

InnovatED

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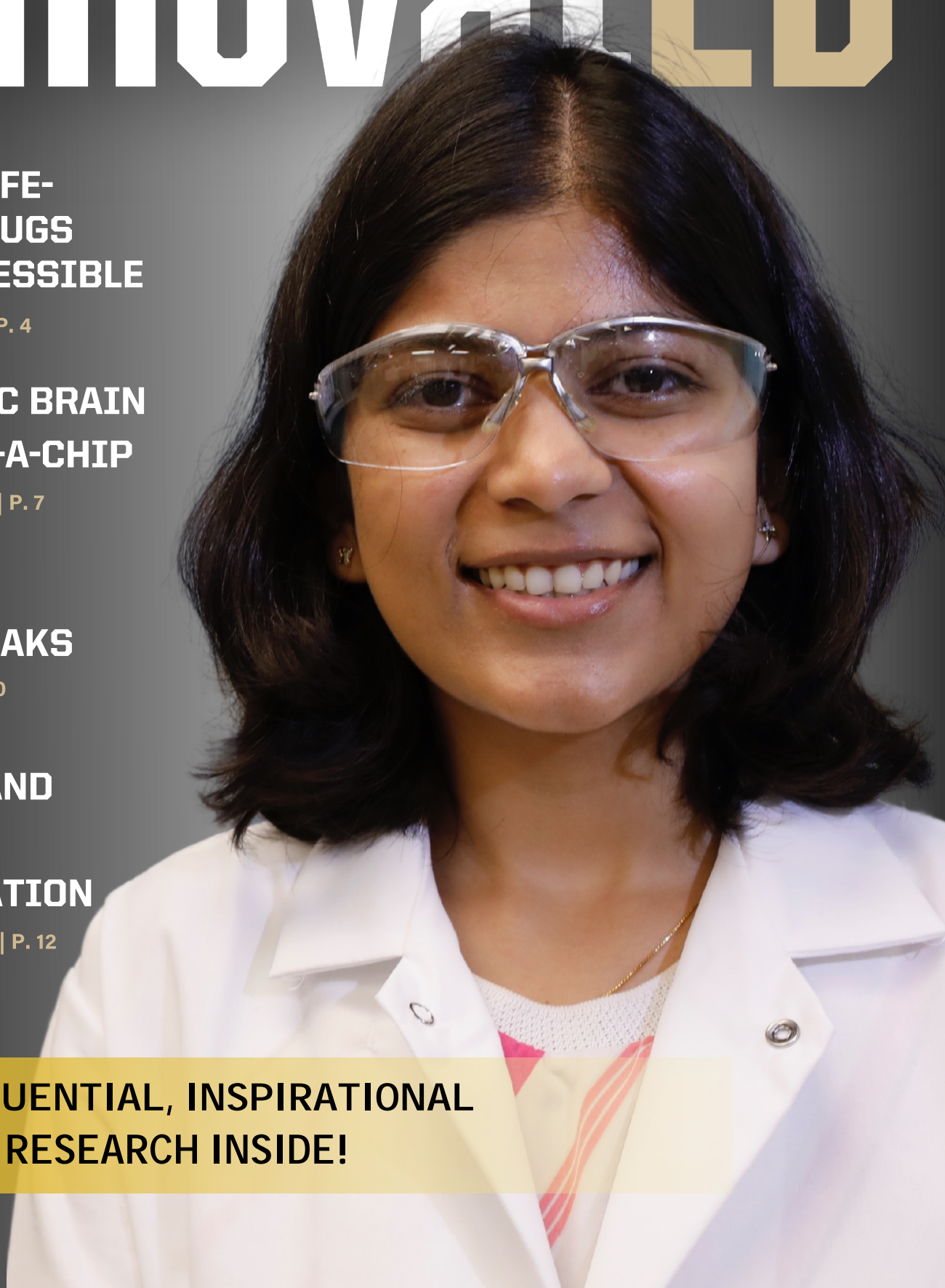
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A LETTER FROM THE DEAN

Dear Purdue Community,

This year has been defined by extraordinary trials and hardship. The pain of loss, isolation, and inequity has permeated not just the Boilermaker community, but the world. Graduate students are not immune to this pain. This year alone, the Graduate School processed more than 541 applications for emergency COVID-19 relief. However, in the face of this extraordinary hardship, I have seen something equally as extraordinary – resilience. As Dean of the Graduate School, I have witnessed tremendous success throughout the graduate community, as we have worked together to define our new normal. Consider this magazine, for example. The inaugural issue of InnovatED was published in August 2020, during a time of significant uncertainty. We were not sure how long the pandemic would last. We were not sure how it might affect the Purdue community. We were not even sure that we should ask graduate students to take the additional burden of writing articles for this issue. Despite this uncertainty, we persisted, because one thing of which we are certain is that graduate research has the power to change the world. With our inaugural issue receiving over 1,000 reads in nearly 20 different countries, it is clear that the world agrees.

Our successes do not stop there. Graduate student participation in professional development initiatives has increased 42% in the last year. Students are attending online workshops, participating in virtual research communication competitions, like the Three Minute Thesis (3MT), and completing virtual internships through our Boilers Work internship program in record numbers. Graduate student enrollment is also up. While many students needed to defer their enrollment, due to COVID, we recently welcomed our largest cohort of graduate students to date. Some current students had to go remote to help family, others had to refocus their research questions, and some had to learn, like all of us, how to balance homeschooling, or creating a home office, classroom, or lab on the kitchen table.



These successes are further proof that it is not our hardships that define us, but how we face our hardships, and our graduate community has done so with determination, grit, and a dedication to improving themselves, our community, and the world at large.

As we move forward and make strides in our fight against COVID-19, I look forward to the day when we can work, learn, and grow together again. I am particularly excited by the prospect of an in-person graduation ceremony, where I can hood our graduate students and congratulate them on their exceptional achievements. Until then, please enjoy this latest issue of InnovatED, a celebration of the influential and inspirational graduate student research conducted at Purdue University.

Boiler Up,

Linda Mason

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MAKING LIFE-SAVING DRUGS MORE ACCESSIBLE

I imagine you just returned from an adventurous jungle safari! Soon after, you are down with fever and chills, and you find out that you have been infected with Malaria. The pharmacist hands you 24 tablets; to be taken in a span of just three days. Not very convenient, is it? This is a problem currently faced by more than two hundred million people around the world who are infected with malaria. Sadly, this necessity of frequent medication, or ‘a high dosage’ to treat the disease, is not the only inconvenience. Higher dosage translates to higher costs for the patients, poor patient compliance, and the possibility of treatment failure. One might ask, why does this medicine require such a high dosage? The reason is the poor aqueous solubility of lumefantrine - the anti-malarial drug. For an orally administered drug to be absorbed by the body and exert the desired effect, its solubilization and dissolution are critical.

Therefore, the goal of my study was two-fold: first, preparing a lumefantrine formulation with improved solubility, and second, developing a simple, low-cost manufacturing method to conceive it. The manufacturing method needed to be cost-effective for it to have a wider application in countries with limited resources, but which extensively depend upon this drug for treating malaria.

‘Formulation’ of a pharmaceutical drug is essentially a recipe to prepare it, just the way there’s one for cooking one’s favorite dish! Consider a simple example of making an egg omelet. One can cook it in a variety of different ways. Then selected ingredients and seasonings are often added to the recipe. Why is that done? To make it safer for consumption, be effective in providing us the required nutrition, and of course, to appease the taste buds!

"DURING MY RESEARCH, IT WAS DISCOVERED THAT BY ADDING THE RIGHT TYPE OF POLYMER AND IN THE RIGHT AMOUNT, THE DISSOLUTION CONCENTRATION OF LUMEFANTRINE COULD BE IMPROVED BY MORE THAN 1000X ITS CRYSTALLINE COUNTERPART! THIS IS ONE OF THE FIRST RESEARCH WORKS WHICH PROVIDES A SIMPLE AND ECONOMIC, YET EFFECTIVE SOLUTION TO OVERCOME THE DRUG DELIVERY CHALLENGES ASSOCIATED WITH LUMEFANTRINE. "

- SONAL BHUJBAL

Similarly, drug molecules are rarely given to patients as is. Usually, the chemical and physical form of the drug molecule is optimized, and other ingredients are added to the recipe to ensure the final formulation is safe, effective, and palatable to the patient. It is critical that the formulated drug acts at the right time and the right target location. Since the slightest error in a formulation can make the drug either ineffective or toxic, a lot of work goes into the process of formulation design to select the right drug form, other ingredients, and their respective amounts.

With lumefantrine, the first modification made was transforming the crystalline form of the drug to an amorphous form, since the latter form is known to have a better solubility. Think of it as converting a large sugar cube into a finer powder, but at a molecular level. This improved the dissolution concentration of lumefantrine by more than 10X the marketed formulation containing the crystalline form. However, it was found that the amorphous form reverted to the crystalline form within a day of storage, not unlike powdered sugar forming large clumps upon long storage. To overcome this challenge, this amorphous form, at a molecular level, was dispersed into a water-soluble polymer to

generate amorphous solid dispersions (ASDs). The polymer both chemically and physically formed barriers that prevented the drug from recrystallizing and increased the drug's stability from one day to over four months.

The effect of various polymers on physical stability (recrystallization), and dissolution (drug release) was studied during the process. During my research, it was discovered that by adding the right type of polymer and in the right amount, the dissolution concentration of lumefantrine could be improved by more than 1000X its crystalline counterpart! This is one of the first research works which provides a simple and economic, yet effective solution to overcome the drug delivery challenges associated with lumefantrine. In addition to this, during the course of the project, a novel analysis platform for characterizing fine ASD particles for their chemical composition, drug-polymer distribution, and drug-polymer interaction was developed. This platform consisted of two state-of-the-art techniques of X-ray photoelectron spectroscopy and time-of-flight secondary ion mass spectrometry. It provided essential information to shed light upon the impact of polymers at a molecular level on the stability and functionality of ASDs.

The Bill & Melinda Gates Foundation is funding this work, with the end purpose of providing cheap, yet effective medicines to patients with low-income. Currently, I am working on preparing effective formulations for drugs used in the treatment of HIV and parasitic diseases with efficient and economic manufacturing processes. As one may have guessed, the first step towards making life-saving drugs affordable and available to all is realizing cost-effective manufacturing processes, and I could not be more excited for having produced the first-of-its-kind research towards treating Malaria, which affects millions of lives each year!

**A B O U T
T H E
A U T H O R**

SONAL BHUJBAL

Sonal is a doctoral candidate in the College of Pharmacy at Purdue University. Her research focuses on developing and optimizing manufacturing processes for preparing physically stable amorphous solid dispersions. Her academic advisors are Dr. Tony Zhou and Dr. Lynne Taylor. She received her M.S. in Pharmaceutical Sciences from Creighton University, Nebraska in 2016. Sonal is originally from Mumbai, India, and in her free time enjoys cooking, reading, and being outdoors in nature.



TRAUMATIC BRAIN INJURY ON-A-CHIP

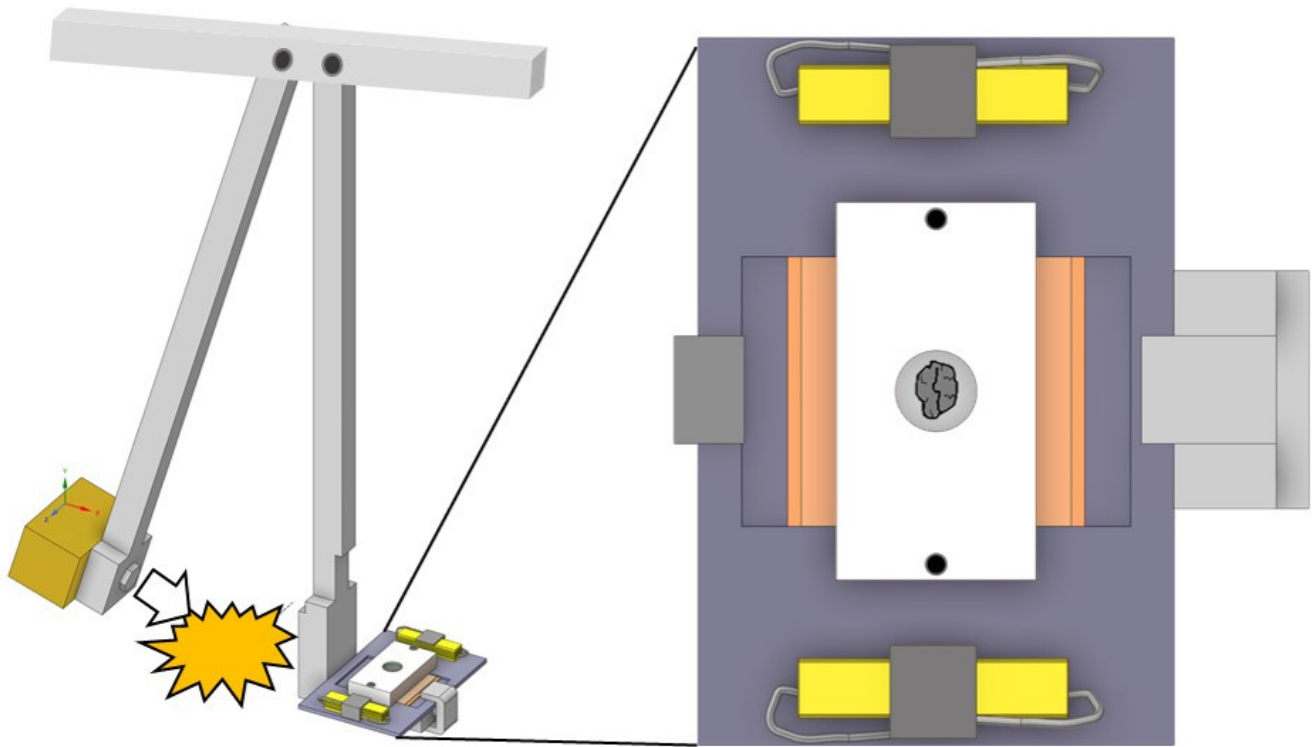
A NEW MODEL HELPS
UNCOVER THE LINK BETWEEN
NEURODEGENERATION AND
BRAIN TRAUMA



Traumatic Brain Injuries (TBI) are the leading cause of death and disability among children and young adults in the United States, according to the Center for Disease Control. This issue first grabbed my attention when one of my friends returned home from Iraq, after experiencing several “mild” brain injuries during his deployment. Although he looked just as healthy as the day he left, he had become a very different person. His personality was much less stable, and he began to exhibit an unusually high amount of risk-taking behavior. I struggled to understand these changes and, after some preliminary research, was surprised to learn that we do not have effective treatments for TBI. We do not even understand the basic mechanisms behind its development. As a result, I became very interested in neurophysiology (specifically neurotrauma) and hoped to design a system capable of better understanding this pathology. In 2018, I joined the laboratories of renowned neurotrauma and electrophysiology specialist, Dr. Riya Shi, M.D. Ph.D., at the Center for Paralysis Research in Purdue University’s Biomedical Engineering Program.

A literature review revealed multiple hypotheses of traumatic mechanisms, providing valuable information and describing several key proteins of interest. However, almost all of the experimental data available was based on either animal or clinical studies, which are ethically and physiologically complex procedures that can be rather limiting in terms of resolution and experimental design. No available model was capable of visualizing TBI-induced sub-cellular damage in the moments (seconds) immediately following injury and the subsequent associated long-term changes. In general, *in vitro* (cells grown outside of an organism) technologies provided the investigative resolution required to address these issues but lacked the necessary durability. Briefly, these *in vitro* groups of cells are usually grown in large, sterile incubators, on soft, thin materials, that are incapable of withstanding high g forces.

In response, we have developed the “TBI on-a-chip” *in vitro* impact injury system. In the simplest terms possible, we are now able to grow a sort of miniature brain on a glass microchip, expose it to clinically



relevant g forces (up to 300g), and observe the changes in real-time. This is accomplished through the use of a highly modified pendulum, capable of systematically applying impact-injuries to networks of brain cells on optically transparent multi-electrode arrays, or clear "microchips" that are fabricated in house and allow us to monitor brain electrical activity. Part of the model's success is attributed to the development of our "miniature-incubator" life support system, which can maintain physiological parameters while withstanding high-impact g forces. This approach provides unprecedented access to the very cells of interest during the traumatic experience. Furthermore, this system also offers an ideal platform for investigating potential pharmaceutical interventions, while greatly reducing the amount of animal experimentation needed for these types of critical drug development studies.

As we continued developing the "TBI on-a-chip" model I became more interested in the link between primary traumatic injuries and the subsequent development of neurodegeneration, a connection that has been clinically established but not mechanistically defined. Our lack of knowledge in this regard has resulted in the limited availability of effective treatment options.

While trauma-related symptoms are obvious and attract immediate attention, the post-impact pathologies that lead to chronic neurodegeneration generally progress very slowly and silently. They can take years to reach symptomatic levels, pushing detection beyond the window for intervention. The inability to diagnose the condition quickly has been a serious obstacle to better understanding the pathogenesis of this disease and establishing effective treatments to deter the development of post-trauma neurological sequelae. To tackle this problem head-on, we have been investigating several key traumatic brain injury biomarkers that are also hallmarks of neurodegenerative diseases, such as Alzheimer's Disease, aiming to not only understand the mechanisms but also identify diagnostic markers and therapeutic targets. By utilizing our novel trauma model, capable of producing precise mechanical impacts and monitoring a slew of subsequent functional and structural changes using a long-term life support system, we are exploring the critical role of initial physical (primary injury) and delayed, biochemical events (secondary injuries), in the development of neurodegeneration. These trauma-linked neurodegeneration studies are ongoing,

and the results are the subject of an upcoming manuscript in Scientific Reports. Additionally, the model is currently playing an important role in multiple projects funded by the National Institutes of Health, the Department of Defense, and Purdue's Institute for Integrative Neuroscience, in addition to being used for collaborative efforts between multiple laboratories here at Purdue and beyond.

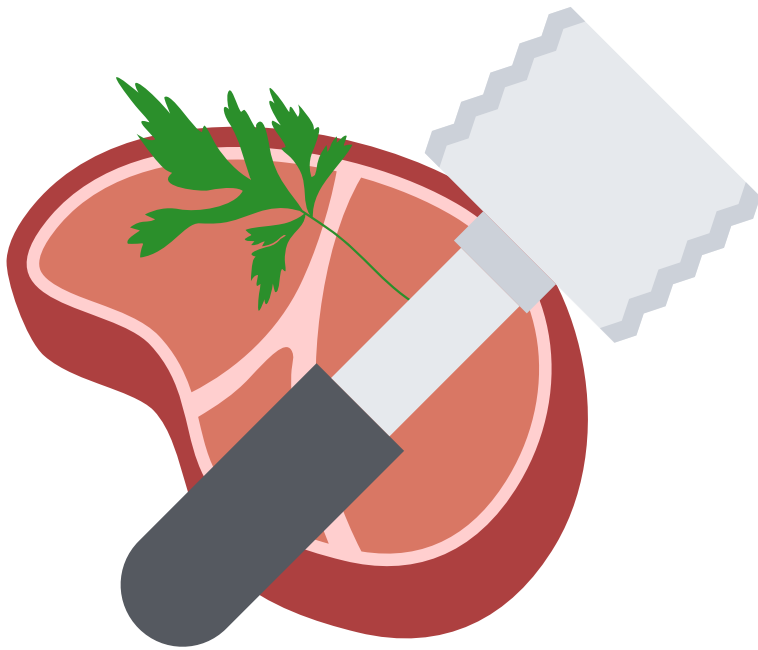
We hope that this new investigative tool will provide a better understanding of the underlying mechanisms of neurodegeneration and trauma, both individually and synergistically, while providing a semi-high throughput tool for drug discovery, and concurrently reducing the number of experimental animals required for this valuable research.

ABOUT THE AUTHOR

EDMOND ROGERS

Edmond is a Ph.D. student in Biomedical Engineering under Dr. Riyi Shi, and a CTSI TL1 Fellow. His work focuses on the mechanisms of neurotrauma induced neurodegeneration. Edmond is originally from Texas, enjoys volleyball and running outdoors with his dog, Daisy. He is interested in academic medicine and research as a career after graduation.





TLC FOR TOUGH STEAKS

Few eating experiences rival that of sitting down to a perfectly cooked steak. As you fondly think back on the steaks you have consumed thus far in your life, likely there are some that stand out from the rest. Some stand out for the right reasons: they were remarkably juicy, intensely flavorful, and so tender that no knife was needed. On the other hand, some likely fall into the opposite category, which more often than not owes to an unfortunate resemblance in texture to boot leather. These chewy steaks represent a critical problem for the meat industry to address: what is it that separates the tender from the tough?

Tenderness is one of the most critical factors influencing whether or not a steak is deemed acceptable or unacceptable to the consumer [1]. Accordingly, cuts of beef that are known to be suitably tender (e.g. tenderloin) are prized by eaters, while those known to be tough (e.g. chuck or round) are less so [2] (hence why in the market you often see ground chuck and round rather than steaks). Typically, these tougher muscles are those that were used continually for movement in the living beef animal [3]. One can

imagine the strength and resiliency a muscle must have to move a 1,200-pound animal from place to place. However, especially for those on a budget, a method to ensure these inherently tough (and thus cheaper) steaks reach a level of tenderness that rivals that of more valuable cuts would undoubtedly be welcome.

Jacob Tuell, a Ph.D. candidate in the Kim Meat Science and Muscle Biology laboratory, is researching a simple strategy to ensure various cuts of fresh beef reach an acceptable level of tenderness by the time of consumption. The process utilizes a piece of equipment that many meat processors already own in a novel way. Using a meat tumbler, commonly used for applications like marination and boneless ham production, large cuts of beef can be rotated for a period of time ranging from 40 minutes to 2 hours.

“There are enzymes inherently present in beef that work to break down the rigid structure of muscle into smaller fragments that we perceive as tenderness. However, this process takes time, and some cuts are

less responsive to this ‘aging’ process than others. Our method aims to speed the process of aging along, as well as overcome the characteristic toughness of certain muscles,” Tuell explained.

To evaluate the effectiveness of the tumbling process, Tuell and his advisor, Dr. Brad Kim, experimented with different durations of tumbling and aging with different cuts of beef. The first phase of the research was focused on addressing the simple question of whether the tumbling process would be successful at tenderization. New York Strip steaks (an inherently tender and valuable cut) were tumbled for a period of 60 or 90 minutes, after which they were aged an additional 1 or 2 weeks.

“We saw an immediate improvement in tenderness through tumbling,” Tuell said. “Steaks that were tumbled 60 minutes were 29% more tender than those that were not tumbled. In fact, it took an additional 2 weeks of aging for the non-tumbled steaks to reach an equivalent level of tenderness.”

The follow-up study also utilized New York Strips in addition to Eye of Round steaks, a cut well-known to be tough and chewy. “Just like in the previous study,

tumbling improved the tenderness of New York Strips, and our 120-person consumer panel confirmed this observation,” noted Tuell. “However, the instrumental tenderness of Eye of Round steaks was not improved with tumbling, although there was a tendency for consumers to notice improved tenderness when tumbled steaks were aged for a longer duration. When consumers eat a steak, they often evaluate it holistically. This means that other factors such as juiciness could contribute to an increased perception of tenderness.”

“While our study did not show that tough steaks could reach equivalent levels of tenderness as the more valuable and tender ones, it did provide promising evidence that, with the ideal combination of tumbling and aging, someday they could. And, tumbling was shown to hasten the tenderization process in New York Strip steaks, which could someday be used to guarantee your steak is acceptably tender,” Tuell explained. Further studies are currently underway in the Kim Meat Science and Muscle Biology laboratory to optimize this process in various fresh beef cuts. “Choosing the right steak should never be a tough decision.”

**A B O U T
T H E
A U T H O R
J A C O B T U E L L**



Jacob Tuell is a Ph.D. candidate in the Kim Meat Science and Muscle Biology lab within the Department of Animal Sciences. He began his doctoral degree in 2018 under the guidance of Dr. Brad Kim. Prior to graduate school, Tuell received his B.S. degree in Animal Sciences with a concentration in Animal Products from Purdue University. Tuell has helped author 6 peer-reviewed papers and 7 abstracts/proceeding papers focused on the quality and oxidation of chicken, pork, and beef products. At present, his research focuses on novel processing techniques to improve beef quality and palatability.

THE TALK AND TABOO OF MENSTRUATION

AN EXPLORATION OF SOCIO-CULTURAL IMPLICATIONS IN NORTH INDIA

In the Oscar-winning Indian documentary, *Period. A Sentence*, the introductory video mosaic depicts women uncomfortably grinning when asked about menstruation, and men responding as if, by the word ‘period’, the interviewer was referring to a class period in their schools. While humorous in its depiction, the documentary highlights the stigma around menstruation amongst women and outlines their journey in adopting hygienic practices to manage their menstruation.

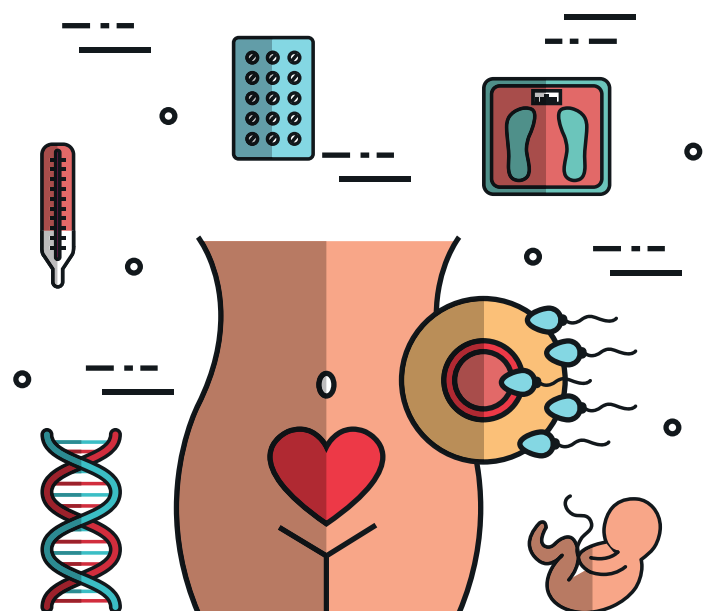
Recently, a UN report noted that, along with the hygienic practices of menstrual management, the stigma around menstruation needs to be addressed as well. This stigma makes it difficult for women to disclose their experiences with other premenstrual symptoms, which can range from forms of physical pain such as stomach cramps, backaches, headaches, to emotional effects such as hunger, irritation, anxiety, and depression.

With a focus on how women navigate disclosure of these premenstrual symptoms in the wake of taboos, we conducted an exploratory study titled the PMS Project in 2019. The study was supported by the College of Liberal Arts via the Global Synergy Grant and designed in partnership with Dr. Jyoti Seth, a sociologist from Punjab University. Ashleigh Shields and I (both Ph.D. Candidates in the Brian Lamb School of Communication) and Dr. Maria Venetis (now Associate Professor, Rutgers University) represented Purdue University in this collaborative project.

We designed this study with three central questions:

- What are some of the current cultural practices that guide talk around menstruation?
- How do college-educated women navigate the cultural practices to discuss their symptoms and seek care?
- How does family communication (specifically with mothers) influence their decision to disclose their symptoms and seek care?

The study was conducted in two locations in Northern India (one rural and one urban setting). The participants were women from government-sponsored colleges; therefore, the common variable that they shared was education opportunities in a university environment.



"...A MOTHER DESCRIBED HOW THEY WERE NOT ALLOWED TO ENTER THE KITCHEN OR TOUCH FOOD THAT WAS SUPPOSED TO BE SERVED TO OTHER FAMILY MEMBERS; HOWEVER, THEY ENSURED THAT THEIR DAUGHTERS DID NOT EXPERIENCE THE SAME DISCRIMINATION. "

- MEGHANA RAWAT

We applied a mixed-method approach and collected 600 surveys (300 from each location) and 20 focus groups. We additionally interviewed 13 mothers of volunteers who attended the focus group interviews to understand how communication around menstruation has evolved over the years within families. The surveys focused on exploring the subject's comfort with disclosing private information about menstruation, and the focus groups explored the socio-cultural constructs. In this article, we focus on the implications of the socio-cultural constructs.

Most women reported that they are influenced by the culture, their social structures, and interpersonal communication with family, especially mothers, to hide their symptoms and "bear with the pain." However, there were examples where both college-going women and the mothers who participated in the study discussed how their education, media, and other interpersonal interactions helped them navigate some strict social norms around menstruation. For example, a mother described how they were not allowed to enter the kitchen or touch food that was supposed to be served to other family members; however, they ensured that their daughters did not experience the same discrimination. As the majority of our participants identified as Hindus, we found examples where mothers expected their daughters to not visit the temple or attend religious ceremonies while daughters were menstruating. However, most daughters revealed that they did not follow this

practice as they believed that menstruation was not "dirty." They asserted that they will not have their daughters follow this practice either; however, we noted that participants from the urban location were more inclined to changing this practice. This was attributed to opportunities such as gender training at college and a broader exposure to mass media.

Thus, our study has the following recommendations for global practitioners aiming to intervene in menstrual health education and management in contexts, such as India.

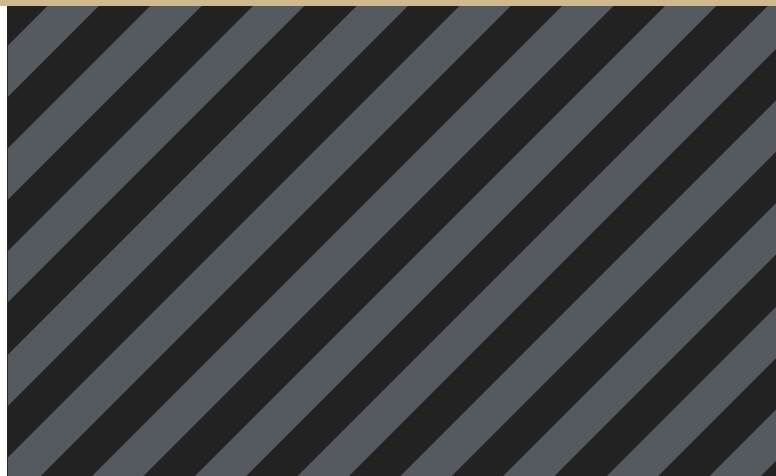
- Our study supports and advances the need to expand menstrual health management interventions, such as launching affordable products and sharing inclusive and scientific knowledge about menstruation, targeted to both girls and boys at puberty.
- Our study demonstrates that two locations in the same geographical area in India reported different understandings and beliefs around menstruation; therefore, a pan-India approach to designing initiatives is inappropriate. For example, participants in the urban city reported receiving gender training and exhibited more knowledge of scientific understanding of menstruation, as well.
- Our results indicate the need to include mothers and other extended family members in the

education initiative around menstruation. The participants in the study, specifically in the urban city, emphasized the need to include men in the conversation so that they can manage menstruation every month without structural barriers. Similarly, the first time that participants reported learning about menstruation was from their mothers, which was often incomplete information and foregrounded more shame and stigma around menstruation. Therefore, targeting systemic changes to include family can bring structural changes in women's experiences of menstruation.

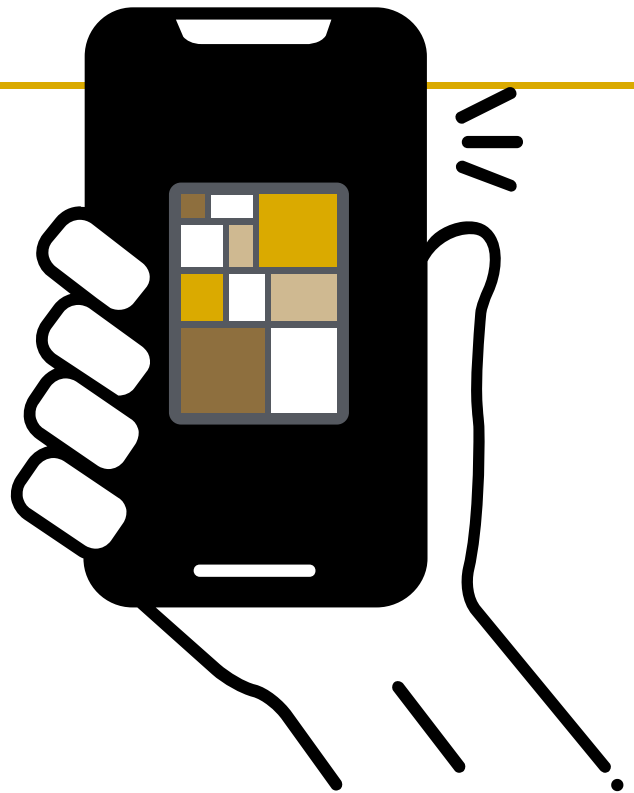
ABOUT THE AUTHOR

MEGHANA RAWAT

Meghana is a Ph.D. candidate at Purdue University majoring in organizational communication and public health. She has 11 years of professional experience in strategic communication, M & E approaches, and research methodologies across for-profit, nonprofit sectors, and academia. Her dissertation focuses on organizational networks of public health departments, specifically evaluating the role of communication in building trust and sharing knowledge in organizational networks. She has collaborated and led menstrual health education in India, and continues to study the impact of free menstrual management products on cultural taboos of menstrual health in the United States.



USING MOBILE CONTEXTUAL MARKETING TO COMPENSATE FOR PUBLIC FUNDING SHORTFALLS AT MUSEUMS



To accommodate the growing audience of young people and digital natives, cultural institutions, such as museums, have been embracing mobile technology to engage with visitors both on- and off-site. Since 2009, mobile apps have become a digital presence in museums, with primary functions including on-site navigation and interaction (e.g., trip planning, audio tours, AR games), display of museum collections and exhibit interpretations, as well as instant share and communications. One area rarely tapped by museum app developers so far is the integration of mobile contextual marketing. For example, can museum apps help stimulate visitors' impulse buying intentions and facilitate gift shop purchases to boost souvenir sales and benefit museums financially?

Mobile contextual marketing strategies are frequently used in retail settings, where businesses leverage the unique features of mobile devices and seamlessly integrate context-based elements, such as consumers' real-time geographical and temporal information, to present tailored messages and highly relevant promotions to consumers in the right place and at the right moment. Push notifications are often used to deliver such marketing messages to individual devices. Although museums are increasingly relying

on their gift shops as a complementary source of income due to a decrease in public funding, such cultural institutions have hesitated to implement proactive marketing strategies for fear of interfering with their educational missions. From the perspective of visitors, shopping for gifts or souvenirs is, at best, a secondary purpose of a museum visit. Thus, if the visitors consider their core museum experience interrupted by the promotion of souvenir shopping, they will not respond to the marketing stimuli as desired and may even form a negative attitude toward the entire visiting experience and the institution. Therefore, museums need to adopt a marketing approach that can effectively increase visitors' on-site purchase intentions without being perceived as intrusive. Mobile contextual marketing strategies may be the solution to this problem.

Established upon prior literature, my research, conducted in partnership with Dr. Alei Fan and Dr. Liping Cai, examines the effectiveness of such mobile contextual applications (i.e., real-time location-based mobile apps) in the setting of museum visits and souvenir purchases. When museum visitors linger at a specific exhibit (e.g., in front of a particular piece of art), they are probably interested in this particular artwork and may be more likely to purchase related

souvenirs if they receive a context-triggered message that allows them to perceive a sense of synchronicity (i.e., the message content and promoted souvenirs are in harmony with their real-time artwork appreciation experience) and acknowledge the benefits of saved time and reduced efforts in searching for such souvenirs in the museum gift shop. Our scenario-based experimental study, with 151 participants from an online research panel, confirms the benefits of mobile contextual marketing in such a non-commercial, experience-centered environment as museums. Because the in-app push function promotes souvenirs related to the on-site artwork, the visitors digest such messages with ease and even enjoyment, leading to an effortless and rather positive evaluation (which facilitates the impulse to buy and own the promoted products). During this process, visitors can still focus their primary attention on the artwork appreciation experience; therefore, the quality of their overall museum experience in terms of education, escapism, and overall satisfaction remains intact.

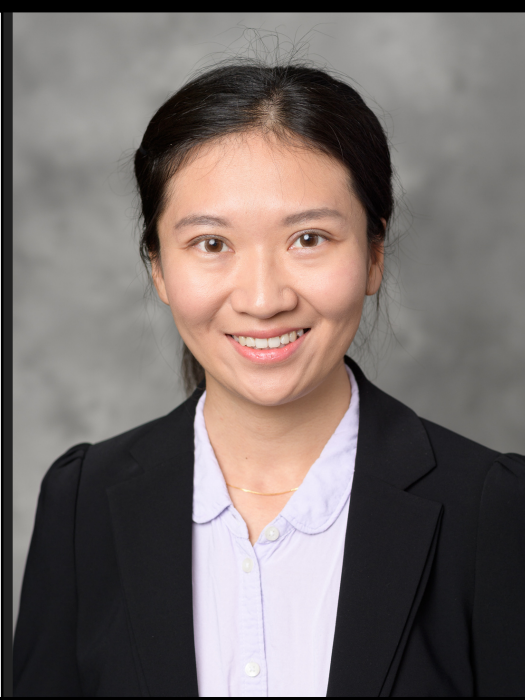
As modern museums increasingly operate under market conditions because of financial cutbacks, they strive to maintain both their social and recreational roles to be more accessible to a wider audience.

Merging traditional activities with technological innovations already tested in other fields (e.g. mobile app marketing in retailing) can give museums a head start in providing added value to visitors and broadening their own sources of revenue. Especially when the marketing stimulus indicates congruency with other contextual cues (e.g., visitor's real-time location and interests), it becomes a facilitator of enjoyable experiences for museum visitors. As this study shows, an enjoyable consumer experience is more than just valuable in its own right; it may also nudge the consumers to evaluate marketing stimuli positively and engage in more purchase behaviors.

Furthermore, for museum management to effectively implement such marketing strategies, they may need to pay more attention to the design and selection of museum souvenirs. Generic souvenirs and non-exhibit-related items commonly seen in museum store merchandise may bring in extra revenue; however, they are not the optimal selections for creating a seamless artwork-connection-consumption experience. When well designed and executed, a simple mobile app feature like this can impress the visitors and help museums thrive in a technology-enabled, visitor-oriented marketplace.

ABOUT THE AUTHOR

XUETING
(KATHERINE)
DOU



Xueting (Katherine) Dou is a Ph.D. Candidate in the School of Hospitality & Tourism Management, working primarily with Dr. Alei Fan and Dr. Liping A. Cai. Her research focuses on tourist behavior, service innovation, and student mobility. She's especially interested in investigating the impact of various interactions during travel on tourists' quality of life. Xueting was also working as a graduate assistant and student advisor in the Study Abroad Office at Purdue University. Originally from China, she enjoys cooking traditional Chinese cuisine as a soothing activity.



TEACHING INDIANA HISTORY THROUGH STEM AND AGRICULTURE

To keep up with powerhouses like Europe and Asia, science, technology, engineering, and math (STEM) initiatives have been on an upward trend in classrooms across the United States (Ejiwale, 2013). One of the biggest problems teachers face is the lack of educational materials or time necessary to integrate these ideas into their curriculum (Johnson, 2012). Currently, options for learning agriculture in a classroom setting are limited. Public elementary schools tend to focus on subjects that are covered by state standardized testing, leaving more applied areas of knowledge like agriculture or engineering and technology to be left out (Mercier, 2015). Currently, options to learn about agriculture at an elementary level lie outside of the classroom in clubs like 4-H, which has an estimated 6 million student participants, grades K-12, or 10.5% of total U.S. enrollment (Mercier, 2015), leaving out a majority of students. One solution to this is professional development and training to provide teachers with lessons that are

short and easy to integrate into their classroom. Some teachers stated they only have 10-25 minutes per day to devote to science teaching. By combining STEM and agricultural education ideas, it is more feasible for teachers to work into their daily schedules.

To help teachers integrate STEM and agricultural lessons into their curriculum, a series of three lesson plans were developed. These lesson plans focused on sheep and their byproducts, as related to Indiana history, which is a major topic in the 4th-grade curriculum and standards. The lessons were presented to 4th-grade students who participated in an immersive classroom experience at a central Indiana historic farm.

The unit consists of three lessons; the first is an introduction, which includes a basic understanding of sheep anatomy, the sheering process, including why sheep are sheered, and common byproducts from

"THE IMPLICATIONS OF INTEGRATING STEM AND HISTORY INTO THE AGRICULTURE, FORESTRY, AND NATURAL RESOURCES CONTEXT ARE LARGE. WE CAN EXPOSE STUDENTS TO A FAR GREATER WEALTH OF INFORMATION AND BETTER PREPARE THEM TO IDENTIFY THE CONNECTIONS BETWEEN STEM AND AFNR, AS THEY PROGRESS INTO ACADEMIC AND PROFESSIONAL CAREERS."

- BRYANNA NELSON

sheep, explicitly focusing on wool. In the second lesson, math takes the lead as students calculate how many products can be created from one sheep or a small flock. This lesson provides a historical understanding of agriculture and life in the 1800s and integrates math and technology ideas. The third lesson ties everything together and provides students an opportunity to create a woven product loom built from popsicle sticks right in the classroom. Students gain an understanding of the engineering design process as they weave strands of wool, creating a piece of art or usable product.

As the unit was presented in an informal setting, the lessons were not assessed using typical learning assessment parameters, but rather observations and informal interviews with the teachers. These observations and interviews were based on engagement, content, and appeal to students and teachers. The unit was found to have engaged the student participants in all areas of science, technology, mathematics, engineering, and history. In some cases, students were exposed to multiple areas at once. Using the historical farm allowed for lessons that fully engage students in the learning process. Students would receive general information within

the classroom and this information would be reinforced by connecting it to history. For example, students would be exposed to the wool product-making process and then taken on a historical tour that explained why citizens wore extensive wool clothing in the past or the process by which that clothing was made. The implications of integrating STEM and history into the agriculture, forestry, and natural resources context are large. We can expose students to a far greater wealth of information and better prepare them to identify the connections between STEM and AFNR, as they progress into academic and professional careers.

In its current state, the lesson plan is tailored to Indiana history, but with a few modifications, it can easily fit any state or local area. Teachers who participated in the lesson enjoyed how engaged the students were and how science, technology, engineering, and math were integrated using agriculture as the context, a topic not often highlighted in the elementary classroom. To enhance the lesson, we recommend allowing students to work in groups. Peer groups allowed students to create discourse and dialogue about the concepts they were learning, as well as help each other along the way.

Future iterations of this unit will hopefully be enhanced by standardization, as it will allow the level of integration across the unit to be increased and ensure a higher level of STEM integration (Wang & Knobloch, 2018) within each lesson.

ABOUT THE AUTHOR

BRYANNA NELSON

Bryanna Nelson is currently a Ph.D. student in the Department of Agricultural Sciences Education and Communication under the advisement of Dr. Hui-Hui Wang. Her current work focuses on interdisciplinary collaborations between STEM and agricultural teachers and introducing students to community and cultural connections when approaching real-world problems as part of a USDA grant-funded project. When Bryanna is not working on research, she enjoys hiking, gardening, and spending time with her dog, Eddy.



STEM TALENT DEVELOPMENT JOURNEY OF UNDERREPRESENTED STUDENTS

Black or African Americans, Hispanics or Latinos, and American Indians or Alaska Natives have been traditionally underrepresented in the science & engineering (S&E) workforce. These underrepresented populations have lower attainment rates of postsecondary credentials compared to their White and Asian peers. The National Center for Science and Engineering Statistics (NCSES, 2019) reported that in 2016, about 21.6% of bachelor's degrees in S&E fields were awarded to underrepresented populations; 13.2%, master's; 8.8%, doctorate. From 1996 to 2016, the share of S&E degrees earned by underrepresented populations has been growing slowly. For underrepresented students, lack of access to advanced and challenging STEM learning opportunities since early schooling (k-5) limit their aspirations for STEM degrees or careers (Olszewski-Kubilius et al., 2017). Ford and Whiting (2011) contended that underrepresented students are more likely to experience social and emotional challenges than their White counterparts. It is crucial to develop underrepresented students' talent in STEM from the time of early schooling.

Talent develops along a four-stage continuum: abilities, competencies, expertise, eminence, or scholarly productivity/artistry (Subotnik et al., 2011). Each stage requires unique catalysts to move individuals to the next stage. Researchers have examined several factors that play a pivotal role in science, technology, engineering, and mathematics (STEM) talent development, such as rich STEM learning opportunities (Forman et al., 2015; Kitchen et al., 2017); networking with peers, faculties (Windsor et al., 2015); psychosocial skills such as academic self-belief, persistence, and strategic risk-taking (Renzulli, 2005; Rinn & Majority, 2018; Subotnik & Jarvin, 2005).

However, little information exists about high-achieving underrepresented students' STEM talent development trajectories.

Therefore, I conducted a retrospective qualitative study to investigate how high-achieving underrepresented students developed their STEM talent throughout their academic careers. The research question that guided my inquiry was — How did underrepresented graduate students strive to be excellent in STEM disciplines throughout their schooling? Fifteen graduate students (5 Black, 7 Hispanic, and 3 Native American) across 10 STEM disciplines at an R1 public research university in the Midwestern U.S. participated in three individual online semi-structured interviews (45 to 60 minutes each interview) between July and December 2020. Data were thematically analyzed (Braun & Clarke, 2006) in NVivo 12.



"PARTICIPANTS SUFFERED FROM IMPOSTER SYNDROME AS A RESULT OF BEING TOLD THAT THEY WERE IN COLLEGE BECAUSE OF AFFIRMATIVE ACTION. ESPECIALLY FOR BLACK FEMALE STUDENTS, FACULTY HAD LOWER EXPECTATIONS AND UNDERVALUED THEIR ABILITIES. PARTICIPANTS MENTIONED BEING CONFRONTED WITH NEGATIVE MESSAGES FROM FACULTY, SUCH AS HEARING 'ENGINEERING IS NOT FOR YOU,' AND 'YOU SHOULD SWITCH TO AN ART MAJOR.'"

- YAO YANG

I found that academic rigor in math and science was critical for STEM talent development. Underrepresented students indicated that they received extensive gifted education enrichment and acceleration, such as advanced classes, middle school honors programs, Advanced Placement (AP) classes, and International Baccalaureate (IB) programs, which helped them lay a solid knowledge foundation and develop a good work ethic. In undergraduate programs, early involvement in research experience prepared them intellectually and psychologically for graduate school. Participants indicated that family, peer, mentor, and spiritual support, played an important role. They also acknowledged that they had a strong sense of loneliness at predominantly White schools. Participants indicated that they experienced social rejection in gifted education programs because of their ethnic identities since youth. Five of them were even bullied, mocked, and teased because of their giftedness as a minority student. Participants suffered from imposter syndrome as a result of being told that they were in college because of affirmative action. Especially for Black female students, faculty had lower expectations and undervalued their

abilities. Participants mentioned being confronted with negative messages from faculty, such as hearing “Engineering is not for you,” and “You should switch to an art major.”

This negative messaging, along with loneliness and anxiety, contributed to internalizing stereotypes. Participants felt pressured to prove their capabilities in STEM. Participants also mentioned that STEM departments barely talked about mental health, were blind to racism, and offered very little emotional support for underrepresented students. They turned to minority communities on campus to find comfort, receive peer mentoring, participate in professional development workshops, and to gain a strong sense of belonging. Because of their obstacles, they developed a strong sense of responsibility to participate in community service and social justice initiatives. They worked hard to be a role model for their communities, actively involved themselves in community service, and devoted time to research activities aimed at bringing social justice to their communities.

The findings of my study imply a need for more culturally sustainable practices in K-20 educational

programs. Underrepresented students may benefit from more supportive and inviting learning environments in which their strengths and talents are better recognized and supported. STEM departments could collaborate with equity and diversity offices at the college level to provide counseling and coaching from mentors in STEM. They should also offer workshops to discuss imposter syndrome, negative stereotypes, and racism.

ABOUT THE AUTHOR

YAO YANG

Yao Yang is a doctoral student of the Gifted Education Research & Resource Institute at Purdue University. Her research focuses on talent development, creativity, and underrepresentation in gifted education. Yao's academic advisor is Dr. Marcia Gentry.



LINKS BETWEEN MILITARY COUPLES' DEPRESSIVE SYMPTOMS THROUGHOUT DEPLOYMENT



The experience of a military deployment, characterized by three phases of the deployment cycle (preparation, separation, and reintegration), has been described as one of the most stressful aspects of military life for military families. Deployment cycles affect multiple life roles and multiple family members; yet, little is known about how experiences and events throughout a deployment cycle influence the later well-being and adjustment of family members.

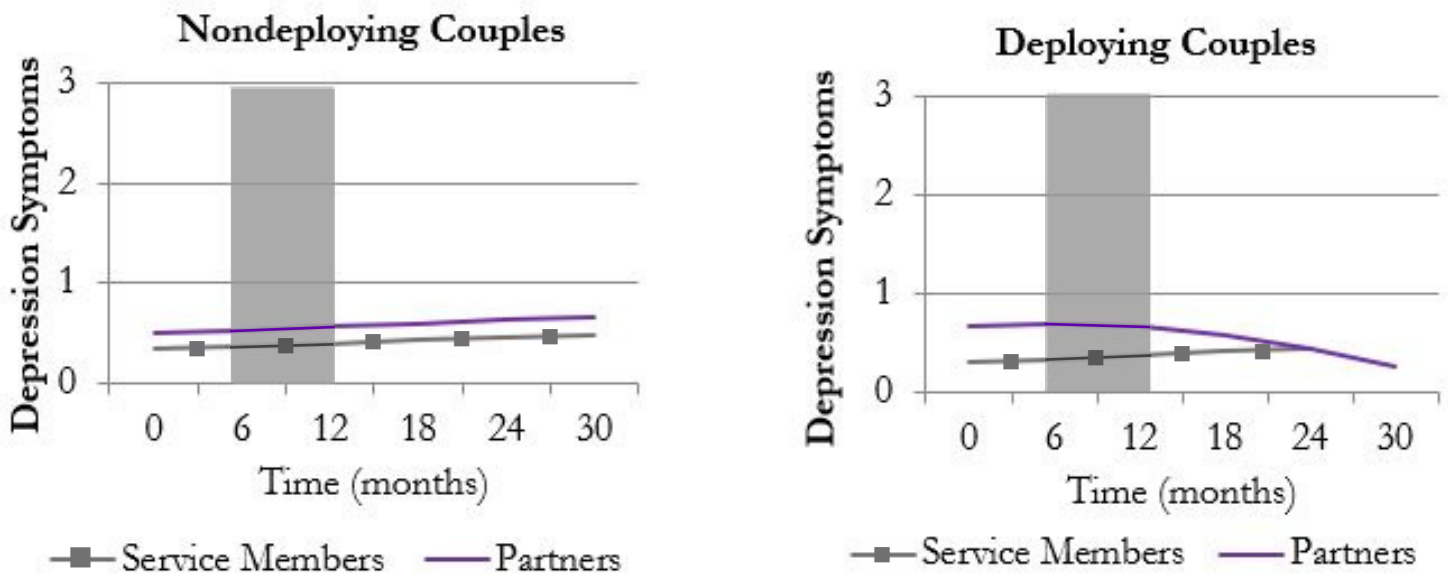
Even the period following service members' return from deployment may pose challenges for some families. At-home partners may struggle with adjusting their daily routines to accommodate the needs of service members. Household and parenting duties may shift during reintegration, and, sometimes, service members may struggle with adjusting back to civilian life. There is speculation that service members and partners even become 'unlinked,' leading to difficulties in terms of how they relate to each other. Many military couples navigate through deployment and its related challenges successfully; however, service members, partners, or both may sometimes experience distress.

To better understand the experiences of military couples and the impact deployment has on their depressive symptoms, this study—which was part of a larger, federally-funded effort—aimed to answer the following questions:

- How are military couples' depression symptoms related to each other across time?
- How does experiencing a military deployment impact links between service members' and partners' depression symptoms?

To address these questions, we recruited Indiana National Guard service members and their partners with an upcoming deployment to participate in interviews about their experiences. Interviewers met with these couples six times during a 2.5 year-long observation period, including once before deployment, twice during deployment, and three times after deployment. Approximately 1/3 of participating couples had their deployment canceled ("nondeploying group") but continued to participate in the study. Couples in the nondeploying group met with interviewers before, during, and after the date of their

Figure 1.



canceled deployment. The nondeploying group served as a comparison group, enabling us to discern between the impact of deployment on depressive symptoms and other factors relevant to military life.

Links between service members and partners were estimated separately for couples in the deploying and nondeploying groups during all six interviews. We used a random intercepts cross-lagged panel model, which enabled us to estimate the following:

- Couples' level of depression symptoms across time (i.e., how severe are depression symptoms?)
- Couples' change in level of depression symptoms across time (i.e., do military couples tend to have stable depression symptoms across time, or—alternatively—do their depression symptoms change? If their depression symptoms change across time, do they change together?)

In Figure 1, we plotted service members' and partners' average depression symptoms. Zero corresponds to experiencing depression symptoms rarely or none of the time, while 3 represents experiencing depression symptoms almost daily.

The grey box represents the average length of deployment for families in this study.

We found that couples' depression symptoms were significantly linked with each other across time, but only for couples who were not separated by a deployment (see left panel of the figure). For couples in the nondeploying group, increases in partners' depression symptoms were linked to a subsequent change in service members' depression symptoms. No significant associations among couples emerged for those who were separated by a deployment (see right panel of the figure).

Based on these findings, we concluded the following:

- Changes in service members' and partners' depression levels were linked, driven by changes in partners' level of depression, but only for couples not separated by deployment.
- Service members and partners may become 'unlinked' to each other during the process of deployment.

These findings indicate that there is a substantial return on investment in programming and interventions designed to support partners in military families, given the impact that their depressive symptoms have on service members' subsequent depressive symptoms. Further, these findings provide evidence that military couples may become unsynchronized with each other during a deployment-related separation. Strategies to support partners in military families and help couples remain linked to each other throughout deployment may help promote smoother transitions into society following military deployment.

ABOUT THE AUTHOR

ELIZABETH COPPOLA

Elizabeth Coppola is a Mirzayan Fellow at the National Academies of Sciences, Engineering, and Medicine and a Ph.D. candidate at Purdue University's Department of Human Development and Family Studies. Her research focuses on the health and well-being of children and families who have been exposed to adversity, stressors, and transitions. Throughout her graduate studies, she worked as a Summer Associate at the RAND Corporation, a family policy intern at Purdue University's Center for Families, and a research assistant at Purdue University's Military Family Research Institute. Prior to her doctoral studies, she was a research assistant at the Center for Academic and Workforce Readiness and Success at Educational Testing Service (ETS). She holds a MA in Criminology, Law, and Society and a BA in Psychology from Villanova University.





INDIGENOUS PEOPLE'S LIVED EXPERIENCES WITH GORILLA CONSERVATION IN UGANDA

Sitting on the edge of Bwindi Impenetrable National Park, Batwa elder, Florence, tells me about her people's displacement from the forest, *"The government told them to come live outside of the forest, other people are living outside and you are suffering here. But we were not suffering, not until we left the forest, that is when we started to suffer. Now it is only legal for people who can afford to pay to go inside of the forest, to see the gorillas"* (9/19/2017).

The first people to inhabit the dense Afromontane forests of Uganda, DRC, Rwanda, and Burundi, the Batwa were hunter-gatherers. Waves of displacement left them marginalized. Dominant migrants from other ethnic groups have gradually taken over montane forests for agriculture and grazing. In 1932 the British colonial regime designated Bwindi as a forest reserve to regulate timber trade and curtail human encroachment. In 1990 Bwindi gained National Park status, and the Batwa lost all access to the forest and their traditional resources in favor of conservation efforts focused on mountain gorillas. The Batwa now

live in designated settlements purchased by conservation trust funds and other sources.

To mitigate the Batwa's loss, community-based tourism enterprises have been implemented. Integrated Conservation and Development Program (ICDPs) strategies provide a model for focusing on the goals of conservation and community development. This has included cultural tourism schemes illustrating the Batwa's unique history, culture, and relationship with the forest. Tourists often sign-up for "culture walks," meant to create alternative livelihoods for the communities displaced by conservation in the park.

Florence's statement above highlights how the Batwa have been exiled from their forest livelihood and resources. They are a forest people without a forest, losing their cultural identity as Indigenous People in a forced effort to assimilate. The COVID-19 pandemic further exacerbated the Batwa's situation, their cultural tourism incomes eliminated by travel restrictions, leaving the Batwa and other local

"A RECURRENT PROBLEM IS THAT MANY BATWA CULTURAL TOURISM PROJECTS ARE GUIDED BY NON-BATWA, WHO RESORT TO NEGATIVE STEREOTYPES THAT DISTORT THE BATWA'S HISTORY BY CALLING THEM FOREST DESTROYERS AND ENEMIES OF THE GORILLA."

- SAVANNAH SCHULZE

communities struggling to survive without regular income from ecotourism-related projects.

My research focuses on understanding how displacement impacts Batwa lives. I am interested in the Batwa's lived experiences with the effectiveness of cultural tourism as an alternative livelihood. I conducted two years of ethnographic research based in Buhoma, a village located adjacent to the main Park entrance. Buhoma is central to gorilla tourism, cultural tourism, conservation, environmental research, and ecotourism ventures. My study relied on oral history interviews, semi-structured interviews (SSIs), and focus groups that were recorded and then transcribed. I used cultural mapping (n=240) to uncover historical and contemporary relationships between the Batwa and their environment. The data collected includes interviews (n=112) with Batwa of all ages (>18+), and with elder men and women familiar with the history and ecology of the area. The interviews focused on the Batwa's knowledge of the forest and their experience with conservation and development projects. I conducted SSIs (n=25) with local wildlife authorities, and international wildlife conservation and development organizations. The interviews were intended to stimulate memory and conversation about the Batwa's history with conservation.

I found that cultural tourism at Bwindi is failing to provide equitable opportunities for Batwa

participation in conservation, which contributes to further marginalization of their communities. Despite these obstacles, many Batwa express their autonomy by engaging with ecotourism in innovative and dynamic ways. The Batwa reported uncertainty about the benefit of dancing in cultural tourism activities because of (1) historical tensions between the Batwa and other more dominant groups, (2) the monopolization of local resources by local elites, and (3) a lack of opportunities to co-manage the conservation of their ancestral lands.

A recurrent problem is that many Batwa cultural tourism projects are guided by non-Batwa, who resort to negative stereotypes that distort the Batwa's history by calling them forest destroyers and enemies of the gorilla. The Batwa would prefer that a Batwa guide tell their authentic stories. The Batwa people are able to express more agency when they directly help develop new conservation and eco-tourism schemes. Some Batwa are experts in song and dance and have trained fellow Batwa, thus creating livelihood opportunities by passing on what is left of their traditional culture.

From my research, I have concluded three things. First, conservation and related development projects should include mechanisms for participation that respects the individual agency of Indigenous Batwa and recognizes their autonomy by acknowledging their entrepreneurialism and amplifying their creative voices. Second, new conservation designs are needed

and should attend to the historical context of each location, by discussing all opportunities with Indigenous representatives before project implementation. Finally, indigenous networks, international organizations, and researchers working on Indigenous lands can facilitate the building of Indigenous-to-Indigenous capacities.

Overall, this study provides an understanding of how well-intended plans to conserve nature can displace and marginalize local populations. Moving forward, future conservation projects must respect local self-determination and work to strengthen cultural identities linked to protected areas.

ABOUT THE AUTHOR

SAVANNAH SCHULZE

Savannah Schulze is a Ph.D. candidate in the Anthropology department and recipient of the Bilsland Dissertation Fellowship. Her academic advisor is Dr. Melissa Remis. Savannah is an environmental anthropologist with a background in primatology, giving her a unique perspective on issues related to human/wildlife conflict, conservation, and the overall well-being and multiple livelihoods of local people in conservation zones. Savannah was awarded the Wenner-Gren Dissertation Fieldwork grant, the Global Synergy Research Grant, and the Purdue Research Foundation research grant to pursue her graduate research. In Spring 2019, Savannah was awarded the National Geographic Early Career grant to return to Uganda to work with Indigenous Batwa and their cultural tourism renovation projects. After graduating from Purdue, Savannah hopes to work in the field of conservation and development in East Africa.



UNVEILING THE UNDERMINING THREAT TO ENGINEERING STRUCTURES



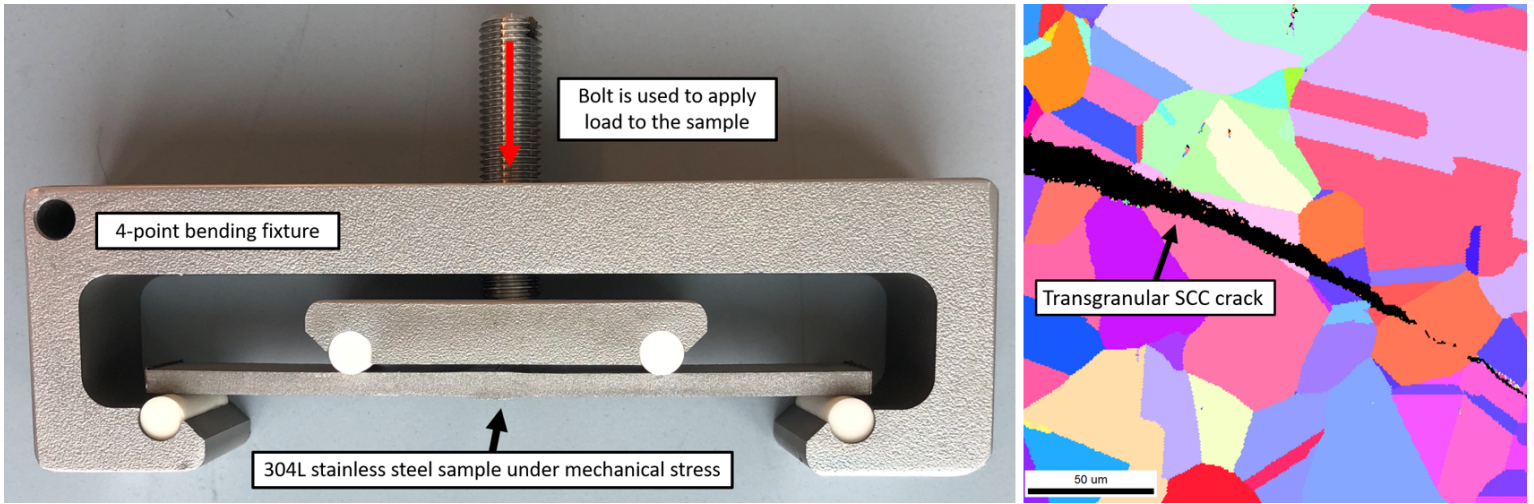
UNDERSTANDING THE MECHANISM OF STRESS CORROSION CRACKING

Can you imagine how much corrosion costs the global economy every year? In 2013, this number was \$2.5 trillion [1]! Among all of the ways the environment causes engineering structures to degrade, stress corrosion cracking (SCC) is one of the most dangerous. Within society, submarines, nuclear power plants, and gas and oil transportation pipelines can suffer from unexpected brittle failure caused by SCC, which can lead to disasters for the economy, national defense, and social security [2,3]. Typically, engineering structures or equipment in the national defense and energy industries are designed to last many decades. However, just a single crack that is only tens of microns (10-6 m) long, much shorter than the thickness of a human hair, can penetrate through metal structures that are a few centimeters thick in less than 10 years [4].

Similar to a pear infested by worms, the surface of cracked structures can appear normal while the crack penetrates through the entire engineering component beneath. This makes SCC especially dangerous because its growth is difficult to predict and monitor. Over the past century, materials scientists have

dedicated extensive efforts to studying how SCC propagates; however, up to today, there is still no universal agreement on SCC growth mechanisms [5-9]. SCC is so named because it is a complex phenomenon that requires both stress (i.e. a mechanical force or load) and a corrosive environment. Thanks to recent advancements in characterization techniques, structural and mechanical analyses have shed light on SCC growth patterns and have allowed the research community to study SCC phenomena at a deeper level.

Underneath their smooth and shiny exterior, metals are made of crystals of atoms. These crystals, called grains, are typically no more than a few tens of micrometers in size (10-6m), and they fit together in a complex manner like puzzle pieces. External mechanical loads on any metallic structure are distributed and exerted on the grain networks. Grains will deform when they are under sufficiently high load, and the stress experienced within each grain has been thought to contribute to the development of SCC. Because of their crystalline nature, grains can only deform along certain directions in the crystal. Materials scientists use a number called the Schmid



factor to describe these deformation directions in grains. Conventionally, the Schmid factor coupled with the stress felt within a given grain have been used to try to predict the path of SCC propagation from one grain to the next [10].

My research has revealed that our conventional understanding of grain-specific stresses and Schmid factor are not sufficient to completely describe SCC propagation. Instead, I have found that the mismatch in Schmid factor between adjacent grains, actually controls SCC propagation.

I am working with stainless steel 304L, which is one of the most common structural materials in use across the planet. To create SCC, I loaded strips of 304L into a 4-point bending fixture, which holds the strip in place while introducing an external mechanical stress. I then boiled the fixtured strips in a magnesium chloride ($MgCl_2$) solution at 155 oC. Boiling $MgCl_2$ is an aggressive and corrosive environment that causes SCC to occur at least 1000 times faster in the lab than say, chloride salts from sea air being deposited on an exposed pipe. I had the opportunity to collaborate with and visit scientists from Sandia National Laboratory to conduct the boiling $MgCl_2$ testing. After my samples broke from SCC, I cross-sectioned and polished them for microstructure characterization in a scanning electron microscope (SEM) at Purdue. Within the SEM, I used a technique called electron backscatter diffraction (EBSD) to map the crystal

orientations of grains around a crack. I examined over 100 cracks in this manner, which provided me with sufficient statistics to understand the relationship between local stress and SCC growth behavior.

I analyzed the Schmid factor of all cracked and uncracked grains near the path of each crack. Based on Schmid's theory, grains with higher Schmid factors experience higher shear stress during the application of the external mechanical load. My results show that more cracks occur in grains experiencing higher shear stresses (i.e. higher Schmid factor) than in grains experiencing lower shear stresses. But, the material itself has more high-Schmid grains than low-Schmid grains. This means that SCC probability is equal across all Schmid factor values – we simply observe more cracked high-Schmid grains because there are more of this grain type, to begin with.

But more importantly, I noticed that the mismatch of Schmid factor values in adjacent grains along the crack path leads to SCC growth. Nearly all cracked grain pairs have significantly different Schmid factors, such that the crack propagates in a low- to high-Schmid, or high- to low-Schmid direction. Only a few cracks propagate between grains having similar Schmid factors (e.g. both low or both high Schmid factor grains). I believe this observation can be explained because grains having different Schmid factors experience different deformation behaviors at the atomic scale. A boundary between adjacent low-

Schmid and high-Schmid grains will suffer from elevated local stress when atomic-level defects pile up on both sides of the boundary during deformation. SCC is thus promoted at these boundaries due to the intensified local stress [11].

Understanding SCC growth mechanisms is a challenging, yet fundamental step towards developing mitigation and protection techniques for real-world engineering applications. Through crystallographic characterization by EBSD, I found that local stress between grains – instead of stress within a certain grain – leads to SCC growth. Since the orientation of the crystal governs the Schmid factor of a given grain, my research opens the possibility of manipulating or controlling grain structure to minimize Schmid factor mismatch during material manufacturing. By revealing the governing factors behind SCC, my work also provides direction for designing SCC-resistant materials and structures that will eliminate this costly and hazardous problem that has haunted many industries for so many decades.

ABOUT THE AUTHOR

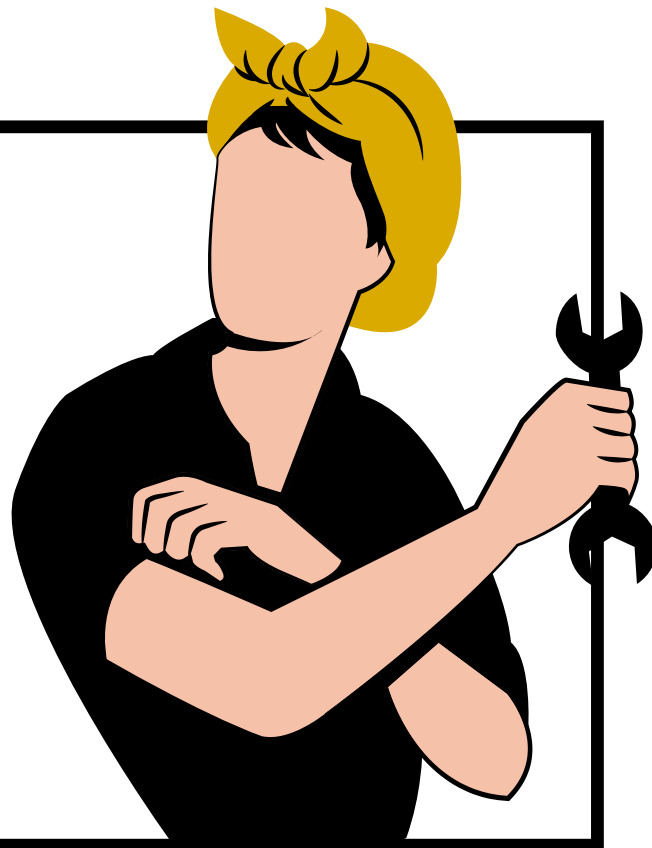
HAOZHENG QU

Haozheng Qu is a Ph.D. student in the Department of Materials Engineering at Purdue University, supervised by Dr. Janelle P. Wharry in the Microstructure Science Group. His research centers on understanding the stress corrosion cracking (SCC) mechanism of stainless steels, and exploring cold spray coating technology as a robust mitigation solution for SCC. Starting from 2021, Haozheng serves as a technical program committee member for the Association for Materials Protection & Performance (previously NACE International & SSPC). He received his B.S. in Mechanical Engineering (2018) and M.S. in Industrial Engineering (2020) at Purdue University.



BOILERS WORK

Internship Program



The Boilers Work internship program provides ten graduate students per year with a \$4,000 stipend to pursue an unpaid summer internship.

This program is intended to help our students garner real-world work experience, refine soft-skills, and establish career connections prior to graduation.

Below are the experiences of two Boilers Work interns.

TIWALADEOLUWA ADEKUNLE

PH.D. STUDENT IN COMMUNICATION

I have always been passionate about non-profits, and I have always been a big believer in their potential to impact communities. I grew up in Ibadan, Nigeria, where my mother led a non-profit, and I got a front-row seat into their outreach and activities. At a young age, I became deeply invested in joining ongoing efforts to support marginalized communities and promote positive change.

After my undergraduate degree, I decided to get a Master's in Communication so that I could work as a communication professional at a non-profit. What I really found in graduate school, however, was a deep

interest in research. I learned, through my graduate courses and experiences, that research did not just live in peer-reviewed journals online or at the library, research also had a place in the community, a relevance to the types of initiatives to which I had always wanted to contribute. It was not only relevant to these community programs – in many ways, their success depended on it. This realization completely shifted my goals and gave me a new vision for how I wanted to help the world around me.

Instead of going into the workforce immediately following graduation, I decided to pursue a doctoral degree in a department that had nurtured my growth as a person and a scholar, and at a university that gave me all the opportunities that I needed to thrive – Purdue. When I found out about the Boilers Work internship program, offered by the Graduate School's Office of Professional Development, I knew that I needed to apply. Many non-profits working with marginalized communities are under-resourced and most internships are unpaid. Through the funding offered by the Graduate School, I could harness my growing skills as a researcher, investing my time toward a cause in which I was deeply interested.

I was thrilled to begin my summer experience as a graduate research intern at a data-driven community health organization located in Cincinnati, Ohio, with a mission to close the gap between health outcomes for minorities and the majority population.

As a research intern, I was supervised by the director for health programs and worked with her to identify a research opportunity that was best suited for my interests and goals. Our collaborative research project focused on quantitatively evaluating the effectiveness of a healthy eating intervention at promoting healthy eating behaviors among participants. Using methods that I learned through my courses at Purdue, I was able to collaboratively design our survey-based project and participate in our data analysis. Through our project, we were able to provide evidence that people who participated in the program did believe that it contributed to healthy eating and meal planning, as they were largely able to overcome barriers such as being on a tight budget and having little time. Given the current public health crisis, our survey also inquired into how well people believed the COVID-19 pandemic impacted their ability to eat healthily, and we gained valuable insight into the impact of the pandemic on nutrition. This project made practical contributions to the organization in that we were able to provide evidence of the program's impact on the community. It also shone a light on areas that might warrant further inquiry and programming, such as how to maintain healthy eating despite the current circumstances of the world.

Through this experience, I was able to learn a lot about the nature of community-academy collaborations. One of the most important lessons I learned was to be flexible and teachable. I learned that some things that make sense to you as a researcher won't necessarily translate to community members. As a result, it was important that I recognized the expertise of community partners who had deeper familiarity with the context than I could have possibly been able to gain in the span of a handful of weeks.

At the end of the day, interning at this community organization was a valuable learning experience, and I was very grateful to have had the opportunity to work with a research-driven community health program. Health equity is a cause that is pressing and urgent, and it was a privilege to be able to contribute my skills to an initiative that is making an impact in this area.



TIWALADEOLUWA ADEKUNLE

Tiwaladeoluwa's research explores individual and organizational responses to health, risk, and crisis issues and the social-political conditions that drive these responses. She takes an applied and participatory approach to research and actively seeks opportunities to collaborate with other researchers, research institutes, and community organizations.

AMANDA BARABAS

PH.D. STUDENT IN ANIMAL SCIENCE

Animal models have contributed to countless breakthroughs and discoveries in biomedical research. Modern medicine, as we know it, would likely not exist without preclinical animal models. However, as central as animals are to research, the care they receive is equally as important. Animal welfare can be defined as how an animal copes with its environment, both living conditions and human interactions. An animal is considered to have poor welfare when it cannot handle the stress presented by its environment such as pain, poor nutrition, and/or lack of physical or mental exercise. Animals with poor welfare often have altered hormone levels, cardiac parameters, behavior, and immune function, all of which can reduce the validity and reproducibility of research data. Ethically, poor welfare reduces an animal's quality of life, as well as public trust in animal research and the scientists who conduct it.

As a Ph.D. student in the Department of Animal Science, my research focuses on the welfare of laboratory mice. Aggression among mice is a natural behavior that helps males protect a territory in the wild but becomes a challenging behavior to manage in the laboratory. It can occur spontaneously in groups of males who had previously lived together peacefully and can cause severe wounding that leads to injury or early death. Even mild wounding can be challenging to identify since the fur obstructs our ability to see the injury. Thus, researchers may be unaware that some of their animals are not only under social stress from attacks but also experience mild pain from physical damage. Aggression also impacts data quality, as wounded mice can have different physiologically than unwounded mice. Therefore, the goal of my thesis is to identify mitigation strategies for reducing aggression between male mice to improve their welfare.

Throughout my Ph.D. I have gained invaluable experience in designing and executing experiments

that aim to improve laboratory animal welfare. However, my research focuses on a single welfare issue and any solutions would only be considered suggested practices for animal care. The findings from welfare research have the potential to benefit countless animals, but they cannot be fully effective unless they are adapted into policies by individual institutions and governing bodies. To gain a more comprehensive understanding of current federal policy on laboratory animal use, I completed a virtual internship with the National Institutes of Health's Office of Laboratory Animal Welfare (OLAW), facilitated by the Boilers Work internship program.

During my internship, I rotated through all three of OLAW's divisions. First, in the Division of Assurances (DOA), I learned what animal welfare policies and standards an institution, such as Purdue, must implement to conduct research on vertebrate animals. Before receiving federal grant money, an institution must submit a written assurance outlining their animal care and use program policies, how they evaluate their animal users, and commitment to following federal regulations. The assurance also must contain a roster for the animal care and use committee, which serves as an ethics board for approving vertebrate animal studies. The DOA also reviews each institution's annual report, which describes any changes/updates in the animal care program and conducts site visits to confirm that practices match the assurance descriptions. By spending time in the DOA, I gained a better understanding of what expectations an institution must meet to perform animal research. I was able to see written examples of assurances and learn how they are evaluated.

Next, I worked with the Division of Compliance Oversight (DCO), which oversees reports of noncompliance with federal animal use policies. A majority of cases are self-reported by assured institutions and describe the problem and corrective actions taken. Often, non-compliance cases are resolved through personnel training, institutional

policy changes, or building repairs/upgrades. However, if the reported correction is not sufficient, DCO members can request additional steps or conduct site visits. While working with DCO, I was able to evaluate example non-compliance cases and work through their evaluation process to identify effective solutions. It is common for animal researchers to fear regulatory agencies, but my time spent with DCO showed me that their goal is to improve programs, not criticize them. The DCO aims to frame solutions around what is best for the animals and eliminate preventable problems.

Finally, the Division of Policy and Education (DPE) provides guidance and clarification of animal use policies. This is typically done through various educational resources such as webinars, conferences, and online tutorials. DPE is also responsible for guiding the public through relevant animal use policy changes. They collect public responses to policy changes through “requests for information” and strive to address prevalent comments or concerns. During my time with DPE, I learned about recent policy changes and the strategic steps being taken to properly clarify these new changes to the public. I also assisted in a larger endeavor to redesign the OLAW website, which required additional policy clarification and new infographic designs. These tasks further developed my communication skills which will aid me in conveying scientific messages to a broader audience.

Overall, my internship with OLAW provided a valuable experience to better comprehend federal animal use policies and standards. It also opened the door to new career options with the federal government that I may not have otherwise considered. The team members I spoke with have diverse backgrounds, but their passion for laboratory animal welfare led them to a unique career role that I could only experience through this internship.



AMANDA BARABAS

Amanda is a Ph.D. candidate in Animal Sciences, advised by Dr. Brianna Gaskill and Dr. Marisa Erasmus. Her thesis focuses on the olfactory signals behind social behavior in male mice. Amanda is originally from the greater Cleveland, Ohio area where she grew up competing in dog shows and earned a B.S. in biology from Case Western Reserve University. After completing her Ph.D., Amanda hopes to either continuing studying laboratory animal welfare or work in laboratory animal use administration.

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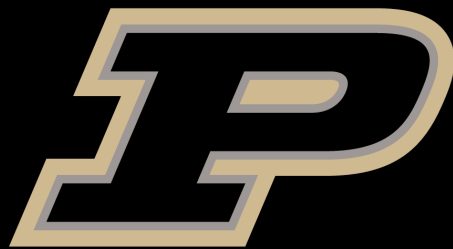
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