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wisconsin engineer

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The MnDOT Autonomous Shuttle Bus Pilot Project hopes to change public transportation with electric, driverless vehicles.

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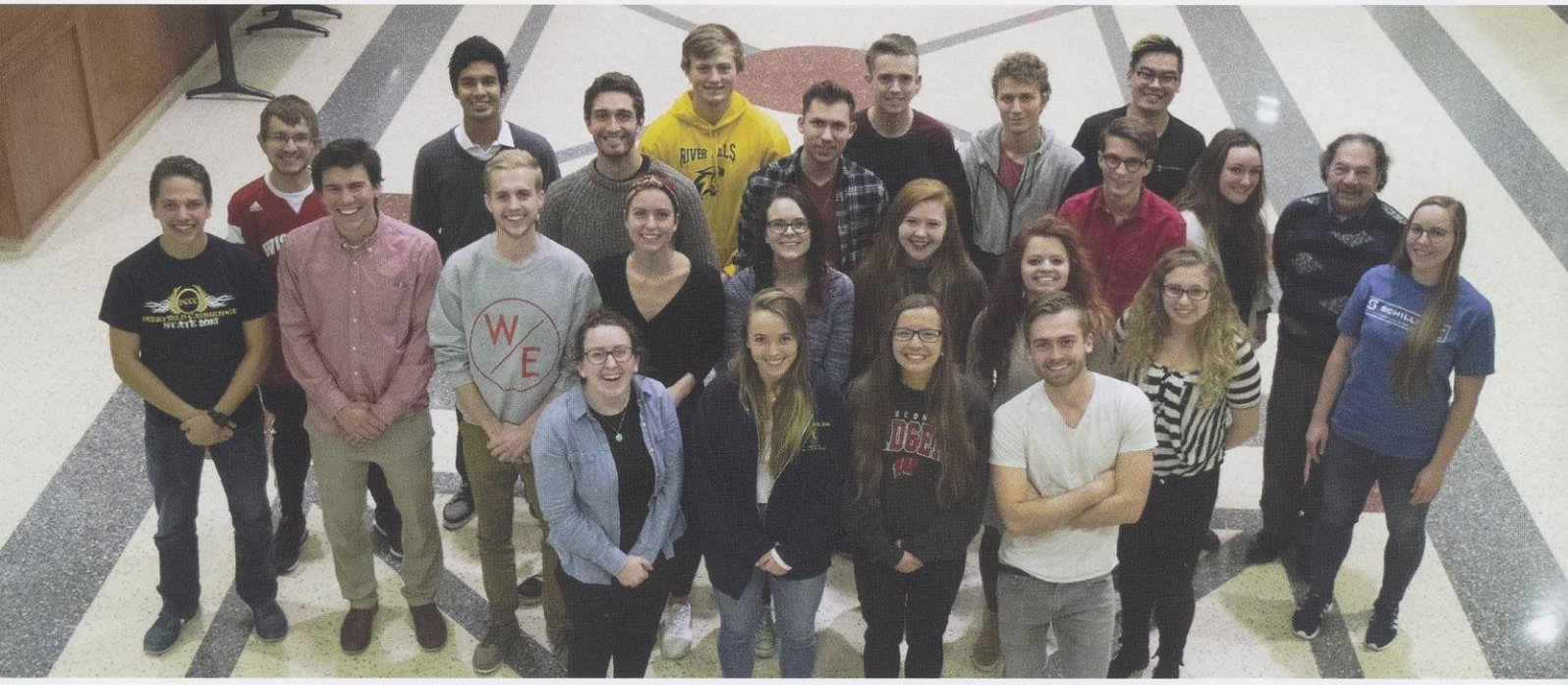

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General

Cover photo by Jason Hakamaki

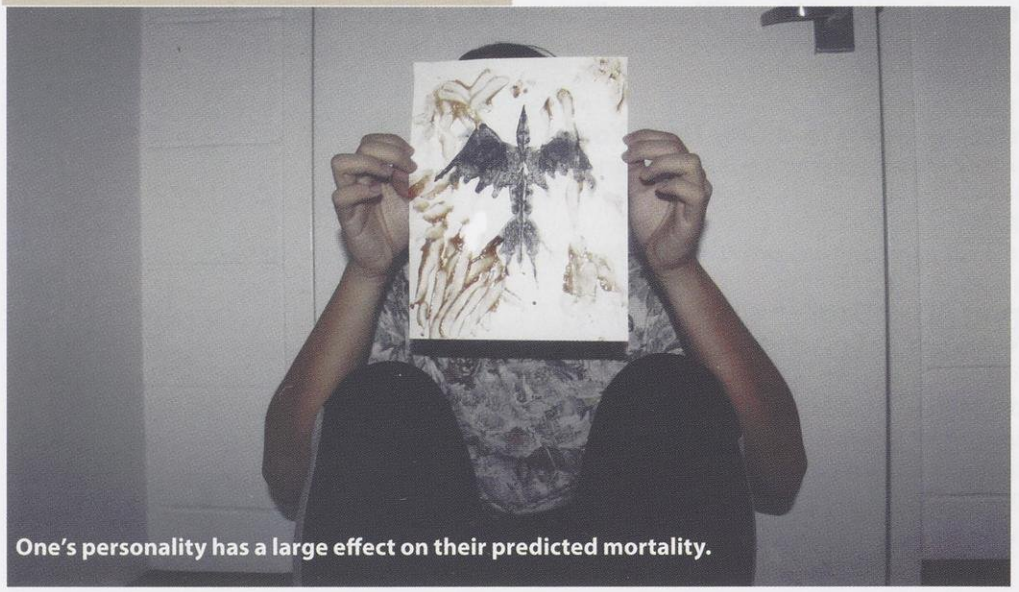
Personality Predicting Mortality

Recent studies regarding personality suggest that personality traits can be used to predict health outcomes, including mortality risk.

What is personality? How does personality influence our daily choices? Can it even predict our mortality? We know that in general, life would be a lot more boring without personality. Personality is a fundamental part of being human, and it can say a lot about who we are as a person. It is a distinguishing characteristic of human beings, with each person displaying a unique combination of qualities and attributes.

Scientists have broken down the most basic types of personality traits into the Big Five. These five include openness, neuroticism, conscientiousness, agreeableness, and extraversion1. Openness includes characteristics such as creativity and insight; those who exhibit openness often have many interests and are open to new things. Neuroticism is characterized by moodiness, irritation and emotional instability. Those who experience neuroticism are often stressed, anxious, experience dramatic mood shifts, and worry often. Conscientiousness is expressed by people who are thoughtful and goal-oriented, often times organized and mindful of detail. Agreeableness includes trust, altruism, kindness, and affection. Those who exhibit agreeableness are often more cooperative and flexible in social situations. Extraversion is characterized by sociability, talkativeness, assertiveness and high amounts of emotional expressiveness, as opposed to introverts who are more reserved and expend less energy in social situations. Each of these widely encompassing traits make up the five basic dimensions of personality, all of which may provide insight into an individual's health and potential risk of mortality[1].

Recent studies attempting to link personality to mortality risk used the Big Five personality traits and took into account whether or not the research participant was a smoker. In this longitudinal data analysis, fifteen studies were conducted by various research groups and synthesized into one conclusive paper. All age groups were taken into consideration, and variables such as age, sex, and education were accounted for. While some of the studies contained only subsets of the Big Five, such as neuroticism, they all contained information on mortality, such as death status and death dates. The studies that contained the full Big Five conducted tests for each trait individually as well as the five together to obtain the most accurate results[2].



One's personality has a large effect on their predicted mortality.

Of the Big Five traits, it was determined that high levels of conscientiousness, extraversion, and agreeableness were all associated with a lower risk of mortality. However, both neuroticism and extraversion were associated with individuals who smoked. The trait with the largest impact on reducing mortality risk was conscientiousness, decreasing the risk of mortality by 89 percent. Both extraversion and agreeableness had a slightly smaller impact, contributing to an approximate 24 percent and 20 percent lower risk of mortality. While both conscientiousness and extraversion were consistent across age groups, openness was not. Individuals over the age of 65 exhibit more openness, suggesting a lower risk of mortality but only in older age[2]. In turn, it may be thought that those below the age of 65 who display openness may live longer than those who do not. However, the general trend was that younger individuals do not exhibit higher levels of this trait, so often times this is not the case.

The effects of personality on mortality risk revealed a greater number of associations between the two than expected. Both extraversion and agreeableness were linked with a lower risk of mortality, which had not been previously associated. This may be due to the fact that most studies conducted did not consider all five of the Big Five personality traits and focused more closely on conscientiousness and neuroticism[2].

In considering smoking as a health behavior affected by personality, research also suggests that more studies need to be conducted to consider how other health behaviors aside from smoking may affect personality. Smoking accounts for only a small portion of the link between mortality and personality, and other mediators, such as social behaviors or psychological pathways, might play a role in explaining the effects of other traits. Personality traits may also be used to identify individuals who are more willing to engage in risky behaviors, which might deteriorate or shorten their life expectancy. For example, it could be interpreted that an individual who enjoys skydiv-

ing demonstrates higher levels of openness while someone who prefers yoga likely does not[2].

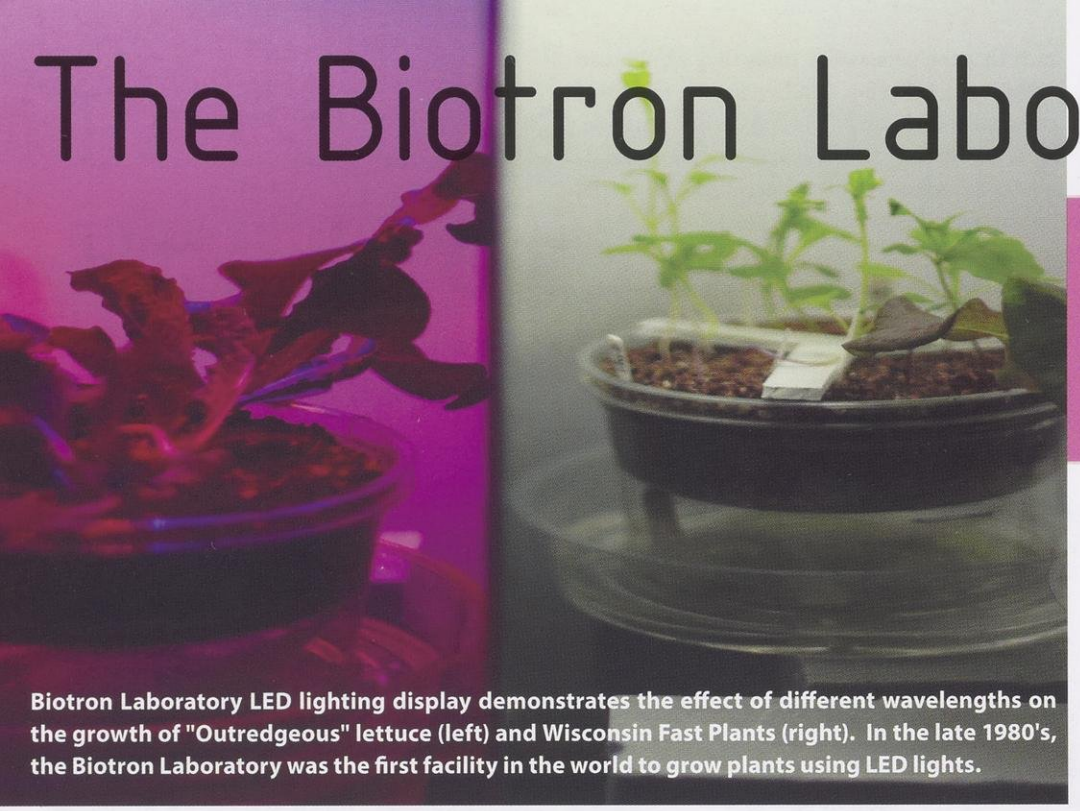
In conclusion, it is those who exhibit low levels of neuroticism and high levels of conscientiousness, extraversion and agreeableness who are at a lower risk of mortality. In addition, those with high levels of neuroticism are more likely to be smokers and, in turn, can expect a short life expectancy. This information can be useful when considering candidates for long-term studies that collect data over years or centuries. It can also be applied to individuals who engage in hazardous behaviors, such that the personality traits they exhibit can explain the behavior. While research regarding personality and risk of mortality is not complete, these studies revealed previously unknown findings and emphasized the apparent and influential link between personality and mortality.

Written by: Lucy Shoemaker
Photography by: Gary Geson
Design by: Suzanne Kukec

[1] **Cherry, Kendra. "The Big Five Personality Traits."** ***Verywell*****, Dec. 2017.**
[2] **Graham, Eileen K. "Personality Predicts Mortality Risk: An Integrative Data Analysis of 15 International Longitudinal Studies."** ***Science Direct*****, Oct. 2017.**

The Biotron Laboratory:

A Controlled Environment Research Center



Biotron Laboratory LED lighting display demonstrates the effect of different wavelengths on the growth of "Outredgeous" lettuce (left) and Wisconsin Fast Plants (right). In the late 1980's, the Biotron Laboratory was the first facility in the world to grow plants using LED lights.

This one-of-a-kind research facility offers controlled testing environments to academic and commercial clients. The facility has provided space for projects that range from pressure effects on pacemakers to LED development for cranberry plant growth.

The ability to control a laboratory space to specific conditions is a challenge that is often hard to facilitate. On the UW-Madison campus, the Biotron Laboratory offers university and commercial clients the luxury of controllable testing environments for plant, animal, and material studies. Clients are able to choose between highly controlled environments or moderately controlled greenhouses. Most controlled environment setups have a basic lab room where research may be monitored and recorded. This leads to multiple experimental rooms, which are lined with thick walls of metal and insulation that allow researchers to completely control each environment individually for their research projects. The rooms are also guarded with heavy metal doors that have a small peeping window to see through. Researchers can control the temperature, light intensity, light quality, humidity, watering, electrical power, and sound in the control rooms through fully automated software. Using this system, researchers are able to isolate one variable and run at full operation, 24 hours a day, with care from the Biotron staff, who work around the clock to monitor various research projects.

During the 1960s, a group of UW-Madison colleagues applied for a grant from the National Science Foundation to build a space for controlled environment testing. The group received $1.5 million in government funding and a substantial amount of aid from UW-Madison to begin construction in the late 1960s. The building was completed in 1967 with 45 isolated control rooms, each with its own heating and cooling system. Originally, the lab was a standalone operation able to run at full capacity without power or other resources from UW-Madison. However, the lab has slowly integrated into the UW-Madison computer network and has given some operations to the Physical Power Plant. The lab became fully operational in 1971 and saw the addition of greenhouses to multiple floors in 1994.

Over time, the facility has harbored research for a multitude of professors and commercial clients. From NASA space probes to 20-foot-tall corn stalks, the staff has seen it all. Biotron director Dr. Hannah Carey houses her own research on hibernating ground squirrels in the facility. The lab has given Carey the exact environment she needs to keep her squirrels in a deep hibernating state with proper temperature and light controls. Carey's room remains dark and cold at a constant temperature of three degrees Celsius so she may conduct her research efficiently.

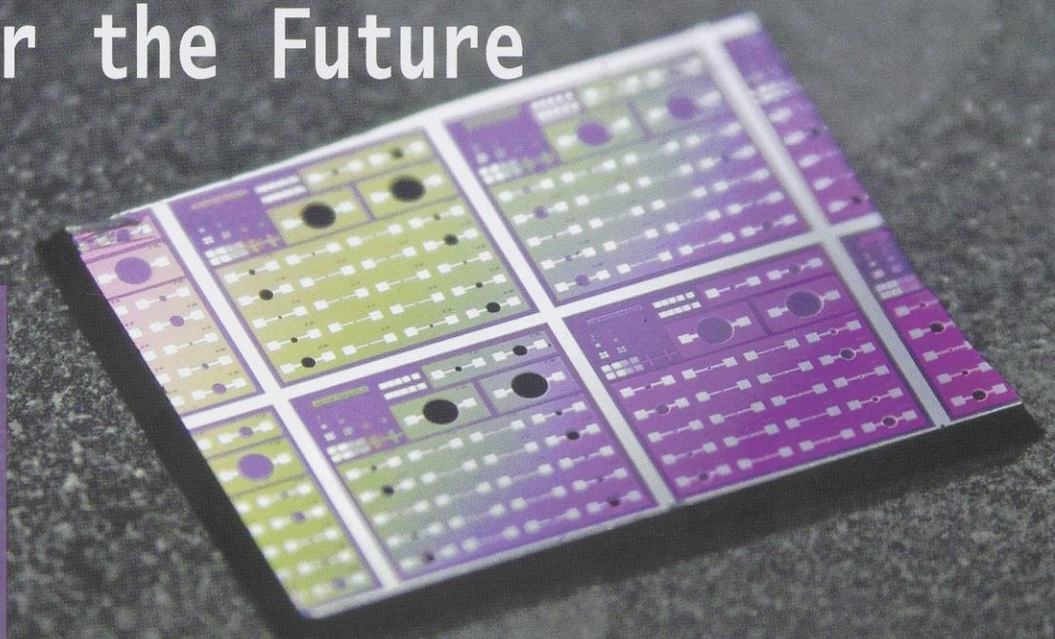
While on a tour of the facility, Jacob Schoville, a horticulture technician, shared some interesting stories of projects that have been housed at the Biotron since its construction. A hypobaric pressure chamber that can simulate altitudes over 10,000 feet was used to test medical devices such as insulin pumps to make sure they continue to function properly at high altitudes. In another instance, a researcher was able to simulate autumn conditions by mimicking the annual decrease in sunlight. This caused the trees that were housed there to change colors even though the study took place in the middle of July.

Greenhouses are featured on a few of the facility's floors. These rooms differ from the isolated interior rooms, as these greenhouses are unable to provide the amount of control as interior rooms. However, these rooms are able to provide natural sunlight and other benefits that allow for more plant-based research. Projects housed here include the gathering of potato plant seedlings, which are transferred to an interior room to complete their growing cycle. These seedlings and potatoes are then shipped all over the country to be planted and harvested due to their immunity to many diseases.

Other projects have included Antarctic drilling equipment, humidity effects on window blinds, and LED lighting development for plant growth. A researcher can replicate the environment of almost any place around the world, from a dry hot desert to the humid rainforest; the capabilities of the lab are extensive. The facility gives the power and controls over to their clients' laboratory space, allowing for a unique individualistic approach to research. As time passes, the lab continues to integrate into the UW-Madison campus, provide a space for research, and support the discovery of information by the UW-Madison community.

Written by: Makenna Hall
Photography by: Mary Shaughnessy
Design by: Suzanne Kukec

Electromagnetic Scattering Laws in Weyl Systems: A Vision for the Future



At a time when technology is rapidly evolving, why do limitations in cellular reception persist? In a recent article published in *Nature Communications*, graduate student Ming Zhou attempts to provide the public with an answer.

Our mobile phone antennae have a cross section similar to nanophotographic sensors (pictured) where a larger cross sectional size will yield better results, be it better images or signal strength. This sensor was fabricated by Kai Zang at Stanford University. This photo makes objects look much bigger than they actually are as a result of research which aims to increase the optical size of a nano-scale object.

At a time when technology is rapidly evolving, why do limitations in cellular reception persist? In a recent article published in *Nature Communications*, graduate student Ming Zhou attempts to provide the public with an answer. Zhou works under Zongfu Yu, a professor in the department of electrical and computer engineering.

The technology involved in cellular reception capitalizes on our knowledge of electromagnetic waves. These waves consist of everything from the very short wavelengths of gamma rays to the long wavelengths of radio waves – and everything in between, including visible light. Waves in the electromagnetic spectrum are all a form of electromagnetic radiation, energy that travels and spreads. For example, when light collides with any particle, its direction is impacted, which causes a phenomenon called scattering.

Currently, the strength of a signal is limited by its dependence on its wavelength. The research group Zhou is a part of proposes a relatively new relationship between an antenna's cross section, the shadow it creates in electromagnetic waves, and its surrounding medium as a solution to our communication dilemmas. Just like a light will cast a visible shadow when an object is in its way, unseen electromagnetic waves cast shadows when encountering objects they cannot travel through.

Historically, the relationship between an antenna's cross section and the wavelength it scatters have made technologies like the antenna on a cell phone a reality; however, it has become a limitation for further technological advancement. "The wavelength relationship is a limitation; you cannot further increase the cross section of an antenna because it is limited by the wavelength and, unfortunately, you cannot change the wavelength by much," Zhou says.

Zhou's team can significantly increase an antenna's cross section by utilizing the fact that in Weyl systems, mediums in which two waves touch each other at certain points, diverging and diminishing cross sections can be realized at any wavelength because they are governed by their surrounding medium. This is beneficial because a medium, tailored to the way a wave propagates, will result in a large cross section at any wavelength. A large cross section would then produce a stronger signal because it can scatter more electromagnetic waves.

Let's think about cellular signal in a building like Engineering Hall. The mobile signal from the cell tower can be weakened because of the building's structure. "One way to increase the signal of a mobile phone is to increase the cross section of its antenna. If this can be achieved, the signal of a phone in a building can be strengthened even when the power of the signal from the cell tower is very weak," Zhou says.

A current area for improvement lies in the fabrication of materials used for scattering such as antennae or solar cells. "When fabricating the device, you'll create some ruffles, which will make it non-resonating," Zhou says. For most applications, Zhou explains that the engineering community is pushing for optimal frequency, but that this is difficult to achieve when devices continue to be rough because their performance is degraded. Weyl systems are especially critical because they are independent of surface texture.

All forms of communication could benefit from this new development. Imagine a world where you could text someone while on the elevator or drive through a concrete tunnel while listening to the radio without interruption. Zhou's research proves that world can exist. However, it is up to scientists and engineers to create an action plan to permanently solve our communication dilemmas.

Written by: Ana Alba
Photography by: Mayukh Misra
Design by: Jonathan Evans

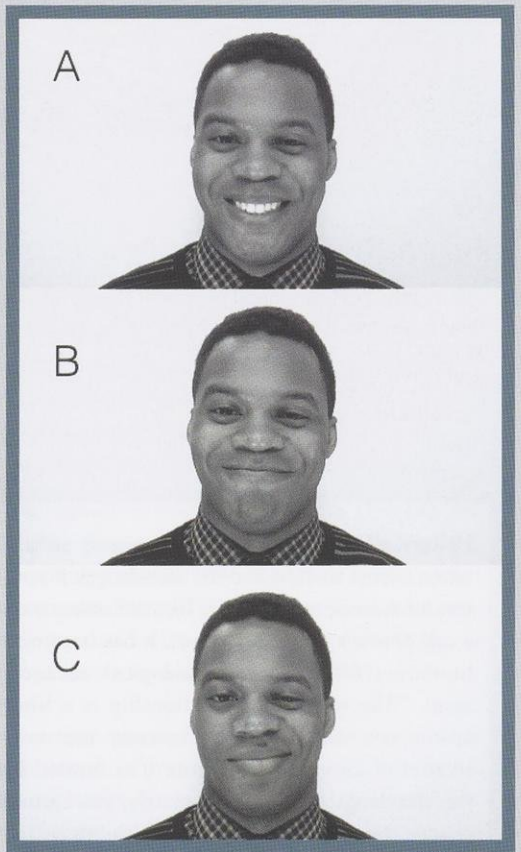
There are many hidden functions of expressions that the majority of people have no idea exist. One such expression is the smile. How much do you know about smiles?

unopened functions of smiles

Are you happy right now? Are you smiling at this moment? It seems that these two questions should have the same answer, as smiles play a huge role in expressing our internal state of happiness. It seems natural for us to smile when we want to share our happiness. But recent discoveries have shown that smiles play a much more significant role in society than just an expression of happiness. It is an evolutionary way to manage relationships with other people.

Jared Martin, a graduate student at the UW-Madison psychology department, studies affective science to uncover what functional role humans' emotions and expressions play in their lives and social interactions. So far, psychologists have identified at least three major purposes of the human smile: to reward, to show affiliation, and to express dominance. Many of these motivations can be considered "fake," but there is something unique in the purpose of each type of smile.

Jared Martin, a graduate student in the UW Department of Psychology



Research images that show three different smiles: (A) reward smile, (B) affiliation smile, and (C) dominance smile.

The most commonly identified function of the smile is to reward. The rewarding smile activates the whole face, including eyes and lips, and it is the most similar to a "natural smile." "This actually makes a lot of sense because when we reward someone, it does actually make us happy," Martin says. People use the reward smile to provide a sign for another person that they are behaving in the right way. For example, this smile appears as a mother rewards her baby for the first steps in its life. She is signaling positive emotions about her child's action and is also reinforcing her positive feelings towards being a mother.

According to Martin, the second function of a smile is to show affiliation. This smile shows the other person that you are friendly and open to interaction. This smile is usually activated by pressing the lips tightly in front of the teeth, and the eyes usually doesn't provide any additional expression. "An example that I like to give is in an elevator. When one person enters an elevator and sees another person, he/she automatically gives a smile just to establish trust for this small elevator trip. However, this smile would not mean that a person wants to be a close friend or wants to get lunch with you," Martin says. In more heterogeneous countries such as the United States, people smile more often because historically, they had to find a way to communicate with people who came from different experiences, cultures, and languages.

The third function of a smile, as described by Martin, is to show dominance. "We would see this kind of smile in a sports competition; when one team starts to win, they would show a dominance smile to the losing team," Martin says. This smile can be recognized by the movement of only one corner of the lip. Often called a smirk or a crooked smile, this type of smile may also be observed in people who do not necessarily have dominance but intend to have it.

These are only three currently identified applications of smiles in society, but there may be many more that remain unclassified. It is important to realize that this study describes patterns, not individual behavior. However, understanding the generalized patterns of behavior opens up endless possibilities for artificial intelligence and machine learning to better understand and interact with humans.

"People unconsciously are able to read facial expression. Evolutionarily, this may have helped us to survive," Martin says. For practical advice on how to become better at reading faces, Martin encourages people to be more engaged with another person's face; make eye contact and pay close attention to a person's reaction and smile. And the next time you smile, consider the motivation: Are you really happy right now?

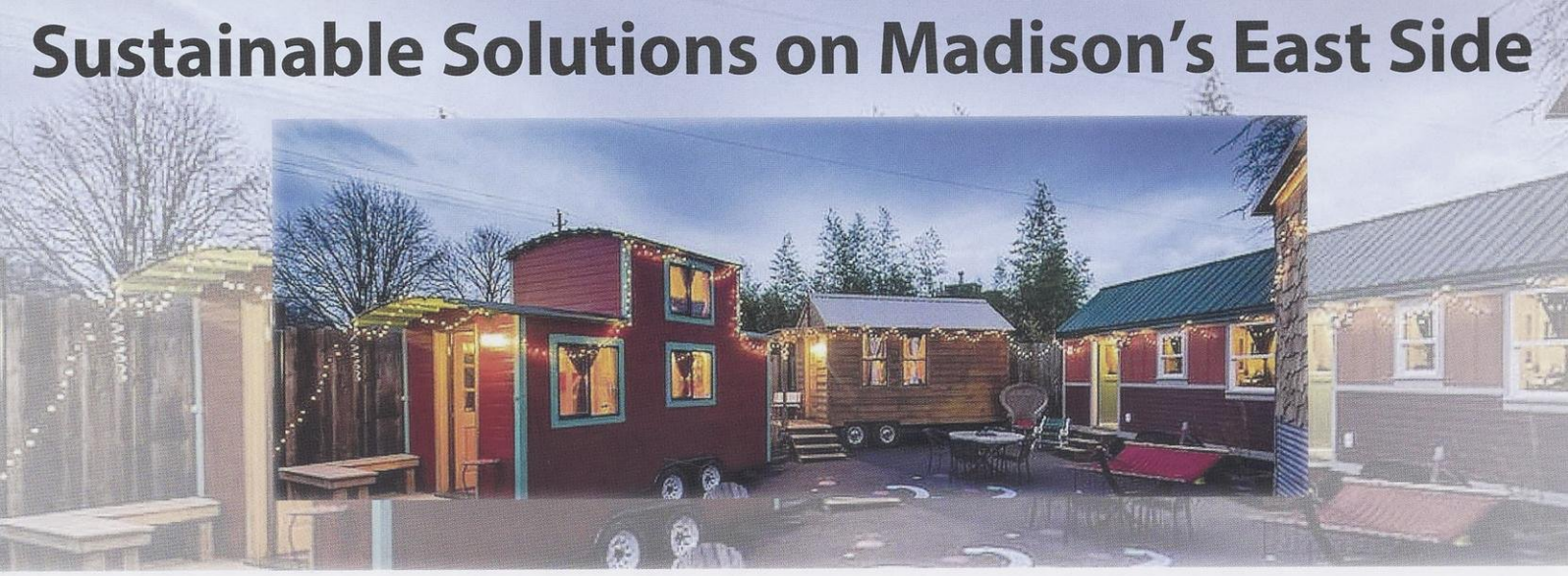
Written by: Yuliia Kapeliushna

Photography by: Cody Schwartz

Image courtesy of: Niedenthal Emotions Lab

Design by: Suzanne Kukec

Sustainable Solutions on Madison's East Side



The tiny homes in Madison are part of a growing trend to build smaller, economically and environmentally-friendly living spaces.

Of the many eclectic and eccentric facets of Madison, perhaps the top of the list isn't so big after all. It's called Occupy Madison. Currently comprised of eight tiny houses that are contained in a lot on the east side of Madison, the nonprofit was started to create a housing project that offered safe, comfortable spaces for Madison's homeless. Over the last five years, these small houses have become a close-knit community that showcases many of the themes advocated by the tiny house movement.

"[Occupy Madison Village is] a self-governed community comprising tiny houses built by and for people in need of stable housing, a workshop for building those houses, gardens, and even beehives."- Lucca Clemente

The origins of the tiny house movement are hard to pin down, but some people credit architect Sarah Susanka for helping the movement to gain momentum with her book "The Not So Big House." She advocates for the development of architecture that emphasizes utility and comfort instead of size and grandeur. A tiny house is generally considered to be anywhere between 100 and 400 square feet, or roughly only one and a half times the size of the average Sellery Hall dorm room. Although minimal in size, most tiny houses are well-planned to make efficient use of space without abandoning aesthetically pleasing architecture.

Along with satisfying spatial needs, tiny houses have garnered large support because they are typically more environmentally-friendly at every phase of their construction compared to standard homes. Tiny houses require less material to build, which reduces the environmental impact of the wood and metals needed during the building phase. After the home is built, the homes use less energy for heating and cooling than traditional homes due to the limited size of the space. Many people choose to live in a tiny house solely to reduce their environmental footprint.

Occupy Madison, however, is concerned about more than just its carbon footprint. Formed in late 2012, the nonprofit centers around "solutions for people facing homelessness in Madison." This local nonprofit grew out of the unincorporated Occupy movement that began in 2011 in response to growing social and economic inequality in the United States. Occupy Madison formed around the same general principles but soon refocused on local issues after many homeless started joining the group. With the tiny house movement gaining more attention, the members, seeing many potential benefits, decided to start their own tiny housing venture.

Occupy Madison's plan started with the purchase of an old gas station on the east side of Madison. The nonprofit turned the lot into suitable land for housing and reserved space for a workshop on site. These houses are located at the intersection of Johnson and Third Street, only a 20 minute walk from Witte Hall. In 2015, the village gained its first resident; six people now call it their home. Lucca Clemente, member of Occupy Madison, summarizes in a Ted Talk, "[Occupy Madison Village is] a self-governed community comprising tiny houses built by and for people in need of stable housing, and a workshop for building those houses, gardens, and even beehives."

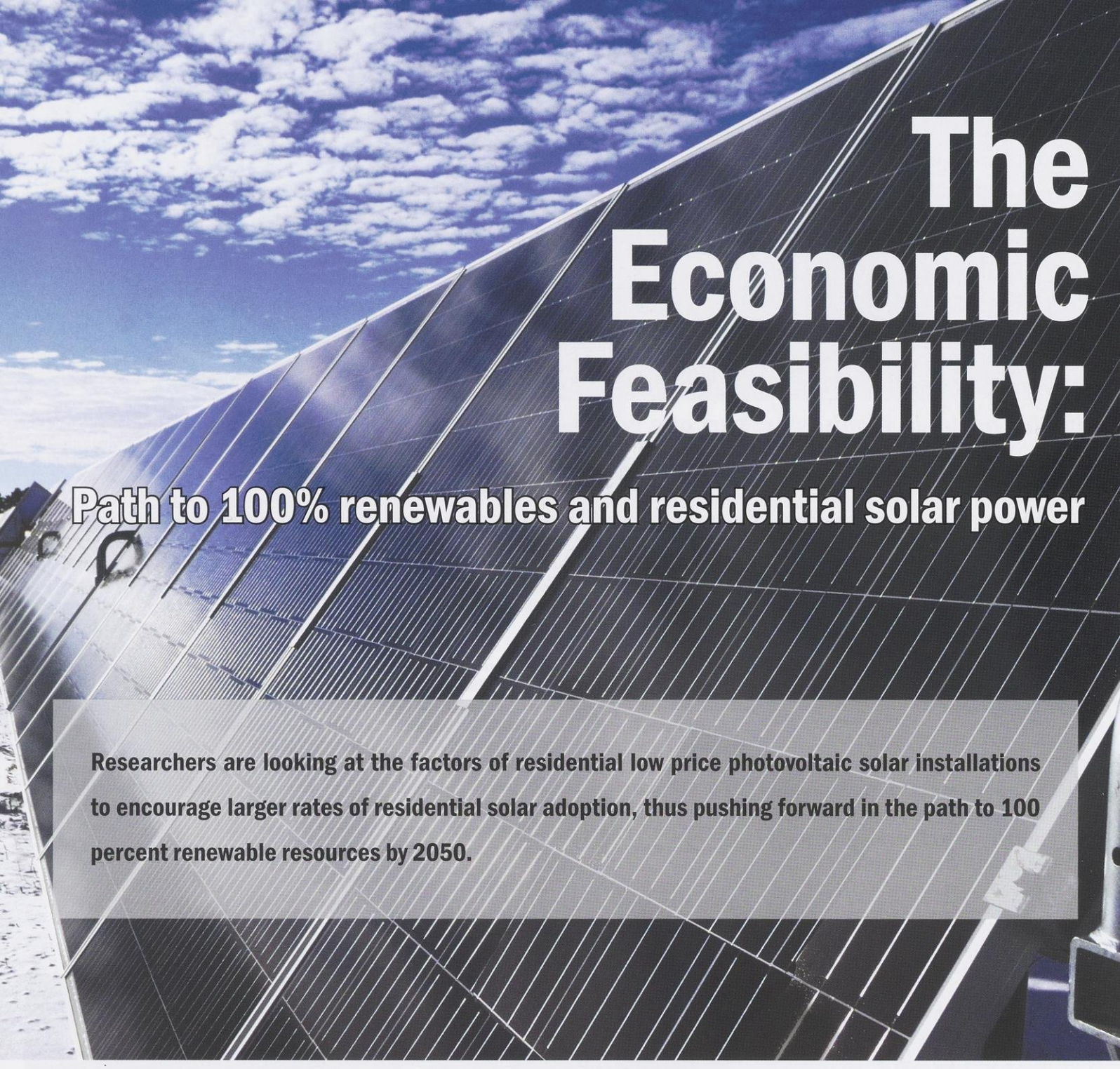
The physical manifestations of Occupy Madison's philosophy can be seen through the six tiny houses that bring new life to an old lot on the east side of Madison. Curiosity about the Occupy Madison village can be satisfied by a quick bike ride to their shop, which features classes, workshops, and volunteer opportunities.

Written by: Ben Hayes

Images courtesy of: www.madisontinyhomes.com

Design by: Tim Campbell

Floor plans are customizable, but space is at a premium, so designs must take that into account.



The Economic Feasibility:

Path to 100% renewables and residential solar power

Researchers are looking at the factors of residential low price photovoltaic solar installations to encourage larger rates of residential solar adoption, thus pushing forward in the path to 100 percent renewable resources by 2050.

The world is traveling slowly to 100 percent renewable resources, but according to leading scientists, this mission can be completed by the year 2050 with current technology. To accomplish this, electricity must replace conventional forms of power such as combustible engines and other systems which run primarily on gas or require a lot of heat. Although many major aspects of the world are already powered by electricity, barriers in industry, transportation, homes, and businesses need to be resolved before the path to 100 percent renewables are a conceivable option. Specifically, two main attributes come into play when considering the path to 100 percent renewables: technical and economic feasibility. In other words, is it even possible to run solely on renewable resources by the year 2050? Considering the fact that the United States currently obtains approximately 10 percent of energy from renewables, there is still a substantial amount of work to be done. One aspect of this question focuses on the economics of residential solar energy.

Eric O'Shaughnessy, a market research analyst at the National Renewable Energy Laboratory, described his research regarding the economics of residential solar. O'Shaughnessy is involved in an academic partnership with Dr. Greg Nemet as well as researchers from Lawrence Berkeley National Lab, the University of Texas, and Yale University, who are studying how to decrease the price of photovoltaic (PV) solar system installation. Their goal is to induce higher rates of residential solar adoption in the United States. A key factor in residential solar adoption is price, so O'Shaughnessy and his

Left: The North Star Solar project is the largest solar facility in the midwest, providing power to approximately 20,000 homes.
Top: The nearly two square mile large facility is part of a trend towards power utility companies providing more renewable energy.

team are looking at the factors that make low-priced systems affordable. "If you can figure out the factors that make low price PV systems, you can shift the distribution of prices in that direction," O'Shaughnessy says. Currently, the installation prices of PV solar systems have a wide price distribution due to location, installer company size, and installer experience. The high prices prevent customers from adopting solar in their homes. O'Shaughnessy is working to use economics as "a tool to create smart environmental policies" and inform policymakers for creating the most economically efficient systems.

O'Shaughnessy's research is data driven, and his team is working with some of the largest solar data sets that are available. One data set, Tracking the Sun, summarizes price trends of PV solar systems installed in the United States. One issue that the researchers must contend with is poor data quality. A variable that is almost always missing is the characteristics of the houses themselves. If a house has a high-pitched roof, the cost to install a PV system will increase because of variables that affect the difficulty of the installation process. O'Shaughnessy and his team are continuously creating ways to control the quality of data to ensure that the data are not problematic. The data are used to make conclusions about market structures; the knowledge gained about the solar market can be used to efficiently increase adoption in residential communities. Right now, both small businesses and large national corporations do installation. The researchers have noted the importance of a firm's experience with PV system installation as a leading factor in low-price PV systems. O'Shaughnessy and his team are "dissecting installer-customer interactions to see what the data can tell us." It was also found that some level of competition amongst installers is important.

Another possible method to decrease the cost of residential solar power is to utilize community solar farms. Rather than each customer installing individual solar panels on their roofs, multiple residential customers would be allowed to subscribe to a much larger system. Because larger systems tend to yield lower prices in an economy, each individual customer would have a lower cost-basis for the same utilization. More research would need to be done to compare this method of residential solar with the smaller individual roof solar panels. One issue that arises in either case is storage of solar energy. Because batteries are so expensive, they are not a practical solution. Fortunately, there is a mechanism to take advantage of solar energy when residents are not home. For example, it is possible to configure water heaters to heat water while no one is home, or to configure air conditioning to plunge the temperature of the air on a hot day so that residents can come home to a cool house. This concept improves the thermal capacity of a house by leveraging solar energy with smart technology.

A special result of this research would be for citizens to adopt solar power in their homes, regardless of their degree of concern for the environment. For example, someone who is not particularly concerned for the environment will likely adopt solar if they feel they directly benefit from the transition. It is safe to say that people do not like paying their electric bills, so if a company tells them that they can save hundreds of dollars a year by utilizing solar power, people will be interested. Sol

O'Shaughnessy's academic partnership is ongoing. This team of researchers will continue looking more specifically at price dispersion, effects of the current market structure, appropriate level of competition, the ideal number of installers, and experience level of installers to improve policy and increase adoption of residential solar power.

It is important to remember how small the share of electricity produced by residential solar power is compared to industrial power generation methods. Transportation, manufacturing, and business also use huge amounts of energy, so there is much to accomplish before the goal of 100 percent renewables can be reached. However, with our current capabilities, a large impact can be made in reducing the economic burden of renewable energy generation.

Written by: Sarah Gerarden

Photography by: Jason Hakamaki

Design by: Suzanne Kukec

What's Happening in Healthcare?

Health care is one issue that most Americans agree they're worried about. Dr. Kevin Look discusses the problems and solutions endemic to the American health care system.

Health care is one of the most hotly debated subjects in American politics, and lack of compromise within the government has left many Americans struggling to pay for their medical care. The United States is one of the only developed nations without universal health care coverage, and access has been limited to just those who can afford it. Health care is a complicated and oftentimes divisive subject, but according to Dr. Kevin Look, a professor at the UW-Madison School of Pharmacy, it is imperative that improvements be made.

The United States rules in entertainment and technology but lacks when it comes to health care. "There has been a lot of evidence to show that health care in the [United States] is worse than in most other developed countries," Look says. "Our costs are higher, we have poorer access and lower quality compared to other countries." In 2014, the Commonwealth Fund, a private foundation dedicated to improving health care in the United States, ranked 11 developed nations on their overall quality of care based on several criteria such as efficacy, equity, and efficiency of care. The United States' health care system ranked last overall. Surprisingly, Canada, a country which many Americans hold as an example of an excellent health care system, ranked only tenth. "When you have universal health care, there're also usually issues with things like wait times and access to newer, more expensive technologies or treatments," Look says. These issues not only affect our neighbors to the north, but the country generally considered as having the best health care system in the world as well: the United Kingdom. These two countries have high quality care at lower costs but have issues with wait time for treatment. On the other hand, in the United States it's not a question of waiting to visit a specialist, but rather the inability to afford one.

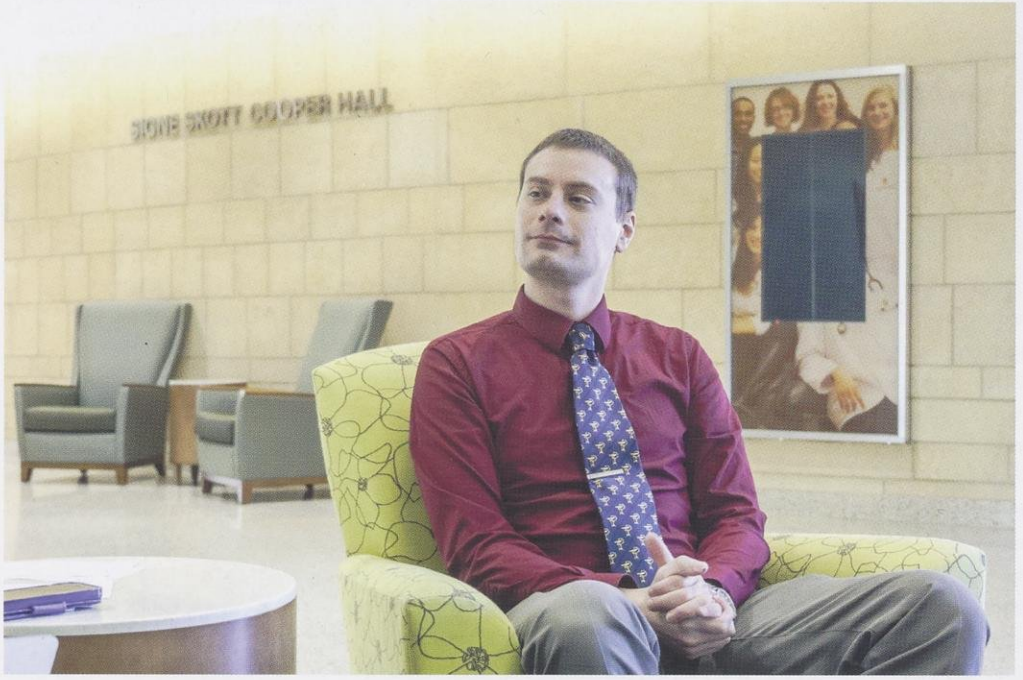
Passed in 2010, the Affordable Care Act, more commonly known as "Obamacare," was an attempt to make health care more affordable for American citizens. Look notes that it has made preventative health care, such as flu shots and mammograms, more accessible. Other medical procedures, such as surgery, are still costly. Nowadays, Look says that "we're seeing people with insurance who just can't afford to use it. Unfortunately, I don't see that improving with a lot of current discussion on how to improve the health care system."

But is the future of American health care totally bleak? Look disagrees, but he states that health care is extremely difficult to change without significant compromise.

"We need to look beyond the politics of it and look at what is really best for the patient and the population ... Until we see that happen, we're not going to see any meaningful change."
-Kevin Look

Look notes that a possible solution may be found in Germany's health care system. German health care is largely privatized, but all citizens have insurance provided by either their employer or the government. This system would satisfy the Republican Party's desire for privately run health care, and the Democratic Party's desire for universal access to health care. For now, however, it looks as though it will be a long time before the two parties will be able to reach an agreement.

In an ideal world, Look, whose work focuses on the disparity present within the American health care system, would like to see a system that provides more equal access regardless of a person's ability to afford it, "whether that's in the form of universal health care or changes to the current system to make it more equal." Although he thinks that change may be a long way off, focusing on high-quality, safe care is crucial to improving the overall health of American citizens. Hopefully, for the good of all Americans, changes in health care will happen sooner rather than later.



Dr. Kevin Look of the Wisconsin School of Pharmacy shares his views on the current Healthcare scenario in the United States.

Written by: Erica Calvache
Photography by: Mayukh Misra
Design by: Suzanne Kukec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Near Real-Time Flood Detection

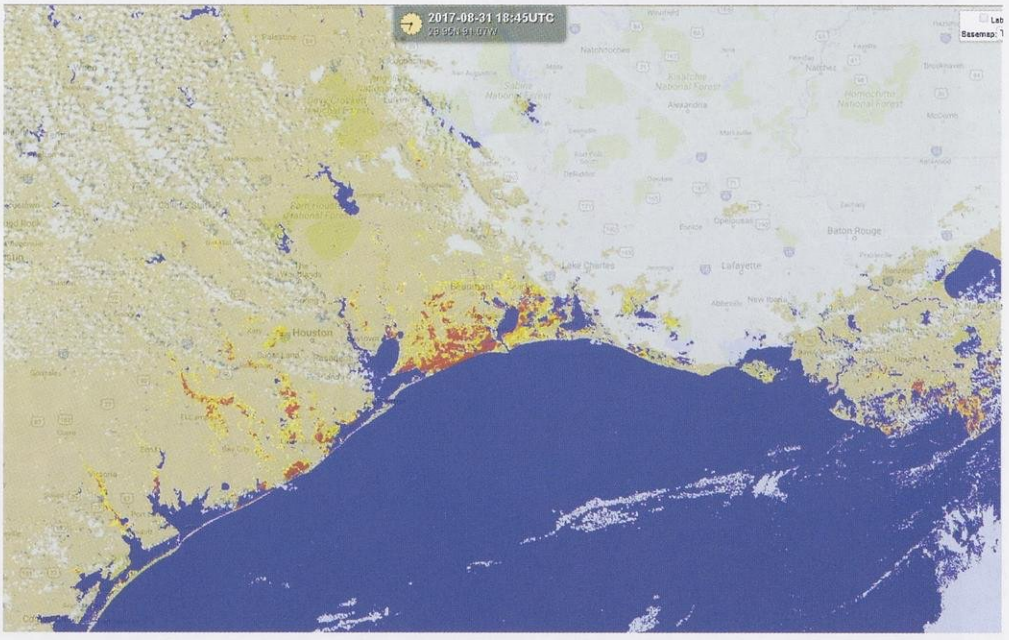
New processing methods in satellite imagery make flood detection more accurate and impactful

Despite the common view that technology and nature operate as opposing forces, today's technologies draw inspiration from, work together with, or monitor the natural forces in our world. One such interaction between science and the environment is in the prediction, tracking, and remediation of natural disasters such as earthquakes, storms, and floods. While we are unable to prevent these events from occurring, having the ability to accurately predict and monitor their effects is invaluable in the assessment and mitigation of lasting damage.

In the case of flooding, satellite imaging is a crucial aspect of monitoring. A research group led by Dr. Sanmei Li of George Mason University including UW-Madison researchers Jay Hoffman, Dr. Dave Santek, and Dr. Shane Hubbard of the Space Science and Engineering Center, is making significant steps in increasing both the accuracy and accessibility of flood detection products. An antenna on top of UW-Madison's Atmospheric, Oceanic and Space Sciences building is one of few in the world that receives direct broadcast from the Suomi National Polar-Orbiting Operational Environmental Satellite System Preparatory Project (SNPP) satellite. This direct broadcast means a very low latency time and the ability to process data almost immediately, unlike at most other organizations.

The concept of satellite flood detection is not new; imaging to track the aftermath of floods has been used for decades. "What makes this different is that we're using new satellite technology," Hubbard says. Specifically, the improved spatial coverage and spectral resolution capabilities of the imaging device itself allow for more accurate understanding of the flooding. While SNPP provides nearly complete global coverage, the polar orbiting satellite Landsat had previously been used for flood detection, but it only overpassed many regions of the globe once every 16 days. "You can't compare a grid cell from the previous day and understand what's happening with the flooding," Hubbard says, stressing the importance of frequent image updates.

A common problem in imaging of flood events is cloud cover. Since many flood events occur during high precipitation, satellite images of flooded areas are often obscured by clouds. With more frequent imaging, there is a greater probability that the image will be taken during a break in the cloud cover. Tests are ongoing to adapt the flood detection algorithm to work with the latest geostationary satellites that are capable of transmitting images as frequently as every minute. By aligning their orbit speed with Earth's rotation, geostationary satellites appear to stay locked in a specific position above the planet. With such a high frequency of images, capturing key events such as the flood's peak will become more feasible. This technology would allow officials to get a more accurate idea of the extent of flooding and react accordingly.



Images of the Texas coastline from the SNPP satellite provide officials with an extensive view of the flooding during Hurricane Harvey.

Another significant improvement Dr. Li and her colleagues are implementing is increased spatial resolution. The previous satellite imaging hardware used a one-kilometer pixel. The researchers' new hardware, the Visible Infrared Imagine Radiometric Suite (VIIRS), can achieve a 375-meter pixel. The much smaller pixel size allows for a more detailed final product that will be able to provide more relevant local data to users.

Most of this data can be processed in about 90 minutes and displayed in the interactive module Real Earth. This module can be accessed by anyone for free at realearth.ssec.wisc.edu and allows navigation of satellite images of many regions in the United States through space and time. One can simply choose the region and time and navigate through the map to see recent flood product images. This website is the result of the image processing carried out at UW-Madison and is central to the distribution of information. As Hubbard says, "Real Earth is the ability to then serve that data up."

The capabilities and applications of this technology are already visible. Organizations such as FEMA (Federal Emergency Management Agency) and NWS (National Weather Service) collaborate with the research group, and the online module receives a great deal of traffic. A recent test of its capabilities was monitoring the aftermath of Hurricane Harvey. With images around the Gulf of Mexico, floodwater was detected throughout South Texas following the hurricane. By using this product, officials and experts were better equipped to assess the extent of the flooding and begin plans for recovery. According to Hubbard, "this information is really important because it gives them some situational awareness." While municipalities in the United States

may not see much use for these images, residents can easily contact local authorities after observing a breach. Being able to monitor larger regions or entire states provides a more holistic view of the scale of flooding problems.

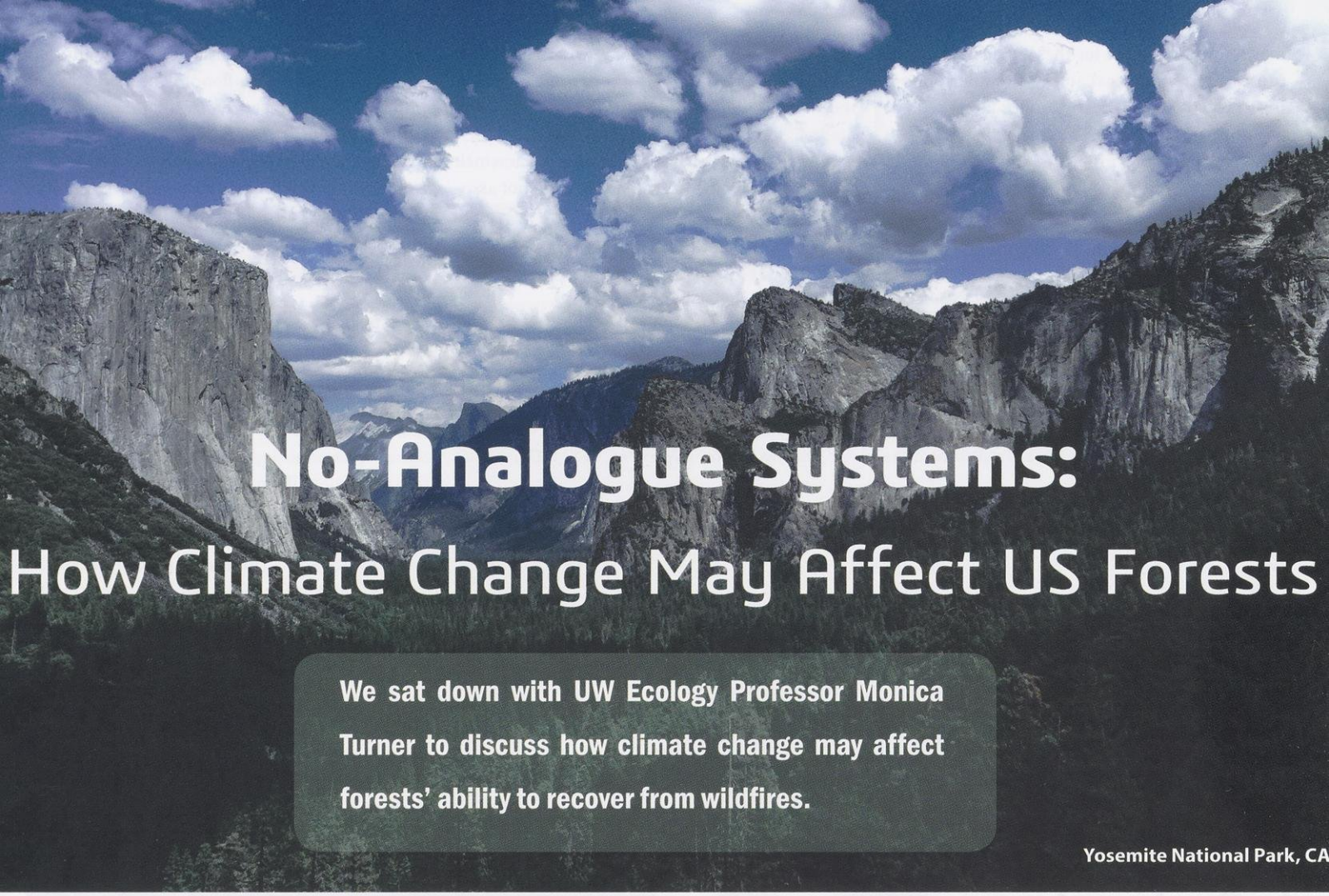
In addition to being useful in densely populated areas, the flood product is even more useful in rural regions and in foreign countries, where flood monitoring capabilities are not as advanced. With officials having the power to see flooding in near real time, measures to save lives and property can be implemented as quickly and efficiently as possible. A similar application is in the monitoring of flood events in areas like Alaska, where the University of Alaska-Fairbanks also receives direct broadcast from the polar orbiting satellite. "Sometimes this is the first way to detect floods in those remote regions," Hoffman says. This satellite imaging is ideal for such regions that experience high flood events generally due to snowmelt or ice damming, which causes flooding not associated with cloud cover and can therefore be more easily viewed by satellite. Flood detection by satellite is more feasible than direct observation in areas of such sparse population.

These advancements taking place at UW-Madison and in the larger scope of the VIIRS project are paving the way for similar application in other regions. "If a country has their own antennae, they would be able to process AND generate this product," Hoffman says. Additionally, the ability to reliably track flooding bears increasing importance as climate change alters precipitation patterns and flood events become more frequent. This image processing and analysis of flood data is one example of the global scientific community applying technological advancements to improve our ability to monitor the effects of natural disasters.

Written by: Katlyn Nohr

Image courtesy of: realearth.ssec.wisc.edu

Design by: Suzanne Kukec



No-Analogue Systems:

How Climate Change May Affect US Forests

We sat down with UW Ecology Professor Monica Turner to discuss how climate change may affect forests' ability to recover from wildfires.

Yosemite National Park, CA

In 1988, beginning in June and continuing until early September, more than 50 individual wildfires tore through Yellowstone National Park in the costliest wildfire season in the park's history. The battle against the flames was the largest firefighting effort in the United States up to that point, with roughly 25,000 people involved and $120 million spent in the process. 793,880 acres of the park were affected – about 36 percent of the park's total area.

Yet despite the highly negative public response, Yellowstone's forests would recover without any significant issues. Forests, like those burned in Yellowstone in 1988, have evolved to be highly resilient to major fires. Wildfires are simply part of their natural regenerative routine. Roughly every 100 to 200 years, a historic drought (like those leading up to the 1988 fires, described as the worst since 1934) creates conditions favorable for a fire, which can then be started by natural causes (of the 51 distinct fires in 1988, 42 were sparked by lightning).

Wildfires play an important role in the life cycle of many forests, and many of their regenerative processes are catalyzed by the presence of fire. After a wildfire burns itself out, the restoration process begins almost immediately. Lodgepole pines, which make up nearly 80 percent of Yellowstone's forests, generate serotinous cones, which only open to disperse their seeds after being heated by fire. Fires very rarely become hot enough to destroy the root systems of larger trees, and seedlings sprout from these roots. Moreover, the now bare soil is more suitable for seedling growth, due to both mineral nutrients in the ash and increased sunlight after the canopy has burned away.

Climate change, however, may disrupt this cycle, despite eons of specialization. Dr. Monica Turner, professor of ecology at UW-Madison, has studied this cycle in Yellowstone for nearly 30 years. She began her work in the park in 1989, studying the forests' recoveries immediately after the fire, and has continued to do so over the decades since. This past summer, she was back in Yellowstone, studying areas that had burned during the summer of 2016 – specifically areas that had also burned in 1988 or the early 2000s. In doing so, Turner was hoping to investigate a more current issue: how climate change may affect forests in the Western United States. How might a forest's resilience (that is, ability to recover from a fire) be altered? What factors might drive a change in resilience? How likely are such factors to manifest?

According to Turner, climate change may affect the recovery process in several ways. Central to this possible change is the frequency of fires. As the climate is altered, drought conditions like the ones that lead to the 1988 and 2016 fires will become less of the extreme and more of the norm. As a result, fires will occur more and more frequently. Forests such as the one Turner studies have evolved to burn only once every 100 years or so, and their mechanisms of recovery are not specialized for intervals closer to 15 or 30 years. Depending on the species, a tree may go anywhere from the first 15 to 50 years of its life without producing cones, and short interval fires reduce the number of seeds for the next generation of the forest to sprout from. If a fire is large enough, the burnt areas may be too large to be replenished by seed dispersion (where nearby unburnt trees spread seeds into burnt areas). Dr. Turner spent the summer of 2017 investigating these hypotheses, and while the study is not yet published, she says that from her own personal observations, there appears to be substantially fewer trees following the short interval fires than there were following the 1988 fires.

Furthermore, climate change may alter ambient conditions after the fire such that seedlings may no longer grow as easily. Drought conditions, specifically high temperatures and lack of water, persist after the fire may considerably reduce the number of seedlings able to establish themselves. Turner is currently working with Winslow Hanson, her colleague in the ecology department, in studying the effects of hotter and drier conditions on seedling regeneration post-fire. Their work has involved transplanting seedlings from higher altitudes, where they grow in cool and wet conditions, to lower altitudes, where conditions more resemble the hot and dry ones that climate models predict will be the norm by the mid-21st century. While their work here is also not yet published, Turner observes overall lower success of seedlings in the hotter and drier conditions.

"We are going to start seeing more fire, and we as a society are going to have to figure out how to live with it."
-Monica Turner

Both through her field work and in various experiments, Turner joins scientists across the globe in the difficult task of trying to predict what our climate and ecosystems will look like in 75 or 80 years. These predictions involve the study of slow-moving systems, while the severity of global climate change necessitates immediate action. To aid this process, Turner, like many other scientists, is working to develop new computational models and further refine existing models so as to more accurately predict future conditions. Existing models are becoming outdated and obsolete given the new patterns that are emerging due to climate change. "Many of the models incorporate empirical relationships, based on conditions and processes over the past 10,000 years. The problem with that is we're now outside the boundaries of what we've experienced over the past 10,000 years, in what's called a no-analogue situation – it's unlike anything we've experienced before. The challenge now is getting away from those empirical relationships and returning to the first principles," Turner says.

With these models, Turner and other scientists can help land managers such as the United States Forest Service and the National Park Service better function in the face of changing conditions. This past summer, Turner's work also involved meeting with representatives from these and other groups in Bozeman and Missoula, Montana about different outputs they would like to see included in the forest models. Specialized outputs would help inform land managers as to how changing conditions might impact recreation areas and how wildlife habitats might be affected, thereby helping them discern the most viable management strategies going forward.

Ultimately, the questions of how to manage American forests will become more and more vital as climate change continues, especially with regard to wildfires. Turner relates this to the Napa Valley Fire this past fall, with the same concepts applicable to the early-December fires in the Los Angeles area. Like the 1988 fires in Yellowstone, the sizes of the California fires stemmed from a combination of ambient weather conditions – intense winds fanning flames in vegetation made exceptionally burnable by drought. Much like humans have built in flood-prone areas, many towns and cities in California are situated in areas that burn. Climate change has shifted ambient conditions to be more favorable to wildfire, thereby putting those places at risk. "I don't see the California fires as being a one-off event," Turner says, "simply because they're consistent with the trends we've been seeing over the past 15 years. We are going to start seeing more fire, and we as a society are going to have to figure out how to live with it."

Written by: Patrick Byrne
Photography by: Ella Gao
Design by: Suzanne Kukec

Intelligence: Coming to a City Near You

Madison is just one of many cities buying into the Smart City trend.

Apple's annual smartphone releases are the highlight of the year for many tech junkies, but this year the iPhone X isn't the only "smart" technology making waves in the lives of many city dwellers. Cities themselves are getting an upgrade, which could mean far more significant changes to your life than iPhone's home button going away ever will.

At the center of these changes is the concept of "smart cities," which are created by integrating technology into many of the day-to-day functions of a city. Features of this integration range from flashy plans for autonomous public transit vehicles to the decidedly less exciting optimization of stoplight patterns using big data. In between, other features to explore include wireless charging platforms for electric vehicles, universally available Wi-Fi, and apps to streamline transit payments and public parking. Yunji Kim, an assistant professor in UW-Madison's department of planning and landscape architecture, explains that "in the beginning, most of where these new technologies actually hit the ground is going to be the larger urban cities."

One such city is Toronto, which recently made a deal with Sidewalk Labs (owned by Google's parent company, Alphabet) to create a new smart technology district called Quayside on Toronto's Eastern Waterfront. They hope to create a "people-centered" region where modern transportation and a focus on sustainability support "a close-knit community that uses data to improve city services." Sidewalk Labs' ambitious plan includes electronic infrastructure, allowing autonomous vehicles and sensors to measure everything from air pollution to traffic congestion. They also have plans to create things like an underground garbage disposal system and new, modular housing which could lead to carbon-neutral communities. To connect citizens to these changes, they created an app called Flow, which will provide both municipal officials and citizens with real-time information about day-to-day concerns like open parking spots and delayed buses. Apps like this are a critical step in bringing a smart city to fruition, as they allow the end user–a citizen–to interact directly with the city they live in.

"Most of where these new technologies actually hit the ground is going to be the larger urban cities."
-Yunji Kim

Closer to home, in 2016, Madison was one of 78 American cities to apply to the United States Department of Transportation's (USDOT) Smart City Challenge, which solicited applications for an "integrated, first-of-its-kind smart transportation system." These kinds of initiatives aim to integrate technology into the essential operations of a city. Ultimately, Madison wasn't selected as a finalist for the competition, but urban planners saved and improved on these plans for future use. Later in 2016, Madison took the plans and joined a new partnership between Sidewalk Labs, Transportation for America (T4A), and 15 other United States cities to collaborate on policies related to autonomous vehicles, shared mobility, and big data analytics. The goal of the partnership is to help city planners improve residents' experiences with all types of transportation, including public transit, pedestrian and bicycle transportation, and personal automobiles.

The MnDOT Autonomous Shuttle Bus Pilot Project bus is hoping to change public transportation with a new electric, driverless vehicle designed for cities.

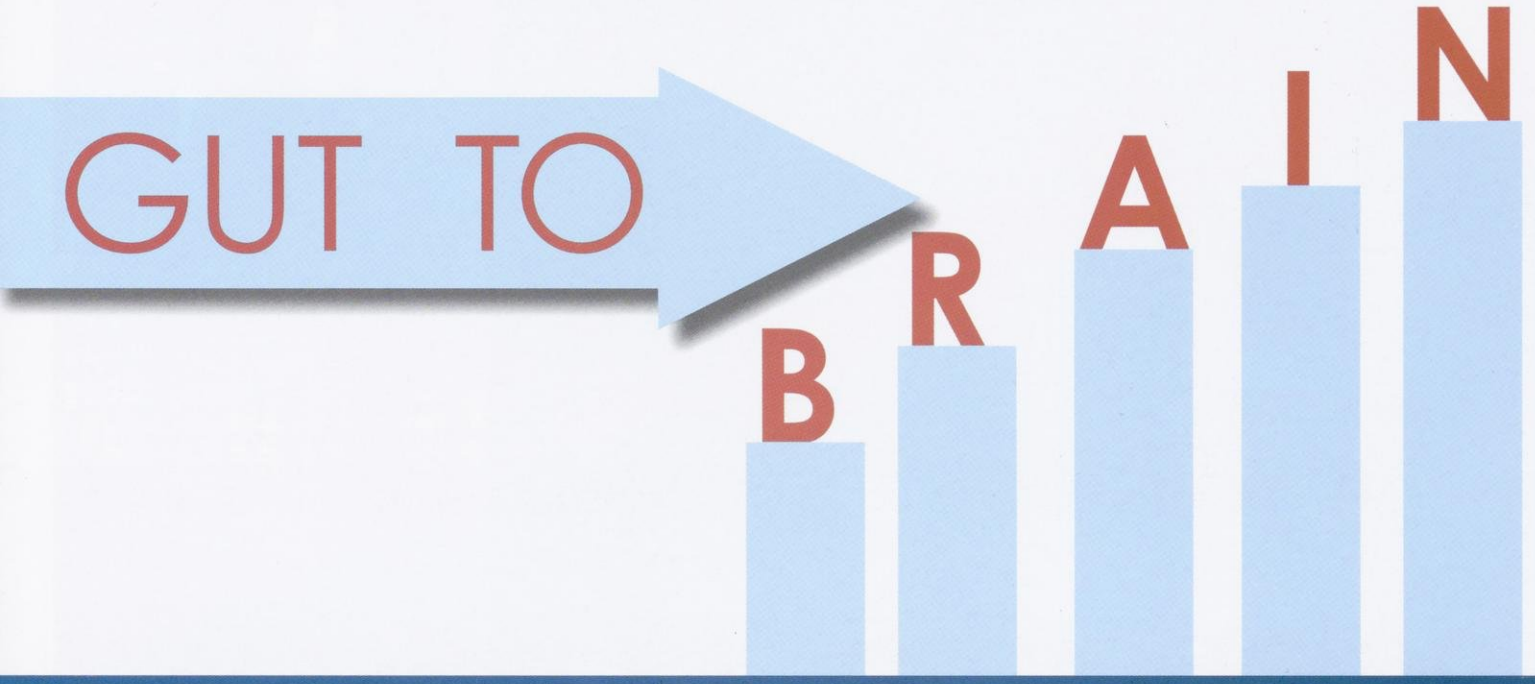
Balancing these forms of transportation is essential to maximize access to jobs and other opportunities in the heart of Madison. For those living on the fringes of the Madison Metropolitan Area, public transit is scarce and at night, often inaccessible. To help provide reliable transit to these residents, Madison is planning to develop an algorithm which will optimize the use of ride-sharing vehicles to reduce rider wait times, while providing service to more areas of the city. This algorithm will eventually be used to run a fleet of autonomous public transit vehicles, which can be called at any time of the day or night.

The geography of the Madison area causes its own unique transportation issues, particularly along the isthmus, where traffic and growth are constrained to a narrow strip of land. These constrictions force residents into high-traffic corridors where they often encounter significant delays during high-usage time periods. To maximize traffic flow in these problem areas and throughout the city, the Smart City Plan includes a smart infrastructure platform. This platform will support Smart Corridors in the problem areas, a city-owned 4G network, and air quality sensors to monitor environmental impact through tracking of vehicle emissions. The Smart Corridors are especially exciting, as officials will be able to test the integration of Wi-Fi and Bluetooth sensors in connected vehicles such as public buses and taxi services. These sensors will interface with the adaptive traffic signals on main roads.

There are still many obstacles to the pursuit of making smart cities ubiquitous across the United States, but advances in transportation networks, autonomous vehicles, and environment-monitoring sensors have set us on an exciting path. Madison's Smart City Challenge plan and Toronto's Quayside development project are just two examples of the multitude of ways that urban planners are using technology to improve the daily lives of residents. At the rate technology is being integrated into every aspect of city life, we may wake up someday soon and realize it's not only our phones that are smart, but our cities are pretty tech-savvy, too.

Written by: Ben Zastrow
Photography by: Jason Hakamaki
Design by: Tim Campbell

GUT TO BRAIN



The gut microbiome might contain a potential causal factor and indicator for Alzheimer's disease.

Alzheimer's disease (AD) patients suffer from memory loss and mental degeneration. This disease is caused by neuronal degeneration and amyloid decomposition. It is unexpected, then, that the pathology of this disease has been associated with the gut microbiome. Recently, PhD student Nick Vogt and his colleagues at the Wisconsin Alzheimer's disease Research Center discovered that AD patients appear to have differences in gut microbial diversity. This finding, along with others, has been published in Nature and provides a new angle in the search for more precise diagnostic and therapeutic techniques.

The relationship between gut microbial changes and AD has been inferred but never supported with evidence for over ten years. The gut is the largest source of microbes in the human body and has many known implications for human health. The gut microbiome has already been extensively linked to various conditions including obesity and diabetes. Only recently have scientists started to notice the microbiome's role in brain diseases. Vogt mentioned an inspiring animal study, explaining that "there have been some animal studies on some transgenic AD mice, which are prone to get the amyloid complex. They are proteins in the brain characterized by AD. If you raise those types of animals under germ-free conditions, they have a reduced rate of noticeable amyloid complex. So, the presence of a modified microbiome seems to be modulating the build-up effect of those proteins in the brain."

People have become more interested in the relationship between the gut and the brain, demonstrated by further study into the relationship between Parkinson's disease and microbial changes. However, as Vogt mentions, "There has been some suggestion in the literature that there might be some role of bacteria in AD, but no one has really tested it before."

> **"Microbial changes are a potential cause of AD, and shows its link with neurodegenerative disease associated with aging."**
> **-Nick Vogt**

Vogt and his colleagues obtained and analyzed fecal samples from participants to find that AD does correlate with gut microbiome and cerebrospinal fluid (CSF) biomarkers . His findings lead to a deeper understanding of AD pathology. One of Vogt's more interesting theories is that Type 2 diabetes may play a part in the development of AD. In explaining this theory, Vogt says his study "showed a decrease in Firmicutes and an increase in Bacteroidetes from fecal samples of AD patients. This kind of change is also detected in Type 2 diabetes patients. People with Type 2 diabetes and insulin resistance are more likely to develop AD." Vogt says that microbial changes are a potential cause of AD, and shows its link with neurodegenerative disease associated with aging. Vogt also mentioned planning to feed special pills from AD patients' fecal samples to healthy people. Further research might contribute to find the potential causal factor of AD and lead to therapeutic method.

The gut microbiome may also act as a diagnostic indicator, as its composition changes before people are diagnosed with AD. In their research with cognitively healthy people, Vogt and colleagues found an interesting trend among potential dementia patients. "The bacterial changes associated with AD-linked proteins before the diagnosis of AD suggest that something in the gut microbiome was going on before these people got AD," Vogt says. If AD can be diagnosed early, prevention efforts might prove to be more successful in the management of the disease. "The whole field of AD is turning more towards prevention and identifying people at risk. Once people show the signs of AD, like dementia and impaired memory, it is already too late," Vogt says. Although there is still a long way to go before these findings are used in therapeutic treatment, Vogt's study certainly indicates the need for further research on the relationship between Alzheimer's Disease and the human gut microbiome.

Written by: Yinghong Liu

Design by: Suzanne Kukec

Engineering... after dark

Janitors at UW-Madison create a welcoming environment for all engineering students.

Picture an engineering student. You are probably picturing a sleep deprived, coffee-consuming, overwhelmed, and overworked young adult. Well, that description might also apply to all college students—so what separates the engineers from the rest of the campus? Is it the tougher classes? Is it the heavier workload? Is it the late nights in the engineering buildings, slaving over seemingly useless calculus and thermodynamics? Maybe it's all of these factors and more, or maybe that's just what engineering students want the rest of the campus to think. Maybe those late nights in Engineering Hall or the Engineering Centers Building are not spent stressing over schoolwork at all. Maybe, there is something else going on late at night that engineering students at UW-Madison have kept secret for generations.

Starting in 1857, UW-Madison engineering has undergone many drastic changes. New buildings have risen and fallen too many times to count—almost as many times as the Engineering Hall lobby has been remodeled in the past decade to hide the rest of the decrepit building from tour groups. One of the few constants in the College of Engineering has been the one janitor family that has passed down the broomstick from generation to generation. I sit down with Edna, the eldest living member of the Geering family, to discuss what it is engineering students actually do in the buildings so late at night and how she plays a role. After all, she is the descendant of the world-renowned Edward "Engine" Geering, founder of the janitorial sciences program at UW-Madison.

Graduating at the top of her class in janitorial sciences, Edna is no stranger to the UW-Madison campus and all the hidden secrets it holds. It wasn't until three years after Edna received her Masters of Broomstick Administration (MBA), however, that she had the privilege of working in the engineering campus. "I had always heard stories of how the engineering campus differed from the rest of the university, but even my father did not tell me any of these so-called secrets," Edna says. Edna soon realized that students in this area of campus would stay up later than the average student—even later than herself in her collegiate years. One night, as Edna was sweeping rejected masters students' theses under the rug, she heard

what seemed to be music coming from beneath her feet. As she followed the sound, she soon found the hidden treasure underneath the engineering campus –a vast room full of hundreds of engineering students.

As it turns out, the third Wednesday of every month with 31 days in it, there is a concert performed by the engineering custodial staff exclusively for engineering students. This band, Sweep Balls of Fire, was formed by Engine Geering III in 1913 because students were getting into too much trouble on the engineering campus. "Because engineering students had so much free time, they would just create a mess in all the buildings that us janitors had to clean up. These activities put a stop to it," Geering says with a scowl. The band and their impactful after-school activities help the engineers do something constructive with their free time instead of causing trouble and creating a mess.

Apart from the concerts, students from every engineering discipline gather biweekly in this vast underground gathering area as they complain to their roommates or parents that they are "studying late" again. "Engineering is actually quite a breeze. I switched majors after my freshman year from undecided to general engineering, and my workload has significantly decreased," one anonymous engineering student says. These after-school initiatives have cut down on the amount of cleanup that the janitors have had to do.

To uphold the stigma that engineering is a tough major, students must be wary regarding access to these events. There are only a few access points to the Engine Geering Hall underneath the engineering campus. One is in the basement of Engineering Hall, and one is in the Engineering Centers Building. Only engineering students access to these activities put on by the janitors. To get into the room, students must show that they have completed their homework for the week, but no students have ever had a problem with this. "Being a janitor not only means cleaning up messes; it also means being a role model for young minds," Edna says profoundly.

Edna, now lead singer of Sweep Balls of Fire, is proud to continue the legacy imparted on her by her predecessors. She plans to continue this tradition for years to come as the engineering campus continues to change. So next time your engineering friend tells you that they are going to study late again that night, now you know they are probably lying. However, there is nothing you can do about it but know they are becoming a better person in the hands of the College of Engineering janitors. One broomstick, mop, or vacuum at a time, Edna Geering and the UW-Madison engineering janitorial staff are creating the culture for successful future engineers.

Written by: Jordan Wolff

Photography by: Carter Swedal

Design by: Suzanne Kukec

> **"Being a janitor not only means cleaning up messes; it also means being a role model for young minds."**
> **- Edna Geering**

Left: Secret doorway (talk to an engineering alumni for the location).
Top: Engineering Hall is where the best "studying" is at night.
Bottom: Only studying hard gets you into the show.

Air Pollution

and the Health of Wisconsin Residents

Wisconsin residents who live in close proximity to high-traffic roadways may be at a higher risk for developing allergic diseases and asthma.

Air pollution causes one in eight deaths worldwide, according to the World Health Organization. Many people are unaware of the extent of air pollution exposure they receive on a daily basis, and with greenhouse gas emissions on the rise, it is crucial to know just how much air pollution can affect not only our environment, but our lifespan as well. As defined by the United States Environmental Protection Agency (EPA), air pollution is "any visible or invisible particle or gas found in the air that is not part of the natural composition of air." Though these hazardous air particles affect everyone's air quality, location is a key component to the relative toxicity of these effects.

Amy Schultz, UW-Madison PhD student in epidemiology of the department of population of health sciences, conducts research related to population outbreaks and population-wide health. In particular, Schultz published a Wisconsin-based study in 2017 on air pollution and its association to allergic diseases for her master's thesis.

Schultz's study focused on whether or not people are more likely to have allergies, asthma, or wheezing if they live near primary or secondary roadways, industrial sites, or are exposed to higher levels of ambient particulate matter as measured by the EPA. The Wisconsin-wide population data was retrieved from the Survey of the Health of Wisconsin (SHOW), an organization that collects annual health data about Wisconsin residents, which researchers use for studies related to population health. Every year, the SHOW program travels to randomly selected census block groups of various communities around the state of Wisconsin. These randomly selected households are visited door-to-door to find adult participants willing to be involved in this health study. "They collect over 2,000 variables on people, anything from smoking, alcohol use, family health history, electronic screen-time, physical activity, as well as bio-samples like blood, urine, and hair," Schultz says. For Schultz's study, she used the information SHOW gathered from the years 2008 to 2013.

As this study focused on irritants, people's lung function was tested with a spirometer, a device which measures how much air can be expired in one second, as well as how much total air can be expired. The asthma data was collected from self-reported data of whether the participant had ever been diagnosed with or experienced asthma at any time throughout the year.

To calculate data on air pollution exposure, Schultz used the Bayesian space-time downscaler model used by the EPA to collect data on air pollution and toxic release inventory. This model makes estimates of air pollution for the whole United States by inputting traffic data, weather, humidity, climatic events, agriculture, etc. of each area they calculated. Estimates are plotted on a 12 by 12-kilometer grid. Schultz focused on particulate matter of 2.5 micrometers (PM2.5) in size or smaller, such as sulfate, nitrate, and black carbon.

As hypothesized, locations near high-traffic roadways and high-emission industries were areas with higher estimated air pollution. Compared with the data received from SHOW, Schultz found that people living in these roadside locations tended to have more allergies and asthma than those who lived in lower estimated pollution areas. The strongest correlation showed higher rates of asthma in people living 300 meters or closer to primary (U.S interstates or state highways) and secondary roadways (like University Avenue). When purely looking at primary roadways, there was an overwhelmingly high association with asthma due to the increase in vehicle traffic. "With asthma, we did see association – those that were exposed to 10.9-15.1 micrograms per cubic meter of air pollution had 3.23 greater odds of having asthma," Schultz says.

The conclusions of this study show evidence that asthma prevalence is higher among Wisconsin residents who live in closer proximity to high traffic roadways when compared with those who live further away.

Survey of the Health of Wisconsin's logo and map showing where the research study participants from 2008 to 2013 are located based on census blocks.

Because the EPA standard for air quality is 12 micrograms per cubic meter, this discovery is concerning. However, Schultz believes more population health studies would reinforce conclusions about whether the EPA's standards should be changed in concern for our health. Schultz's next plans with this dataset will be about people living next to industrial farms in Wisconsin by looking at their exposure to ammonia and methane. Schultz will first look at whether residential proximity to an industrial farm in Wisconsin is associated with greater likelihood of having asthma, allergy symptoms, or decreased lung function.

The conclusions of this study show evidence that asthma prevalence is higher among Wisconsin residents who live in closer proximity to high-traffic roadways when compared with those who live further away. This suggests that traffic and vehicle exhaust may be big contributors to the correlation of air pollution with particulate matter of 2.5 micrograms per cubic meter or smaller, and asthma.

It is easy to forget that these silent, often invisible pollutants in our air may be affecting our lives and overall health. However, each day we are learning more and more about how pollution impacts our world. The continuation of these types of studies are extremely important to remind us that air pollution is all around us, and we are the main culprits for its existence. As we are the ones contributing the most to the reality of air pollution, we are also the ones that can make a difference by reducing our consumption of fossil fuels to make the world a better place to live in.

Written by: Erin Clements

Image courtesy of: Survey of the Health of Wisconsin

Design by: Suzanne Kukec

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