively targets rising rates of obesity, youth diabetes and associated chronic diseases, as well as overall academic achievement. Marquette President Michael R. Lovell recognized Dr. Paula Papanek (left), H Sci '99, director of the Exercise Science Program in the Department of Physical Therapy, with a 2018 Difference Makers Award for her work as principal investigator of the program.

sociated with obesity among African-American women.

Continuing her work with a \$5,000 grant from Marquette's Civic Dialogue Project, Harris promotes dialogue and advocacy around social justice topics, including those that are health related.

New attention on Latino and Latina health

A little over two years ago, Dr. Lisa Edwards, professor of counselor education and counseling psychology, and

Dr. Lucas Torres, associate professor of psychology, launched Marquette's Latina/o Well-Being

Research Initiative with the goal of bringing together partners to address disparities in mental health and physical health care, as well as immigration issues, the neighborhood and the role of family.

The research duo's next step is to supply a missing piece of the mental health puzzle by conducting the first-ever, in-depth survey of Latinas and Latinos in Milwaukee about their mental health needs and mental health care experiences. Since Latina/os were previously underrepresented in broader community surveys, this focused effort could lead to groundbreaking findings and new ideas to improve health and equity issues as they affect Latina/os.

SARA RAE LANCASTER

"Health inequities rob people of educational, economic and social opportunities."

Dr. Abiola Keller

2018 Marquette Research News

Research road map

A visionary guide for capital investments over the next 10 to 20 years, Marquette's 1.5-year-old campus master plan is already transforming Marquette's environs.

The new Athletic and Human Performance Research Center rising at 12th and Wells streets is just one sign of the plan's attention to research and innovation — a priority very much in tune with the university's strategic plan, which includes "Research in Action" as one of its central pillars. Based on a careful future-needs assessment and much stakeholder input, the plan envisions many research-oriented improvements, with two deserving special mention:

- The planned BioDiscovery District would bring together two of the university's top-funded research departments — biomedical sciences in the College of Health Sciences and biological sciences in the College of Arts and Sciences. The state-of-the-art complex will help the two programs realize new collaborative

synergies while replacing outmoded research facilities siloed in separate buildings.

- Innovation Alley is envisioned bridging Engineering Hall on one end with a new home of the College of Business Administration on the other end, creating a vibrant interdisciplinary space where faculty and students from these colleges (and others) engage in solutions development and other creative

and entrepreneurial endeavors with corporate partners who will maintain presences there.

To see images of what's envisioned, search online "Marquette campus master plan."

UPDATES

Clearing the fog

The groundbreaking work of **Dr. James Kincaid**, Grad '74, professor and chair of chemistry, and his research group — using resonance Raman (RR) spectroscopy as a "freeze frame" technology to reveal the inner workings and fleeting intermediate states of important enzymes — will continue for the next four years through a new project funded by a \$1 million grant from the National Institutes of Health. Extending a 30-year comprehensive study of so-called heme enzymes, which collectively orchestrate a range of crucial physiological functions, this newest project focuses on two enzymes involved in steroid metabolism: namely, CYP17 and CYP51, both current drug targets for various diseases, including prostate cancer and atherosclerosis.

While the study of these membrane-bound enzymes has been complicated historically by their tendency to aggregate in solution, obscuring molecular definition, this research program addresses that problem with an innovative nanodisc technology. Kincaid says this solution not only "provides an environment mimicking the natural cell membrane," but also enables synthesis of unique constructs where the enzyme is closely associated with its natural or

alternative reductases to catalyze important physiological reactions. "It's a clear window into what is usually a foggy view," says Kincaid.

Get your imaging results and your radiation dose

Discover has been there as **Dr. Taly Gilat-Schmidt**, associate professor of biomedical engineering, has advanced research to improve diagnostic imaging quality and reduce patient radiation exposure. Now with nearly \$2.5 million in support from the National Institutes of Health, Gilat-Schmidt has launched a complementary effort to better measure CT radiation dosages to patients.

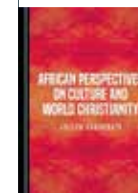
The four-year study is critically needed. The estimated 76 million CT scans performed in the United States each year account for half the radiation delivered to patients by medical procedures. Yet existing automated tools to measure radiation dosage do not model a patient's anatomy and can be off by 40 percent or more in some cases.

Working in collaboration with the Medical College of Wisconsin, Varian Medical Systems and Children's Hospital of Wisconsin, Gilat-Schmidt will use expertise from the radiation and radiation oncology fields to develop algorithms that take into account scanner and anatomical complexities, making possible accurate, rapid and personalized organ-level radiation reporting as part of every CT scan.

COMPILED BY STEPHEN FILMANOWICZ AND JOE DIGIOVANNI, JOUR '87



Marquette Bookshelf



African Perspectives on Culture and World Christianity, by Dr. Joseph Ogbonnaya, assistant professor of theology, delves into the relationship between culture and Christianity, and examines the extent to which

Christianity is indigenous to individual regional cultures, rather than descended from migrants.



Decolonial Approaches to Latin American Literatures and Cultures, co-edited by Dr. Tara Daly, assistant professor of Spanish, engages with the theoretical concepts of decolonialism and coloniality in the context of Latin American literary and cultural studies.



The Greatest Mirror, by Dr. Andrei A. Orlov, Grad '04, professor of theology, traces the origins of the idea of a heavenly double — the angelic twin of an earthbound human — back to early Jewish writings, primarily by exploring the Jewish pseudepigrapha or falsely attributed works.



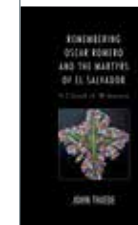
Ireland in an Imperial World: Citizenship, Opportunism, and Subversion, co-edited by Dr. Timothy McMahon, associate professor of history, examines how the British Empire shaped Irish society at home, while Irish men and women shaped and undermined the Empire overseas.



Perla was originally written in French by Frédéric Brun and has now been translated to English by Drs. Sarah Gendron and Jennifer Vanderheyden, associate and assistant professors of French, respectively. It is the story of a woman who survived the Holocaust, written posthumously from her son's point of view.



The Prado: Spanish Culture and Leisure, 1819-1939, by Dr. Eugenia Afinoguénova, professor of Spanish, uses Spain's most iconic art museum as a medium for the nation's political history, and explores its relation to the monarchy, society and the church.



Remembering Oscar Romero and the Martyrs of El Salvador: A Cloud of Witnesses, by Rev. John S. Thiede, S.J., assistant professor of theology, calls for an expanded definition of martyrdom, by elaborating on four case studies of murders in El Salvador, most notably the six Jesuits killed at Universidad Centroamericana in 1989.



Teaching the Entrepreneurial Mindset to Engineers, co-authored by Dr. Lisa Bosman, research assistant professor in the Opus College of Engineering, explains what "the

entrepreneurial mindset" is and why it matters to engineers and engineering students, while providing educators with tools and strategies for incorporating it into their curricula.



Visions of Sainthood in Medieval Rome: The Lives of Margherita Colonna by Giovanni Colonna and Stefania, co-edited by Dr. Lezlie Knox, associate professor of history, presents the first English translations of texts detailing the life of Margherita Colonna, a religious order leader beatified by Pope Pius IX. The translation offers insights into 13th-century notions of religion, gender and piety.

PUBLICATION SPOTLIGHT



God is Not Nice, by Dr. Ulrich Lehner, professor of theology, challenges the benevolent pop culture conceptions of God, offering an iconoclastic reminder of the true God who is "unpredictable, awe-inspiring, and demands our entire lives." Written for a general audience, as well as academics, the book has been cited in publications ranging from

The Washington Post to *The Weekly Standard*. Writes Rod Dreher in *The American Conservative*, "God Is Not Nice is a must-read book for parents, religious educators, and ordinary Christians who want to be free of the cardigan-wearing pushover deity of American pop culture, and introduce themselves to the radical greatness of God."

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