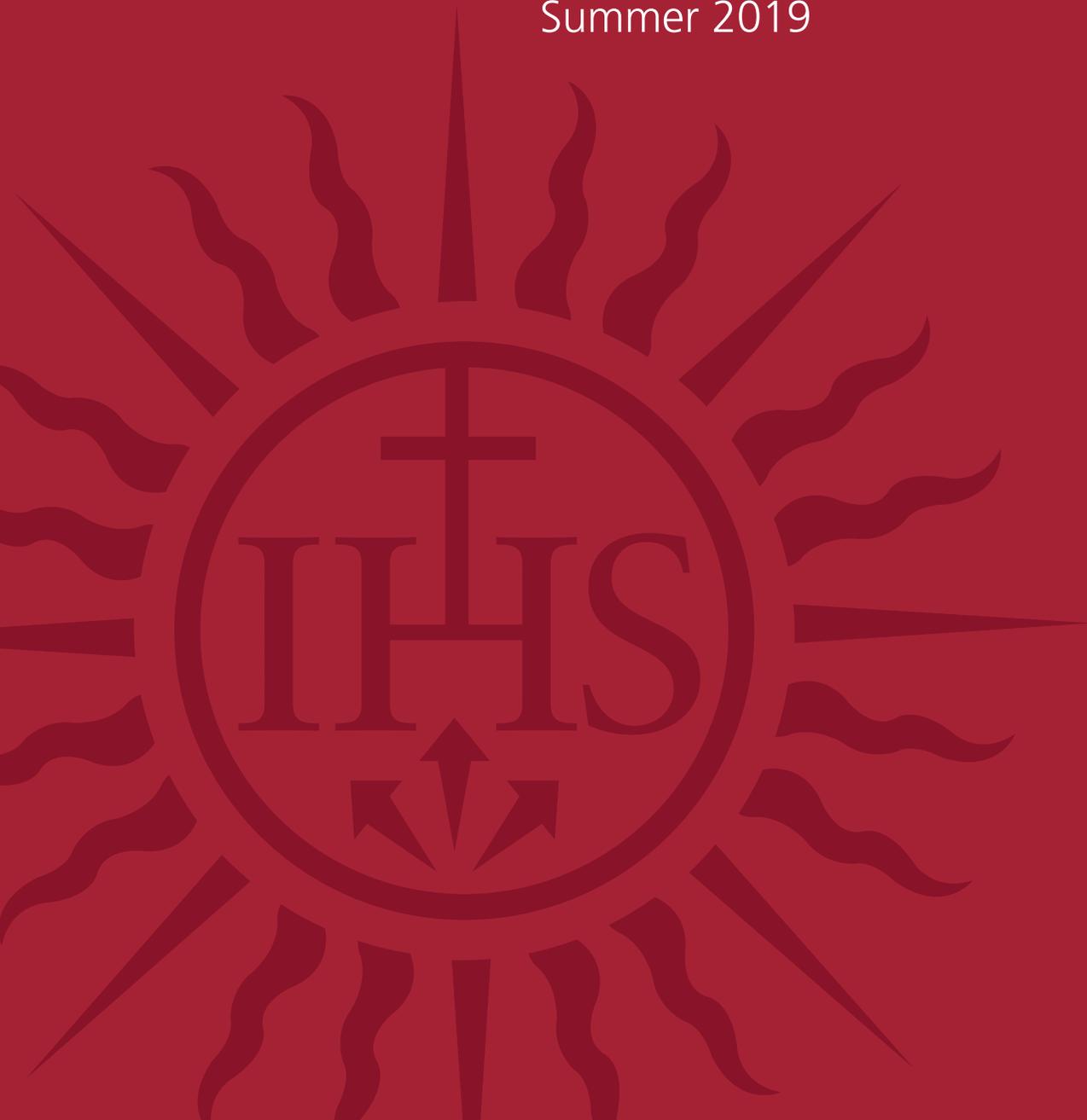




Summer Scholars Program

Summer 2019

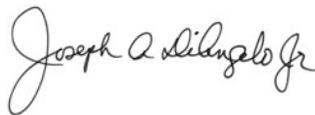


Welcome to the 20th Annual Summer Scholars Dinner at Saint Joseph's University. This year, 98 students and 57 faculty mentors, representing 23 departments and programs participated in the Summer Scholars Program. We are excited to have families, donors, administrators and staff join us in tonight's celebration. This signature program would not be as extremely successful without your support.

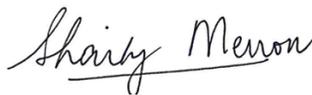
We especially like to thank the Faculty Mentors who give of their time and energy to work closely with students engaged in creative scholarly work and independent research across the University. Our Summer Scholars are grateful for the opportunity you have provided and recognize the difference it makes in their Saint Joseph's experience.

Thank you for taking the time to join us tonight as we celebrate the accomplishments of our impressive student scholars. We would also like to thank everyone whose support continues to make scholarly activity at Saint Joseph's University a priority.

Sincerely,



Joseph DiAngelo, MBA, Ed.D.
Dean, Haub School of Business



Shaily Menon, Ph.D.
Dean, College of Arts & Sciences



Angela McDonald, Ph.D.
Dean, School of Health Studies and Education



Cheryl McConnell, Ph.D.
Provost/VP for Academic Affairs

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The Office of the Dean, SHSE
The Office of the Provost
Sigma Xi



Paul J. Angiolillo
Department of Physics
Saint Joseph's University

Ph.D. The University of Pennsylvania

Research Interests: Experimental Condensed Matter Physics

Dr. Paul J. Angiolillo earned his B.S. in Physics from Saint Joseph's University and then went on to obtain a M.S. and Ph.D. in molecular biophysics from the University of Pennsylvania. After a 4-year stint teaching in the Department of Mathematics, Physics and Computer Science at the University of Sciences in Philadelphia, Dr. Angiolillo joined Saint Joseph's in 2000. He served as chair of the Department of Physics from 2007-2015, and currently is Interim Associate Dean for Research and Faculty Engagement. Dr. Angiolillo's research program has evolved away from biophysics and is now concentrated in the area of experimental condensed matter and materials physics. Specifically, he is currently studying both charged ground and excited states in conjugated organic conducting and semi-conducting materials using electron spin resonance spectroscopy. He has collaborated with groups at the University of Pennsylvania and Duke University, where he has been visiting scholar for over a decade.

As the miniaturization of electronic devices continues, there is the continuing challenge to fabricate electronic materials ever smaller. Traditional silicon-based materials will ultimately give way to new paradigms for device manufacture. One such group of materials is focused on using tailored organic molecules. These organic materials have potential uses in not only electronic devices, but also in harvesting the Sun's energy (photovoltaics), and as platforms for the new area of spintronics.

From time to time, Dr. Angiolillo studies materials other than organic semiconductors and conductors. He has studied the nature of stick-slip friction in Velcro, radiation-induced radical defect centers in calcite from extinct cephalopods, and recently he has studied the stability of surfactant laden (soap) thin films, which is currently is an unsolved problem in physics. Much of the research in his lab is conducted by student researchers, and results in conference presentations and scientific publications with student coauthors.

Oxygen Binding in Perfluorocarbons – An NMR Study

Ryan Armbruster, '19

Faculty Mentor: Paul J. Angiolillo

Department of Physics



Supported by the SJU Summer Scholars Program

Perfluorocarbons are carbon-fluorine molecules of increasing interest in biomedicine. First discovered in the 1960's, these molecules were created to handle extremely corrosive uranium fluorides because they are biologically inert and extremely stable. A common perfluorocarbon that many know, is Teflon, a perfluorocarbon product that takes an extreme amount of wear, possesses a low coefficient of friction, and is an immiscible compound. In the 1980's, perfluorocarbons drew interest due to the high amounts of oxygen they can sequester. The medical community became interested in these materials as possible non-hemoglobin oxygen carriers for use in trauma and neonatal medicine.

Ways that these materials have been used as oxygen carriers is in the use of a liquid inhalant, and more recently they have been used as a contrast agent in ^{19}F MRI scans. Some practical applications of perfluorocarbons as a liquid inhalant have been in the use of liquid perfusion in pre-mature infants, which is a method to allow the infants to breath a liquid after birth to allow the lungs to continue to develop and slowly adapt to the external, gaseous environment. As a blood substitute they have been administered to assist in surgeries where blood banks have scarce amounts of allogenic blood.

In our lab this summer we explored the physics and chemistry of how these perfluorocarbons “bind” molecular oxygen. To approach this question, nuclear magnetic resonance (NMR) spectroscopy was used to study the physical attributes of the perfluorocarbon-oxygen “bond.” Since molecular oxygen is paramagnetic, its effect on the spin-lattice relaxation time (T_1) and the spin-spin relaxation time (T_2) of the ^{19}F nucleus was measured. These characteristic times reflect the environment of the ^{19}F , and provide information on the ^{19}F - O_2 interaction.

NMR spectroscopy was used to record the relaxation times of two different perfluorocarbons: perfluorodecalin and Perflubron. In each of these perfluorocarbons, T_1 and T_2 relaxation times were measured for both oxygenated and deoxygenated samples, to evaluate the effect of oxygen concentration on relaxation times. In general, the relaxation times were significantly decreased in the oxygenated samples with respect to the deoxygenated samples, signaling an interaction between the ^{19}F nucleus and molecular O_2 . Work is commencing on relating these data to structural differences between the two states.

The Stability Surfactant Laden Freestanding Films

Katie Cucinotta, '21

Emily Lehman, '21



Faculty Mentor: Paul J. Angiolillo

Department of Physics

Supported by the Peter & Dorothy Kowey Research Fellowship, the John P. McNulty Scholars Program, Sigma Xi and the SJU Summer Scholars Program

Every child at some time has been fascinated with soap bubbles and their ephemeral existence. One doesn't normally think of these whimsical objects as having anything to do with serious science, but soap films, as well as other liquid films, are ubiquitous, and occur over a wide range of phenomena. They are central to numerous areas of geophysics, biophysics, and engineering. In geology, the behavior of lava flows, or the dynamics of continental ice sheets is very similar to soap flowing in a soap film. In biophysics, cell membranes, the linings of mammalian lungs, and tear films in the eye can be explained, as well, by soap film physics. In astrophysics and climate science, soap film flows have long been used to study two-dimensional turbulence in phenomena which include flows in hurricanes, typhoons, and the great red spot of Jupiter. In engineering, thin films serve in heat and mass transfer processes to protect surfaces, and applications arise in paints, adhesives, and membranes.

Thin films, and thin soap films in particular, remain a largely understudied and underappreciated branch of fluid dynamics. Despite the simplicity of their appearance, films often display distinct and unique patterns in their internal motion, and, as mentioned above, are often used to study 2-dimensional turbulent flow. Understanding the stability of soap films is an unsolved problem in physics, and one that is being studied by several groups of scientists. Interestingly enough, Dawn Ultra[®] is the physicists' gold standard for studying the physics of thin surfactant (soap) films.

The lifetime of soapy thin films was studied as a concentration of Dawn Ultra[®] in water-based samples at constant temperature and relative humidity (RH). Prior to film lifetime measurements, the critical micelle concentration (CMC) of Dawn was measured. These measurements were done using the Du Nouy ring method. The surface tension of a Dawn Ultra[®]-water solution decreases until the CMC point is reached. The data from this study evinced a CMC of 27.27 mN/m corresponding to a concentration of 17.19 mg/L.

At effectively 100% RH, the thin film lifetime was observed to scale exponentially with surfactant concentration, ranging from approximately 85 s at 1% Dawn (by volume) to over 2000 s at 100%. Surprisingly, at ~60 RH, lifetimes spanned a range of 23 s at 2% to approximately 7400 s at 90%. Studies are continuing at intermediate RH.

Focusing on Function – Does Prompting Surrogate Decision-Makers to Reflect on Patients’ Functional Values Impact Their Decision-Making Process?

Corinne Merlino, '20



Faculty Mentor: Paul J. Angiolillo
Department of Physics

Supported by the John P. McNulty Scholars Program and the SJU Summer Scholars Program

In recent years, we have seen a shift in the US healthcare system toward respecting the patient’s autonomy when it comes to making medical decisions. This is due, in part, to encouragement from professional societies and payers on physicians to engage in shared decision-making with patients with the intention of aligning medical care to the patient’s values. However, when patients are incapacitated, surrogate decision-makers are called upon to make medical decisions that respect the patient’s values. This often occurs in the context of critical illness, patients often become incapacitated and face highly consequential decisions that may result in death or serious debility.

Prior studies have shown that patients value preserving physical and cognitive function over the longevity of life. However, when physicians engage families in shared decision-making in the ICU they rarely discuss patient’s functional values including the ability to speak, think clearly, eat, live independently, and walk. This may be because surrogates are not aware of their loved one’s functional values, that they do not feel functional outcomes are as important as mortality, or that clinicians do not appropriately guide surrogates to consider functional, non-mortal outcomes during these conversations. We hypothesize that when functional values are not part of this shared decision-making process, patients are left vulnerable to receive unwanted care or care that is not in line with their values.

In order to address this problem, we are performing a qualitative study among surrogates of critically-ill patients at The University of Pennsylvania to evaluate whether prompting surrogates to reflect on patients’ functional values influences their decision-making process and describe surrogates’ perspectives on if and how considering functional values influences their substituted judgments. To do this, we are presenting surrogates with hypothetical clinical scenarios and asking them to navigate these and explain their decision-making process. Surrogates in the intervention arm of the study are prompted to reflect on functional values before encountering the clinical scenarios, surrogates in the control arm are not. Surrogates also undergo semi-structured interviews to explore their attitudes and beliefs about the role of considering patients’ functional values and outcomes when making substituted judgments. Data is collected via voice recordings of these encounters. Data will be analyzed by performing a comparative thematic analysis of surrogates’ decision-making process for the hypothetical clinical scenarios to determine if there are thematic differences based on prompting surrogates to reflect on patients’ functional values.



Catalina Arango Pinedo
Department of Biology
Saint Joseph's University

Ph.D. University of Massachusetts

Research Interests: Environmental Microbiology and Bacterial Gene Regulation

Bacteria are my passion. I am fascinated by the sophisticated mechanisms that bacteria use to control their gene expression in response to environmental conditions, and most of my research is directed towards understanding these mechanisms. For example, some bacteria are able to “choose” the most energetically favorable carbon source when there is more than one available in the environment and use it first. This behavior, called catabolite repression, is the result of an intricate interaction of proteins and other molecules, where some sense the presence of the preferred carbon source and others communicate the signal to specific genes that are turned on or off. Although the players (proteins and such) are similar in different bacteria, the role they play may be very different! I use the bacterium *Sinorhizobium meliloti* as a model organism to study gene regulation through the catabolite repression system. My students and I are trying to understand how catabolite repression works in *S. meliloti* by studying a group of proteins, the Phosphotransferase System, that we know are involved in this regulation. Using tools from genetics, biochemistry, and bioinformatics, we hope to learn more about how this regulatory system works, and to gain understanding of how it may control genes in other bacteria.

Identification of Regulatory Sequences Necessary for Control of Gene Expression by the Two-Component System Sma0113/Sma0114 Using a Motif Recognition Algorithm

Ihunna Amugo, '20



Faculty Mentor: Catalina Arango Pinedo
Department of Biology

Supported by the NSF RUI Collaborative Grant and the SJU Summer Scholars Program

Signal transduction by phosphorylation is performed by many organisms, the two-component system is the phosphorylation-mediated signal transduction system in bacteria. A two-component system (TCS) is composed of a sensor kinase that is usually membrane-bound, which phosphorylates the second component of the system, the response regulator, to begin the signal transduction, which is typically DNA-binding protein. This summer I worked with a two-component system in *Sinorhizobium meliloti*. Genes *sma0113* and *sma0114* code for a novel two component signal transduction system in *Sinorhizobium meliloti*, the response regulator, *sma0114*, does not have a DNA binding domain which would suggest that it may be interacting with some sort of protein effector, such as transcriptional regulators, that are DNA binding. I looked for regions that transcriptional regulators typically bind to, called motifs which are regions located upstream of the transcription start site, using transcriptomic analysis and a motif discovery software.

A transcriptome can be used to identify sets of genes that are regulated by the same regulatory system. A transcriptome is the full set of RNA sequences in a cell that are present under specific condition and RNA molecules that are the result of gene expression under those conditions. A transcriptome of a wild-type and an Δ *sma0114* mutant *S. meliloti* strains, for which there is no Sma0114 protein being expressed, was conducted to identify the Sma0113/Sma0114 regulon. Transcriptome analysis of an *sma0114* deletion mutant indicated that the system is involved in regulation of a large number of genes, suggesting that it may interact with a few transcriptional regulators that control subsets of those genes. A motif discovery algorithm, called MEME suite was used to identify regulatory sequences shared by the commonly regulated genes; this finding will provide further evidence that the Sma0113/Sma0114 proteins are part of a global regulatory system that acts through a defined set of transcriptional regulators. By inspecting the expression patterns of these two strains, I can further identify sets of genes that are all regulated directly or indirectly by either Sma0114, and by searching for motifs in the promoter regions of these genes, information about the existence of common transcriptional regulators can be discovered. This research could contribute to our understanding of mechanisms of gene regulation in an important agricultural bacterium, *S. meliloti*.

Production of an Overexpression Library of Genes to Identify Those That Regulate Succinate-Mediated Catabolite Repression in *Sinorhizobium meliloti*

Jacob Feiertag, '20



Faculty Mentor: Catalina Arango Pinedo
Department of Biology

Supported by the NSF RUI Collaborative Grant and the SJU Summer Scholars Program

Heterotrophic bacteria selectively use substrates from a mixture of different carbon sources. The presence of preferred carbon sources prevents the expression, and often also the activity, of catabolic systems that enable the use of secondary substrates. This selection of one carbon source over other through enzyme inhibition is called carbon catabolite repression (CCR). Although the CCR mechanism has been extensively researched in *E. coli* and *B. subtilis*, not much is really understood in the catabolite repression mechanism found in *Sinorhizobium meliloti*. In *S. meliloti*, the bacteria will selectively use succinate over other secondary carbon sources (raffinose, lactose, and others). Thus, the utilization of secondary carbon sources will be decreased in the presence of succinate, because expression of the genes needed to use these carbon sources is repressed. Expression of other genes, not just catabolic genes, is also affected by the presence of succinate, a global regulatory system known as succinate-mediated catabolite repression (SMCR).

The proposal at hand will serve to investigate the possible genes responsible for the succinate-mediated catabolite regulation using gene overexpression. A collection of genes from *S. meliloti* will be made into an overexpression library by placing them in plasmids under the control of a strong or constitutive promoter, and these overexpressed genes will be screened in order to find which overexpressed gene results in a change in the SMCR regulation pattern. The overexpression plasmid(s) in the strain(s) of interest will be sequenced to identify the gene being overexpressed. In a future project, a strain with a deletion of this gene(s) will be constructed to examine the phenotype and confirm the biological relevance of the identified genes.

The findings from this research can help researchers understand how other organisms with similar structure and metabolism are also regulated. This can be helpful for humans, as some bacterial pathogens operate with the same regulation pathway as *S. meliloti*. Researchers can cater their approach to halt the metabolism of these bacterial pathogens, ultimately helping public health and well-being.

Dissecting the Structure of Pmela in the MelA-agp Operon, Via the Binding of AgpT

Toliver Freeman, '20



Faculty Mentor: Catalina Arango Pinedo
Department of Biology

Supported by the SJU Summer Scholars Program

Sinorhizobium meliloti is a Gram-negative bacterium that has the ability to form symbiotic relationships with legumes, like alfalfa, that allow it to fix atmospheric nitrogen. This bacterium also has the ability to carry out the process of succinate mediated catabolite repression (SMCR). This means that *S. meliloti* will use the entirety of its primary carbon source (succinate) before using its secondary carbon source (mainly sugars or carbohydrates such as raffinose, lactose, stachiose, maltose) when both carbon sources are presented to the bacterium in conjunction. Therefore, there is some inhibitory effect that the presence of succinate has on expression of the genes that are necessary to use secondary carbon sources. The mechanism for this repression has not been described. *S. meliloti* has the melA-agp operon, which contains genes that are needed by the bacterium to utilize the secondary carbons sources. The melA-agp operon's expression is controlled by succinate mediated catabolite repression.

The mechanism of regulation of the agp-melA operon is largely unknown. Prior research to identify regulatory sequences in the promoter has shown that AgpT is a regulatory activator protein of the agp-melA operon, and that it binds to the first 30 base pairs of the promoter region. Mutagenesis studies showed that if nucleotides in positions 1-4 were deleted, expression of agp melA was eliminated. In particular, nucleotide substitution mutagenesis showed that nucleotides 2, 4, and 16 are necessary for expression of the genes, indicating that they are necessary for binding of AgpT and activation by this regulatory protein. Elucidation of the binding sequence of AgpT will facilitate identification of other regulatory sequences in the promoter region of agp-melA.

The goal of the research is to identify the sequence to which the activator AgpT specifically binds in the promoter region of the agp-melA operon. The specific purpose of this research project is to investigate which nucleotides in the 30 bp region at the 5' end of the promoter are essential for expression of the genes, which would indicate that they are important part of the binding sequence for AgpT.

I will complete the evaluation of importance that the nucleotides have on AgpT binding in positions 5-8 of the promoter region of the melA-agp operon. The construction of plasmids in which these nucleotides have been mutated is being carried out by researchers in the Arango lab; I will introduce these plasmids into *S. meliloti* and monitor the expression from these mutant promoters. Additionally, I will construct plasmids with mutations in nucleotides 10, 15, 20, and 25.



Ernest Baskin

Department of Food Marketing
Saint Joseph's University

Ph.D. Yale University

Research Interests: Judgment and Decision-Making

Dr. Ernest Baskin is an assistant professor of food marketing at Saint Joseph's University. He is an expert in consumer behavior and marketing research. His research focuses on consumer judgment and decision making with a particular interest in consumption decisions as well as consumer biases and context effects using experimental methodology and survey design.

Over the summer, his summer scholar looked at the effects of product color on consumer choice. They conducted a number of experiments on how products differing from their prototypical color affects product perceptions and behavior. In addition, they wrote a business case for in-class discussing regarding the research that they had conducted over the summer.

Impacts of Color on Purchase Behavior as Researched and Evaluated in Real World Events

Claire Sylvester, '21

Faculty Mentor: Ernest Baskin
Department of Food Marketing



Supported by the SJU Summer Scholars Program

With the current rise in health awareness and consciousness of America, we found it fascinating to evaluate how consumers perceive color based on their prototypical and non-prototypical preference towards their food and given response how these differences could affect consumers' purchase behavior.

Prototypical as defined by Dictionary.com “the original or model on which something is based or formed.” Where Non-Prototypical is just the opposite, for example eating a blueberry that is green when you know its prototypical color is blue.

The first portion of our project dealt with research into this topic and understanding what background and knowledge is already known with regard to the impacts of color preference on purchase behavior. To our surprise, there is little to no research done in this field of study. Therefore, our first action was to do devise relevant testing. This meant that we implemented a survey that allowed us to analyze various responses based on what the participant had displayed in front of them. The first test displayed 4 different colored cereals claiming a cherry flavor, the second test displayed 3 different colored yogurts claiming to be blueberry flavored, and the third test displayed 4 smoothies claiming to be coconut (all testing was randomized). Within each test a series of questions were asked, for example, do you find this healthy, artificial, naturally derived from the flavor claimed etc.

The second portion of our project consisted of further research into how this can and has applied in the real world. We apply our research and testing to different events that apply to this topic of “Impacts of Color on Purchase Behavior” in a case study. We dive into the controversy over Kraft Mac & Cheese’s release of their revamped non-artificially colored now naturally sourced coloring using paprika, turmeric, and annatto on their mac & cheese. We explain why they used this tactic and why it was successful based on research and evidence from our own testing on consumer perceptions and liking ratings of colors and change in the prototypical colors and flavors one is “use to”. This tactic was highly successful for this company where as for others it has not been.

We also analyze Trix cereal’s approach to a healthier artificial dye free cereal and why that was unsuccessful for the company. Again, we used evidence from the data we have gathered not only from our testing but also from research gained from notable sources in determining why in this case the tactic used in releasing an non-prototypical color of an iconic product turned out to be unsuccessful even for such a health conscious generation.



Elizabeth Ann Becker
Department of Psychology
Director Behavioral Neuroscience
Kinney Center Faculty Affiliate
Saint Joseph's University

Ph.D. University of Wisconsin

Research Interests: Social Behavior, Epigenetics, Autism Spectrum Disorders

Dr. Becker The primary research interests of the Becker Behavioral Neuroendocrinology Lab are two-fold; first, to understand the neural mechanisms that underlie the transmission of species typical behavior from parent to offspring. In particular, we focus on non-genetic, parental contributions to the development of offspring brain and behavior (e.g. how parental care influences offspring biology). Second, we are investigating a potential link between maternal antidepressant use and the development of autism spectrum disorders. Our research is supported by the National Science Foundation, the Tom and Mary Gallagher Foundation, Sigma Xi and Saint Joseph's University.

The Becker Lab In the Becker Lab, we use the monogamous and territorial California mouse (*Peromyscus californicus*) to examine parental contributions to the neurodevelopment of typical and disordered social behavior. We focus on understanding the impact that parental behavior has on the roles that neuropeptides (vasopressin and oxytocin) and hormones (testosterone and corticosterone) play in regulating social behavior.



We have a new area of research in the lab examining the neurodevelopmental consequences of early-life antidepressant exposure (via maternal drug use throughout lactation). Our findings suggest a causal link between SSRI (a class of antidepressant) use by nursing mothers and dysregulation of the oxytocin system which is implicated in the development of autism spectrum disorders.

Summer Research Students Molly DuPuis and Rob Roy, who returned for a second summer of research, were joined by Ashley Russell and Fox Ryker to complete various aspects of the above mentioned projects. The scientific contributions of this summer's research team were invaluable. We plan to present our research at numerous conferences in the upcoming year.

The Effects of Corticosterone Injections on Adult Female Blood Plasma Levels

Molly Dupuis, '20

Ashley Russell, '20



Faculty Mentor: Elizabeth Ann Becker
Department of Psychology

Supported by the SJU Summer Scholars Program

Due to the subjective nature of stress in humans and the large variety of confounds in human research, a rodent model to study the effects of stress is essential. Corticosterone (CORT) is a hormone secreted by the adrenal glands of rodents that modulates energy regulation, immune system reactions, and stress responses. Comparable to cortisol in humans, CORT is released in rodents in response to a stressful stimulus. Previous studies have shown that high endogenous CORT levels, roughly $90 \mu\text{g}/\mu\text{L}$, are indicative of a depressive-like state in adult rodents (Bingham et al., 2013). By using various routes of corticosterone administration, researchers can mimic this naturally stressful environment. Many studies have used high-dose injections of CORT as well as high stress inducing activities such as the elevated plus maze and the forced swim test. Using direct administration of CORT instead of a physical or social stressor controls for the natural hormone levels of the subjects and leads to less individual variability.

It has been determined that high-dose CORT injections (40 mg/kg) daily for a varying number of days during the gestational period reduced body weight and maternal care behaviors as well as increased depressive-like symptoms in pregnant rodents (Brummelte & Galea, 2016; Marks, Fournier & Kalynchuk, 2009). However, other studies have shown that low-dose injections, such as 10 mg/kg and 20 mg/kg, daily ranging from 6 to 35 days also create a depressive-like state in both male and female rodents (Zhao et al., 2008; Pytka et al., 2017). In this study, a low-level injection of CORT (10 mg/kg) was used as a baseline stressor; this amount of CORT is based on a previous study by Bingham and colleagues (2013). It is important to determine if this dosage of CORT is actually increasing CORT blood plasma levels and is producing immediate and lasting effects on endogenous CORT levels.

40 virgin female *Peromyscus Californicus* mice were used in this study. The females were between the ages of 6 to 10 months of age. 24 mice were given a subcutaneous injection of either 10 mg/kg of corticosterone or vehicle, or received no injection, between the times of 7 and 11 am on five consecutive days with two equal injections on the sixth day one hour apart. Blood was collected retro-orbitally one day before the first injection, one day after the last injection, and two weeks after the last injection. 16 separate subjects were given one injection of either 10 mg/kg of corticosterone or vehicle followed by blood collection one hour after injection. The collected blood was centrifuged, and the plasma was extracted and frozen at $-80 \text{ }^\circ\text{C}$ until analysis. The concentration of CORT in the samples will be measured by an ELISA (Enzo Life Sciences), or an Enzyme-Linked Immunosorbent Assay.

Repairing California Mice Increases Latency to Birth in Females

Robert J. Roy, '20

Faculty Mentor: Elizabeth Ann Becker
Department of Psychology



Supported by the SJU Summer Scholars Program

The California mouse displays atypical mammalian behavior by forming monogamous pairs in nature (Kleiman, 1977). Field studies have found evidence that California mice litters aren't born until months after a monogamous pair has formed (Ribble, 1991). These results have led California mice researchers to conclude that the species requires their pair bond to be firmly established in order to mate (Gubernick & Addington, 1994).

These monogamous pairs often last until one or both of the partners die (Kleiman, 1997). Death of a mate is common in both natural and laboratory settings, but simultaneous death of both mates is uncommon. However, the California mouse social model is based around the bi-parental care and increased defensive capability resulting from the continued presence of both the male and female. Therefore, there is possible incentive for California mice to find another mate after their original died. However, it is unclear if their monogamous mating system extends past the death of a mate and prevents them from forming a second pair bond. In the Becker lab mice are paired with new mates if their original mate died. While these re-paired mice will produce new litters it is unclear if the introduction of a new mate is detrimental to the mouse's reproductive potential. Our study set out to answer this question.

For the proposed study, birth records across five years were analyzed. Relevant data collected included: Pair dates, birth date of the first litter, animals that were repaired, and reasons for re-pairings. The date a pair was created and the birth date of their first litter was used to calculate the latency each pair had until their first litter. This was compared with the gestational period of California mice (30-35 days). Comparing latency to the gestational period allowed researchers to calculate the approximate time most California mice mate. Approximate mating time was analyzed in relation to an animal's sex and mating history pairings.

Results have so far concluded that mice who were re-paired have a longer average birth latency than mice in their initial pair. These results were prominent for females whose average birth latency increased by two weeks as opposed to the five days seen in males. This results challenge traditional views of monogamy that suggest mate lost will result in abstinence for the surviving mate. However, it is unclear if the births from re-paired mice indicate a secondary monogamous relationship, or are simply a utility to continue reproduction.

Examining Developmental Antidepressant Exposure as a Possible Contributing Factor to Autism Spectrum Disorder

Fox Ryker, '23



Faculty Mentor: Elizabeth Ann Becker
Department of Psychology

Supported by the SJU Summer Scholars Program

As neurotransmitters travel from the axon of one neuron to the dendrite of another, they are received by receptors, and in turn stimulate the receiving neuron. A regulated quantity of neurotransmitters is then reuptaken in order to prevent overstimulation. A selective serotonin reuptake inhibitor (SSRI) is an antidepressant that blocks serotonin from reuptaking, allowing for prolonged stimulation of the receiving neuron.

With that in mind, our focus is on maternal postpartum depression, which when treated with SSRIs may lead to hyperserotonemia in offspring. Hyperserotonemia is high levels of serotonin in the blood, which may also stunt the production of oxytocin. Additionally, hyperserotonemia is found in 30% of people diagnosed with autism spectrum disorder.

To study behavior we work with mice, specifically the *Peromyscus californicus*. They are exceptional models, for they are monogamous and coparental. Our hypothesis is that experimental mice viewing social stimulus will have similar brain activation as control mice viewing nonsocial stimulus. Experimental mice will have reduced oxytocin in the paraventricular nucleus (PVN), bed nucleus stria terminalis (BNST), and medial amygdala (MeA).

We work with both sexes, and have three groups: control, stress-only, and experimental. We administer injections and install osmotic pumps. The control group receives saline injections and pumps, the stress-only group receives corticosterone injections, which is the abundant stress hormone found in mice, and saline pumps, and the experimental group receives corticosterone injections, and fluoxetine pumps, which is the SSRI.

At gestation days 15-20 the mothers are injected, and undergo pump surgery postnatal day (PND) 2. Their offspring are weaned PND 28, and undergo either a social or nonsocial interaction test (SIT) PND 65. The SIT consists of either a same sex novel social stimulus, or a nonsocial stimulus. The mouse has three minutes to acclimate and three minutes to investigate.

An hour later, the mouse undergoes a transcardial perfusion, in which their brains are fixed with paraformaldehyde. The brain is then sliced and stained for c-Fos, which is a marker for neural activity, and oxytocin in the PVN, BNST, and MeA.



Shantanu Bhatt
Department of Biology
Saint Joseph's University

Ph.D. Emory University

Research Interests: Regulation of Gene Expression in Bacterial Pathogens

My lab focuses on the roles of regulatory small RNAs (sRNAs) in the virulence of the bacterial pathogens enteropathogenic *Escherichia coli* (EPEC) and *Escherichia albertii*. EPEC and *E. albertii* belong to the class of pathogens called attaching and effacing (A/E) pathogens, because they adhere to intestinal cells and destroy microvilli. These structural changes, in turn, reduce the ability of intestinal cells to absorb water and nutrients, leading to diarrhea. Under extreme conditions, severe dehydration can lead to death. The ability of A/E pathogens to cause diarrheal disease is housed within the cluster of genes termed locus of enterocyte effacement (LEE). Therefore, understanding the regulatory controls that impinge on the LEE is critical for developing effective interventional strategies.

EPEC - To date, over 40 protein-based systems are known to regulate gene expression from the LEE of EPEC. In contrast, the roles of regulatory small RNAs (sRNAs) remain cryptic. My lab identified the first three small RNAs – MgrR, RyhB, and McaS – that synchronize gene expression from the LEE of EPEC. Moreover, during our study we discovered a novel mechanism by which MgrR exerts its effect. Since then, we have discovered 4 additional sRNAs – Spot42, OmrA, OmrB, and DsrA – all of which further refine gene expression from the LEE. To the best of our knowledge these 7 sRNAs are the ONLY identified RNA-based regulators of the LEE in EPEC.

E. albertii – The bacterium was first isolated in 1991. However, it has been routinely mischaracterized. Moreover, until 2016, not a single gene had been mutated in the bacterium, because of the absence of a reliable method for genetic engineering. My lab developed the very first protocol for engineering mutations in the genome of this bacterium. We demonstrated the reliability and reproducibility of this technique by mutating multiple genes that are known to be involved in the virulence of other A/E bacteria such as EPEC and EHEC. Since then we have begun to address the functionality of these genes. We have identified four regulators – Ler, GrlR, GrlA, and Hfq – that affect gene expression from the LEE of *E. albertii*. These four factors represent the ONLY experimentally validated regulators of the LEE of *E. albertii*. One of these regulators, Hfq, exerts its effect by facilitating base-pairing between sRNAs and their target mRNAs, thereby implicating sRNAs in bacterial virulence. Current ongoing research on *E. albertii* seeks to identify the specific sRNAs that regulate the LEE in this bacterium.

Investigation of the Role of the RNA Chaperone ProQ on Regulating the Locus of Enterocyte Effacement (LEE) in Enteropathogenic *Escherichia coli*

Emily Costello, '21



Faculty Mentor: Shantanu Bhatt
Department of Biology

Supported by the Nicholas & Susan Nicolaides Research Fellowship and the SJU Summer Scholars Program

Enteropathogenic *E. coli* (EPEC) primarily infects infants in developing countries and is transmitted through contaminated food and water. EPEC is an attaching and effacing (A/E) pathogen, so called because members of this group form characteristic A/E lesions on the surface of infected intestinal cells and destroy their microvilli. A/E lesions decrease the ability of intestinal cells to absorb nutrients and water, which leads to diarrhea. The locus of enterocyte effacement (LEE), a major pathogenicity island in EPEC, allows for the formation of A/E lesions. The LEE encodes the proteins for a type 3-secretion system (T3SS) including structural and effector proteins. The master transcriptional regulator Ler, encoded by the *LEE1* operon, activates transcription from the other LEE operons, which, in turn, leads to LEE-encoded protein expression. The structural proteins EspA, EspB, and EspD make up the extracellular filament of the T3SS that extends from the bacterial cell and punctures the host cell membrane to connect the cytoplasm of the host cell to that of the bacterial cell. This connection enables the bacterial cell to secrete effector proteins, such as the translocated intimin receptor (Tir), into the host cell. Tir is then integrated into the host cell membrane where it associates with intimin located on the outside of the bacterial cell. Tir-intimin interactions ultimately signal host cell proteins to reorganize the host's cytoskeleton beneath the attached bacteria to form A/E lesions, resulting in increased bacterial colonization and diarrheal disease.

RNA chaperones enhance the binding of small regulatory RNAs (sRNAs) to their target mRNAs which can affect transcriptional elongation, mRNA stability, and/or translation. In addition, sRNAs have been shown to play a role in the regulation of the LEE. The goal of this research project is to determine if the RNA chaperone ProQ affects expression of the LEE as well as EPEC motility, and if so, to determine its operational mechanism. Previous research has found that ProQ in *Escherichia coli* binds a large number of mainly cis-encoded sRNAs to facilitate their binding to their target mRNAs. However, not much research has been done on ProQ in EPEC. This summer I determined that the deletion of *proQ* in EPEC increases expression of the LEE-encoded protein Tir while reducing the flagellar-dependent motility of the bacterium.

In the future I plan to perform western blot experiments to probe for other LEE-encoded proteins to determine if the phenotype seen with Tir is seen with other LEE-encoded proteins. Thereafter, I would like to figure out the precise molecular mechanism by which ProQ affects gene expression from the LEE of EPEC. Additionally, I would like to perform western blot experiments to probe for FliC and FlhDC to determine the hierarchical level at which ProQ affects motility.

Investigating the Role of Sigma Factor RpoN in the Regulation of the Type III Secretion System of *Escherichia albertii*

Mary Marino, '22



Faculty Mentor: Shantanu Bhatt
Department of Biology

Supported by the SJU Summer Scholars Program

Escherichia albertii is an emerging gastrointestinal pathogen that has caused severe health concerns in developing countries. First isolated in the early 1990's from the diarrheal stool of children from Bangladesh, *E. albertii* has not been extensively studied and is often mischaracterized as related food-borne bacterial pathogens such as enteropathogenic *Escherichia coli* (EPEC) or enterohemorrhagic *Escherichia coli* (EHEC). Therefore, it is critically important that the genetic mechanisms of this pathogen are more comprehensively characterized in order to more easily distinguish it from these other species of bacteria and to learn ways in which the bacteria may be combatted.

E. albertii, EPEC, and EHEC cause similar symptoms upon infection such as diarrhea and dehydration due to their attaching and effacing (A/E) tendencies. A/E pathogens bind intimately to the surface of infected intestinal cells by means of pedestal-like structures that connect the two cells. The formation of A/E lesions results in the disintegration of microvilli, which, in turn, reduces the ability of intestinal cells to absorb water and other nutrients, leading to diarrhea. The ability to form A/E lesions is due to the genetic element known as the locus of enterocyte effacement (LEE). The LEE is a pathogenicity island which codes for a type III secretion system (T3SS) that allows *E. albertii* to inject toxic proteins into intestinal epithelial cells.

The transcription of genes in the LEE that code for such proteins is dependent upon its corresponding sigma factor, a protein involved in the initiation phase of transcription. The sigma factor joins with a core RNA polymerase to form a holoenzyme complex, and then guides the holoenzyme to the promoter region of the DNA strand of interest. This summer, I investigated the role of sigma 54 factor, or RpoN, in the transcription of T3SS proteins in *E. albertii*. RpoN is known to be responsible for the expression of nitrogen-related genes and plays an important role in the stress response of the bacterial cell, as demonstrated by previous experiments. Through Western Blot Assays using *E. albertii* mutants that did not possess a functional *rpoN* gene, I determined that the synthesis of the LEE-encoded protein Tir and EspB is diminished in the *rpoN* mutant, suggesting that RpoN positively regulates the expression of these two LEE-encoded proteins. Future studies are geared towards elucidating the molecular mechanism by which RpoN controls gene expression from the LEE of *E. albertii*. Additionally, the role of RpoN in other biological processes such as acid resistance, catalase functionality, and biofilm formation will also be assayed.

Identification and Characterization of sRNAs that Regulate the LEE4 Operon in Enteropathogenic *E. coli* (EPEC)

Zoe Mrozek, '21



Faculty Mentor: Shantanu Bhatt
Department of Biology

Supported by the John P. McNulty Scholars Program and the SJU Summer Scholars Program

Enteropathogenic *Escherichia coli* (EPEC) is a gastrointestinal pathogen that causes diarrhea and death in infants in developing countries. As an attaching and effacing (A/E) pathogen, upon its infection of the host, EPEC binds to intestinal epithelial cells and proceeds to destroy the microvilli that extend from the epithelial cells. Microvilli are essential organelles as they function in the absorption of food, water, and nutrients. In its attachment to epithelial cells, EPEC injects effectors that cause actin polymerization, leading to the formation of A/E lesions on the surface of the infected cell. The connection of the pathogen to the host cell allows for further bacterial colonization and disease. Due to the change in morphology of epithelial cells by microvilli destruction and lesion formation, absorption can no longer occur in the intestine leading to the observed diarrheal symptoms which can lead to mortality.

The ability of EPEC to form A/E lesions derives from its pathogenicity island locus of enterocyte effacement (LEE). LEE encodes the components of a type III secretion system (T3SS) involved in bacterial virulence. While many proteinaceous factors that regulate LEE have been identified, small RNA (sRNA) regulators have not been studied to the same extent. sRNAs are a group of RNAs that affect gene expression posttranscriptionally by base pairing to target mRNAs to impact translation or mRNA stability. Many such sRNAs require the RNA chaperone protein Hfq to facilitate their base pairing to their target mRNA.

My research is specifically focused on determining Hfq dependent sRNAs that regulate the *LEE4* operon of the LEE. I first constructed a translational fusion in which the 5' untranslated region (UTR) of *LEE4* was fused to a *lacZ* allele lacking its ribosome binding site and translation start codon. The 5' UTR and 45 nucleotides into *sepL*, the first gene of *LEE4*, were amplified by Polymerase Chain Reaction (PCR) with an upstream arm homologous to the *araBAD* promoter and a downstream arm homologous to the *lacZ* gene. Homologous recombination was then used to replace a *cat-sacB* cassette located between the *araBAD* promoter and *lacZ* gene in the bacterial chromosome with the amplified *sepL* region to form the *P_{araBAD}-sepL'-lacZ* hybrid fusion. The recombinants were transformed with plasmids expressing individual Hfq-dependent sRNAs, and β -galactosidase activity from the *sepL'-lacZ* fusion was monitored. I am currently in the process of evaluating which Hfq-dependent sRNAs can potentially regulate *LEE4*.

Investigation of the Role of the RNA Binding Protein CsrA in *Escherichia albertii*

April Pivonka, '22

Faculty Mentor: Shantanu Bhatt
Department of Biology



Supported by the John P. McNulty Scholars Program and the SJU Summer Scholars Program

Attaching and effacing (A/E) pathogens are one of the main causes of diarrhea amongst infants in developing countries. These pathogens are disseminated via contaminated food or water. A/E bacteria induce these effects by means of a type 3 secretion system (T3SS) that connects the bacterial cytosol to that of the host and enables effectors to be dispatched into the host cell where they alter the host's cytoskeleton. This results in pedestal formation and the inability of the intestines to properly absorb nutrients, leading to diarrhea. Examples of A/E bacteria include enteropathogenic *Escherichia coli* (EPEC), enterohemorrhagic *E. coli* (EHEC), and *Escherichia albertii* (*E. albertii*). In the majority of outbreaks involving *E. albertii*, the bacterium was initially misdiagnosed as EPEC or EHEC and later reclassified as the correct bacterium. This has led to a lack of data on this particular pathogen and illustrates the necessity of identifying as many unique traits of *E. albertii* as possible for correct classification.

The virulence of A/E pathogens is mainly controlled by a cluster of genes called the locus of enterocyte effacement (LEE). Although transcriptional regulation of these genes has been studied extensively, posttranscriptional regulation has not been largely examined. An example of posttranscriptional regulation includes the use of RNA-binding proteins to control mRNA stability and/or translation. One such protein, CsrA, regulates mRNAs posttranscriptionally by directly binding to them.

My research aimed at interrogating the role of the RNA binding protein CsrA in regulation of the LEE of *E. albertii*. First, I deleted the CsrA gene in *E. albertii* by using a recombineering-based protocol that was developed in our lab. Using Western Blotting, we examined the levels of the LEE-encoded Tir protein in the mutant bacteria, which serves as an intimin receptor for correct attachment of the bacterium to the host cell. The results revealed a decrease in Tir production in the mutant bacteria, illustrating that CsrA is involved in the production of this protein. We also examined the role of CsrA in glycogen biosynthesis. Glycogen production was increased in the CsrA mutant compared to the wild type *E. albertii*, demonstrating that CsrA plays a role in suppressing glycogen synthesis. Future studies are aimed at elucidating the regulatory pathway(s) by which CsrA controls the LEE and glycogen biosynthesis. Results from our study will be critical in determining the molecular mechanisms of pathogenicity of *E. albertii*, which, in turn, will aid in developing suitable clinical measures to counteract transmission of this emerging pathogen.



Shenid Bhayroo
Department of English
Saint Joseph's University

Ph.D. Louisiana State University

Research Interests: Media and Culture Industries, Political Economy, News, Journalism, International Media

As a former full-time journalist, my research now, as a college professor, focuses primarily on how to better understand the norms, routines, processes and workings of the media and culture industries. I ask questions about the many things that media workers do, using the theoretical lens of critical political economy. In as much as the "press" is considered the Fourth Estate, it is also an economic enterprise. What we read that is printed on paper, or listen to on audio devices or watch on screens, is the outcome of process that involves the production, distribution and consumption of information content by news workers. In the news media world, these news workers are storytellers we know as reporters, journalists, editors or anchors.

Former and current students who work in, or aspire to work in this world of storytelling - as news reporters or journalists - must be adequately equipped with hands-on, and critical thinking skills so they are able to do this important work. My academic research goals attempt to answer macro-level questions about media and culture industries. The answers to these questions are often integrated with my pedagogical approach, both in the classroom and in the field. These relate to the development of critical awareness at the micro and macro level of our work.



For example, the South Africa summer study abroad program - "Media and Cultural Studies in South Africa" - simulates for students the life of a foreign correspondent. For five weeks students live and work as reporters would in a foreign country. Students learn how to tell stories, how to be responsible, thoughtful and ethical travelers in a foreign country, how to apply preexisting knowledge to navigate novel experiences, and also how to do meaningful service from a social justice stance. Many of these outcomes lie at the intersection of personal development and community engagement in an academic and scholarly context.

The Role and Impact of Non-Governmental Organizations (NGOs) on the Economic Empowerment of South African Women

Cara Smith, '21



Faculty Mentor: Shenid Bhayroo
Department of English

Supported by the SJU Summer Scholars Program

The system of racial segregation, known as apartheid, officially ended in 1994 with the election of Nelson Mandela as president of a democratic South Africa. Apartheid policies enforced protection of the political, economic and social interests of the white ruling class through a complex system of laws that exercised control over almost all aspects of the lives of the black majority. The democratic government, now in power for 25 years, has not yet been able to transform the neoliberal capitalist economy it inherited, although it has tried to implement poverty reduction programs, among other efforts, to undo apartheid. The state has not been able to fundamentally improve life for the majority of South Africa's impoverished black working class. As a result, non-governmental organizations (NGOs) have served to provide many of the support systems for people in need.

Although NGOs appear to be helping underserved communities, some have argued that they benefited from neoliberal policies and are more accountable to their funders than the people they serve. Critics are concerned that NGOs focus more on technical solutions rather than the real underlying issues related to poverty. However, NGO officials argue that focusing on technical solutions, like literacy, will lead to improving larger underlying issues.

My research project examined how NGOs function in the South African economy. The major elements I studied was the extent to which non-governmental organizational support has impacted black South African women. Specifically, I looked at the role NGOs play in the economic empowerment of South Africans.

A review of scholarly literature, allowed me to create interview questions. I had the opportunity to interview "Mum" Rose Thamae, the founder of The Sunrise Campaign, a community-based organization that is focused on empowering women and ending gender-based violence. I also interviewed Mia Malan, the editor-in-chief and executive director of The Bhekisisa Centre for Health Journalism. The donor-funded South African news organization covers news from a solutions journalism perspective and highlights inequalities in health in South Africa.

The field research conducted in South Africa, combined with my literature review presents strong evidence that NGOs still play a significant role as a supplementary support system for women in South Africa, despite the dramatic reduction in national and international funding for NGOs.



Kristin L. Burr

Department of Modern and Classical Languages
Saint Joseph's University

Ph.D. Washington University in St. Louis

Research Interests: Medieval French Literature; Pedagogy

My scholarship focuses on thirteenth-century Old French verse romance, with an emphasis on tales involving King Arthur's court. I study issues related to gender, examining the changing role of the courtly lady and the ways in which the definition of chivalry shifts. My current project is an in-depth investigation of the literary function of love tokens. In twelfth-century Old French romance, lovers regularly exchange concrete objects that serve as signs of their affection. These tokens bind the pair together, offering proof of fidelity, identity, and true love.

Many thirteenth-century verse tales, however, are far from traditional. Trusting their audiences' knowledge of romance conventions, composers toy with expectations concerning characters, customs, and topics. The portrayal of love tokens in these narratives becomes more complicated, as well: authors start to transform the theme with amusing—and sometimes surprising—results. I analyze how composers build upon traditions established in earlier works to transform the significance of tokens and create a different image of chivalry and love, simultaneously forging a new model of the relationship between the hero and the heroine.

This work on love tokens has opened a related research path on relics in romance. At times, a knight's dismembered body part becomes an odd sort of love token, and it is also described in terms associated with relics rather than with chivalry. I am currently studying these cases and expanding my research to romances beyond the thirteenth century as well as to other literary genres in which relics play a key role.

I have been fortunate to have native French speakers in classes at times, and their presence enriches everyone's experience, both linguistically and culturally. My interest in pedagogy in designing courses for students learning a second (or third) language informed my participation in this year's Summer Scholars program, during which I worked with a student looking at bilingual and English as a Second Language programs in Philadelphia-area schools.

Whether in research on medieval French literature, courses I've developed on French-speaking regions of North America—including Québec, Acadie, Louisiana, and New England—or my pedagogy, I focus on how identities are formed and evolve over time, displaying levels of complexity that become increasingly apparent as one examines them more closely.

Bilingual Education: An Examination of the Effects of Bilingual Education Systems and Their Current Usage in and Around the Philadelphia Area

Eileen Burner, '21



Faculty Mentor: Kristin L. Burr
Department of Modern and Classical Languages

Supported by the SJU Summer Scholars Program

This summer, I engaged in an investigation of English as a Second Language (ESL) education programs in and around the Philadelphia area. After taking an education class at Saint Joseph's University that highlighted bilingual education, I became interested in why more schools did not utilize this extremely beneficial type of program. Thus, I decided to interview program directors from all types of ESL programs around the area to discover how their programs were structured and why. I took the information I had learned from my education classes, especially the class that discussed bilingual and ESL education, and generated a short list of questions that would help me gain an in-depth understanding of each ESL program. Next, I contacted schools in Philadelphia and in its surrounding suburbs to schedule interviews with program directors.

From these interviews, I learned about many different types of ESL programs. Some had a few bilingual classes, some had each English Language Learner paired with an English-speaking student, some allowed their students to use their home language whenever they could, and some only just started their ESL program this year. One major deterrent that I found to implementing a bilingual program in schools was funding. It is extremely expensive to fund this type of program due to the specialized teachers that would have to be hired. It is also a struggle to find certified teachers to hire for these programs. Many schools did not implement a bilingual program due to the amount of languages present in the school. Some schools had over 80 languages spoken, so, in these cases, a bilingual program does not make sense.

As I began my research, I noticed that each ESL program was vastly different from the next, which I found to be perplexing due to the strict regulations placed on schools. To understand the differences, I researched the legislation surrounding English Language Learners (ELLs) and what is required of districts who have them in their schools. I found that at both the federal and state level, there is not much more than a paragraph dictating what is required of schools with English Language Learners. Thus, schools are free to design their own programs for the group of bilingual students they have. I also became interested in the statistics and opinions supporting bilingual programs. I read several articles on this topic to help me better understand the reasoning behind bilingual programs and their alternatives. In the past, much of the research done in bilingual education was flawed and showed negative results for students, so many states moved away from these programs. However, new research shows that bilingual programs have many benefits for students such as higher scores on tests of executive functioning, perspective taking, and metalinguistic awareness. Researchers have also noticed that bilingual programs make students and families feel valued, and that students are happier overall. Higher test scores, attendance, and parent involvement were also noted.



James H. Carter
Department of History
Saint Joseph's University

Ph.D. Yale University

Research Interests: History of Modern China; Chinese-Western Relations

My teaching and publications emphasize the relations between China and "the West," usually, Europe and/or the United States. In contrast to many scholars who study this important dynamic, I tend to focus on these relations at a person-to-person, rather than a state-to-state, level. I think it is important that we understand how individuals have encountered the gaps between China and the West: how it has shaped their lives, provided or denied opportunities, and presented new and often unanticipated challenges.

I have taken this interest and applied it to contemporary US-China relations as well. One of the most satisfying parts of my work at Saint Joseph's has been the several trips to China I have made with students, watching them encounter China and Chinese people firsthand, rather than mediated through the reporting and scholarship of others. I have been active working with the National Committee on US-China Relations to help do this work more broadly, accompanying several delegations of US Congressional staff to China and serving as a guide and resource to make sense of their visit and their meetings with Chinese and American officials.

I aspire to help Saint Joseph's University students acquire and apply the tools they need to understand the past and present of China's relationship with the West and, especially, the United States.

Religious Repression of Uyghurs and the Role of Media

Olivia O'Reilly, '20

Faculty Mentor: James H. Carter
Department of History



Supported by the SJU Summer Scholars Program

The Chinese government brands their country as a nation that holds freedom and peace at its core. But when it comes to forces threatening their political legitimacy, freedom and peace are quickly replaced with persecution. This conflict of appearances between what is said by the Chinese government versus its actions were at the center of my investigation this summer. The Chinese government uses their state owned media sources to illustrate topics in a positive light. One instance of this inconsistency is the media's depiction of Uyghurs in China.

The Uyghurs are an Islamic, ethnic minority group located in the Xinjiang province. The Uyghurs have historically been oppressed by the Chinese government. They are an alternate to the Party's ideals and therefore seen as politically threatening. Over the course of time, religious persecution in China has changed. Recently, news sites outside of China have been investigating labor reform camps in Xinjiang. Many Uyghurs are being held there without legal justification. Although injustices like labor reform camps have been brought to light, the Chinese government still does not brand their actions as harmful. The Party claims that Uyghurs want to be in the camps and that it is a preventative measure to combat terrorism before it happens.

The objective of my project is to find first how the government goes about repressing the Uyghurs. Secondly, how the Party uses media outlets to validate this repression. For this portion of my project I take the news that the Chinese state-sponsored news sites create and compare the English version to their Chinese version. Since both the English version and the Chinese version are created by the state owned news sites, they will use the narrative of the Chinese government. Through this comparison I will be able to see what the Chinese government wants Chinese speakers to know versus what they want foreigners to know about Xinjiang and the Uyghurs.

Additionally, the search to find articles fitting for this comparison will be analyzed as well. Since the Chinese government actively censors media sites there will not be much content on the repression of Uyghurs to begin with. This shortage of articles on the topic of Uyghurs shows us how the Chinese government does not want to comment on the events taking place and would rather keep their people from knowing about it entirely.



Jose F. Cerda
Department of Chemistry
Saint Joseph's University

Ph.D. Michigan State University

Research Interests: Spectroscopic and Electrochemical Studies of Redox Proteins and Heme Model Compounds

Heme proteins are a family of proteins that contain the heme cofactor and are involved in many types of biological functions. For example, heme *b*, a type of heme cofactor found in myoglobin (Mb), hemoglobin (Hb), and heme peroxidases, is used by heme proteins for oxygen storage and transport, electron transfer, oxygenase, catalase, peroxidase, and gas sensing. Although all these protein structures may be different, the heme cofactor is the active site in all of them and my research goal is to understand how heme-protein interactions uniquely defines the biological role of a heme protein.

For many years, we have used UV-vis spectroscopy and electrochemical techniques to study heme proteins because of the physical-chemical properties of the heme cofactor: hemes absorb strongly in the UV-visible region and can also be subjected to oxidation reduction reactions. In our studies, we have used fluoride binding as a probe of the heme pocket structures of Hb, Mb, horseradish peroxidase (HRP), and clam hemoglobins. Fluoride ion is an interesting choice since it is not a physiological ligand. However, many heme proteins have the ability to bind fluoride ion and differences in the fluoride binding properties suggest differences in the heme pocket structure.

Our past studies using this method have shown that the heme pocket structure affects the electronic properties of the heme in the presence of fluoride. However, because of the presence of all types of heme-protein interactions, it is very hard to pinpoint a particular protein-heme interaction as the sole definer of the biological role of a heme protein. To achieve a greater scope in understanding the role of the heme-protein interactions, my SSP research students have used temperature-controlled experiments to study the thermodynamic properties of fluoride binding. In doing this, we have been able to measure the enthalpies and entropies of fluoride binding in Hb, Mb, and horseradish peroxidase (HRP).

During this summer, by using the aforementioned approach, we studied additional aspects of heme protein behaviors such as denaturation and autooxidation. We are in the process of interpreting our measured thermodynamic values to understand the molecular mechanism of heme protein denaturation and autooxidation.

Thermodynamics of Fluoride Binding in Denatured Heme Proteins

Aidan Bauer, '21

Gerardo Rivera-Colon, '21



Faculty Mentor: Jose F. Cerda

Department of Chemistry

Supported by the SJU Summer Scholars Program

Heme proteins are a group of proteins that contain a heme cofactor, which contains an iron cation with a porphyrin ring. The heme is typically the active site of these proteins. Myoglobin and hemoglobin are examples of heme proteins that bind oxygen. In Dr. Cerda's lab, we use fluoride binding as a probe of the heme group and its interactions with the surrounding protein. Further, we run temperature-controlled measurements to determine the thermodynamic properties of fluoride binding in heme proteins. The measured enthalpy, entropy, and free energy of fluoride binding in a heme protein can be used as a quantitative tool that can lead to the understanding of the molecular interactions that are important for heme protein function.

During the summer, we conducted two major experiments, both of which had to do with the protein denaturing of myoglobin. The first was a natural denaturing process through the aging of myoglobin. We carried out these experiments with the protein in the fridge and at room temperature. In the second part of our study, we denatured myoglobin through the addition of guanidine (GuHCl). For this experiment, myoglobin was prepared in buffers containing GuHCl concentrations of 0 M, 0.25 M, 0.5 M, 1.0 M, 2.0 M, 2.5 M, and 3.0 M.

In our aged denaturation experiment, where we kept the myoglobin in the fridge and ran our experiments at predetermined days, after examining the measured enthalpies (ΔH) and entropies (ΔS) of fluoride binding, there was no clear trend that led to the belief that the protein was denatured, even after 20 days. In our aged myoglobin experiment in which the protein was left at room temperature (25 °C), from 5 to 10 days, the enthalpy change (ΔH) and entropy change (ΔS) values remained relatively constant. However, after 15 days, the ΔH and ΔS values started to decrease. The thermodynamic data of fluoride binding in myoglobin show clear signs of denaturation after 15 days.

In the presence of increasing concentrations of GuHCl, myoglobin showed a definite trend in the measured ΔH and ΔS . At approximately 1.0 M GuHCl, the ΔH and ΔS values decreased, relative to its "native state". From 1.0 M to 2.0 M in GuHCl, the ΔH and ΔS values became significantly more negative as the protein changed from its "native" conformation to an "intermediate state" in which the protein is molten and begins to denature. As the concentration of GuHCl was increased from around 2.0 M to 3.0 M the ΔH and ΔS values became more positive and the protein was in an "unfolded state". We are now in the process of using the measured thermodynamic values to interpret the molecular behavior of the denaturing process of myoglobin.

Thermodynamics of the Redox Reaction of Hemoglobin

Raesibe Tanaka Mada, '20



Faculty Mentor: Jose F. Cerda
Department of Chemistry

Supported by the SJU Summer Scholars Program

The focus of our research is primarily on heme proteins. Heme proteins such as hemoglobin and myoglobin are proteins that contain a heme cofactor. Heme proteins contain a central iron ion that dictates the chemical properties of the heme and its interactions with the surrounding protein.

Traditionally, heme proteins such as hemoglobin and myoglobin, which are oxygen transport, and oxygen storage proteins, are viewed as heme proteins whose physiological oxidation state is the reduced, ferrous state (2+). However, because of the presence of the ferric ion, both heme proteins readily change its oxidation state to the ferric state (3+), exhibiting rather interesting electrochemical properties. During this summer, my project consisted in studying the thermodynamic properties of the oxidation-reduction reaction of hemoglobin and the autooxidation of myoglobin.

The first project consisted of running an experiment on the electrochemical properties of hemoglobin as a function of temperature. The resulting measured thermodynamics properties of the oxidation-reduction of hemoglobin were then compared to the measured thermodynamic properties of ligand binding in hemoglobin.

In the second part of my project, the autooxidation rate constants for myoglobin were measured under different experimental conditions. Myoglobin samples were mixed into 12 different buffer samples. The 12 buffer samples were pH 5, pH 7 buffers, each with and without fluoride, at 10, 25, and 40 °C. The UV-Vis spectrometer was used to follow the spectra upon autooxidation of myoglobin, from the oxy state to the fully oxidized state, roughly over the span of 90 minutes. This was done to determine how the buffer solution and temperature affect the autooxidation rate of myoglobin (and hemoglobin).

In the first set of experiments, the measured enthalpies and entropies of the oxidation-reduction of hemoglobin in the presence of fluoride, are similar to the measured thermodynamics properties of oxygen binding in hemoglobin. This data indicates that hemoglobin exhibit redox activity that may be important for the biological role of this protein. Regarding the autooxidation of myoglobin, our results show that pH 5 with fluoride and at 10°C, is the optimal environment in which oxy-myoglobin goes fully oxidized at its fastest rate.

Further experiments will be performed to obtain a greater scope of how both hemoglobin and myoglobin utilized its oxidized state to for its role of oxygen binding and understand what is the physiological role of the autooxidation reaction exhibited by both of these proteins.



Peter A. Clark, S.J.

Department of Theology and Religious Studies
Director-Institute for Clinical Bioethics
Saint Joseph's University

Ph.D. Loyola University of Chicago

Research Interests: My research this summer, with the Opioid Task Force of the Institute of Clinical Bioethics, focused on medical marijuana as a potential replacement therapy. Methadone and suboxone, which are FDA-approved opioid replacement therapies, have been effective at alleviating opioid dependence and helping to lessen withdrawal symptoms, however they are not successful for all patients and do not come without risks. Various adverse effects to these drugs which must be considered include anxiety, cardiac effects, muscle aches, agitation, insomnia, nausea and diarrhea. In addition, access to these replacement therapies is a challenge, as there are also legal and logistical impediments to acquiring them. Often, the demand for these medications exceeds the supply. We are examining the role of cannabis as a potential replacement therapy in treating opioid withdrawal symptoms and decreasing the probability of relapse. Cannabis and opioids share a common primary use of analgesia. A recent review by the National Academies of Science and Medicine confirmed cannabis' effectiveness in treating chronic pain in adults. Studies have shown that patients taking opioids for chronic pain who also have access to cannabis decrease their opioid use by 40-60%. These patients also reported to prefer cannabis to opioids. Furthermore, cannabis has been shown to consistently decrease the dose of opioids needed to reach suitable pain relief. The hope is that medical marijuana can become a third replacement therapy for those addicted to opioids in the United States.

The remainder of the summer consisted in helping to formulate ethical policies for Caritas Baby Hospital in Bethlehem, Palestine. The Institute of Clinical Bioethics at Saint Joseph's University is now representing Caritas Baby Hospital as their Bioethics consultants. We are in the process of assisting the medical staff at Caritas in forming a Pediatric Advanced Care Team (PACT) to provide an extra layer of support-healing, comfort and quality of life- to the care of children in Palestine with terminal illnesses. This team of physicians, nurses, social workers and pastoral care members would provide support, consultation and services to these children and their families. This is the first such team in Palestine. In addition, the 2 bioethicists in the Institute consulted at the 17 hospitals we represent in Pennsylvania, Maryland and Delaware and taught ethics to over 450 medical interns, residents and fellows in these hospitals. We also established a new Center for Addiction and Recovery Education (C.A.R.E.) at Saint Joseph's University within the Institute of Clinical Bioethics. The Center's work will be grounded in compassion and *cura personalis* and will promote understanding of addiction and seek to reduce its impact across all layers of society. The focus of C.A.R.E. will be education, research, public policy and community engagement.

The of Role Social Media in the Vaccination Controversy

Michael Fontana, '20



Faculty Mentor: Peter A. Clark, S.J.
Department of Theology and Religious Studies and
the Institute of Clinical Bioethics

Supported by the SJU Summer Scholars Program

The purpose of my project is to investigate how social media has aided the surge of vaccine hesitancy in the US. Vaccine hesitancy, defined by the World Health Organization, is the delay or refusal of vaccines despite their availability. My goal is to analyze the social, legal, medical, and ethical implications of the vaccine controversy and ultimately publish a paper for the *Journal of Bioethics*. Dr. Peter Clark SJ and I assembled an interdisciplinary team to investigate each issue effecting the vaccine controversy. Our interdisciplinary team includes as follows: Lauren Rutt, a senior, double majoring in Marketing and Business Intelligence & Analytics, investigating the social issues involved with vaccine hesitancy, Archen Krupedev, a second year medical resident at Mercy Catholic Medical Center, investigating the medical advantages and improvements of vaccinations, Dr. Peter A. Clark SJ, the director of the Institute of Clinical Bioethics, investigating the ethical implications of immunizations, and myself, a senior Biology major and Fellow of the Institute of Clinical Bioethics, investigating the legal issue and offering recommendations for the vaccine controversy.

The World Health Organization declared vaccine hesitancy as a top ten health threat in 2019. The Anti-Vaxx movement, activists who openly reject vaccinations, has gained traction in the United States, supplying well-intentioned parents with misinformation that could keep them from vaccinating their children. The CDC stated that the percentage of unvaccinated children has quadrupled since 2001. People began to question the safety of vaccinations when former Dr., Andrew Wakefield, proposed a false link between the MMR vaccine and autism. It wasn't until 2004 that researchers discovered the Wakefield study was fabricated and that he had financial ties to several lawyers that fighting lawsuits with vaccine-producing companies. Even still, his publication wasn't retracted from the British journal, *Lancet*, until 2010, and currently causes hesitations in a parent's decision to vaccinate their children.

In addition to investigating each component of the vaccine controversy, our paper will discuss recommendations for how the vaccine controversy should be handled on social media, legally, and ethically. We included recommendations for how platforms should regulate searches that would supply the users with inaccurate information about vaccines, even going as far as removing outright fraudulent information from pages. Currently, 15 states allow for medical, religious, and philosophical vaccination exemptions, Pennsylvania being one of the 15. We would recommend state legislatures do away with philosophical exemptions, tighten parameters for religious exemptions, and enforce specific laws for medical exemptions. To eliminate the Anti-Vaxx movement and promote vaccination success, we aim to propose and outline an interdisciplinary Pro-Vaccine Information Task Force, that would actively search out misinforming antivaccine information and refute or remove posts, articles, websites, etc. by supply viewers with factual information related to the success of vaccines. We hope that our paper can be used to aid the Pro-Vaccine agenda and work to increase child vaccination rates.



Vaping: A New Epidemic

Medical, Legal and Ethical Implications

Thomas Jenkins, '21



Faculty Mentor: Peter A. Clark, S.J.
Department of Theology and Religious Studies and the
Institute of Clinical Bioethics

Supported by the SJU Summer Scholars Program

Vaping is the act of inhaling nicotine in the form of aerosol, it often includes flavoring and is delivered by an electronic device called an e-cigarette. E-cigarettes are powered off batteries and vary in size, while most can fit in the palm of a user's hand. The aerosol they contain is often referred to as salt nic or e-juice. They were originally designed with the intention of helping adult smokers wean off or even quit combustible tobacco products. However, their use has developed into a nationwide epidemic of nicotine addiction among high school and middle school youth, the most popular brand being Juul.

According to the CDC, the National Youth Tobacco Survey reported that around 20% of all high schoolers had tried or currently use an e-cigarette in the last 30 days. According to the surgeon general between 2011 and 2015 there was a 900% increase in youth vaping. Despite public efforts millions of a new generation are addicted to nicotine, while the long-term effects of e-cigarettes are still unknown. Many e-cigarettes and e-juices are still subject to FDA review in 2020.

After consulting both pharmacological and medical studies, it can be determined that many e-cigarette brands contain harmful chemicals. Many of the chemicals have been studied and their risks assessed individually but not much information exists for the e-juice constituents when undergoing pyrolysis. Despite potential harms from e-cigarettes, it is a common misunderstanding among the public, specifically the youth, that e-cigarettes are generally safe. However, it is likely that e-cigarettes are or can be safer than traditional cigarettes and if this is true they could be used to reduce the harms of nicotine addiction for current smokers.

In spite of a lack of information on the long term effects of e-cigarettes, companies have heavily marketed their products to those under 18. This marketing strategy is reminiscent of the nefarious tobacco companies that addicted young to nicotine so as to ensure their long term dependence on cigarettes. Juul specifically has heavily advertised on social media where youth are likely to see and be influenced by their ads. As a cult following on social media developed, Juul and other e-cigarette ads or other forms of unofficial propaganda spread quickly through multiple social media channels. This allowed the industry to stop advertising to youth themselves, and as concern over the growing health problem spread, they deleted large portions of their social media accounts. Juul and other companies only then began to market themselves as an alternative to traditional tobacco products for adults only after a large majority of minors had become addicted.

Law makers have already begun to act, strictly limiting sale to minors, and even in the case of San Francisco banning Juul and other e-cigs until they are FDA approved. E-cig companies have broken numerous laws in disseminating misleading information about new unstudied products and are liable to legal action against them for risking the health of the youth. As and more information on vaping is uncovered the legal actions and regulations to protect the public health will become more apparent.

A Follow Up on Chronic Kidney Disease in Nicaraguan Sugarcane Workers With a Medical, Legal and Ethical Analysis

Madeline Wargins, '21



Faculty Mentor: Peter A. Clark, S.J.
Department of Theology and Religious Studies and the
Institute of Clinical Bioethics

Supported by the SJU Summer Scholars Program

Chronic Kidney Disease is a disease that effects tens of thousands of men in Central America. This project specifically focused on Nicaraguan sugarcane workers diagnosed with Chronic Kidney Disease of undetermined causes (CKDu). Our SJU research team suggests that it is a combination of side effects from the controversial pesticide, glyphosate (found in RoundUp), heat stress, and poor working conditions (such as little to no shade, no water breaks, etc.) Our research team is working on an analysis of CKDu, how it should be treated in a developing nation, and if a ban on glyphosate is possible. Many of the sugarcane workers in Nicaragua that are diagnosed with CKD are not receiving proper treatment and have an increased exposure to extreme heat and glyphosate.

As a result of our research and building on work that has been done previously, one of our outcomes of this research project that we believe would reduce CKD in Nicaraguan sugarcane workers would be to propose a ban on glyphosate. Similar bans on glyphosate have been tried in El Salvador and Sri Lanka. Sri Lanka and El Salvador have since lifted the bans either entirely or partially. Originally, Sri Lanka was the first to implement a nationwide ban on glyphosate in 2015. However, in mid-2018, the ban was lifted due to overgrowing weeds and agricultural inefficiency without the pesticide. The country was unable to find an alternative. However, France is one of the newest countries announcing their ban on glyphosate/Round Up Pro 360. As a whole, the European Union approved the use of glyphosate. However, France made their decision in January 2019 based on scientific studies and animal experiments that determined glyphosate to be a potentially carcinogenic product for humans. France plans on completely removing glyphosate by 2021.

Recently, Bayer AG (who now owns Monsanto), has come under fire and is facing many lawsuits that are claiming glyphosate is carcinogenic. A couple in California who are diagnosed with non-Hodgkin's lymphoma have been awarded \$2 billion in damages by a jury. Many researchers are looking for an alternative to glyphosate. The University of Maryland conducted a study in 2017 that tested the effects of using acetic acid as a safer alternative. They presented data that suggests that using herbicides, other than glyphosate, would be costlier. But if glyphosate is shown to be a contributor to CKD in sugarcane workers, and is also implicated in other diseases like cancer, then we can begin to balance the cost of not using it in agriculture versus the cost that using it has on human health and welfare.

I have talked to members of non-profit organizations that are currently researching, or have researched, the specific issue of CKD in Nicaraguan sugarcane workers. The Center for International and Environmental Law has assisted a group of over 2,000 ex-sugarcane workers diagnosed with CKD in filing a complaint to the International Finance Corporation. Members are now receiving benefits that are worth almost \$6 million, including: basic food supplied monthly to association members, remodeling a treatment center, new income generation projects (that have provided revenue for members that help cover medical or funeral bills), and research on CKDu and its causes by Boston University's School of Public Health.



Laura M. Crispin
Department of Economics
Saint Joseph's University

Ph.D. The Ohio State University

Research Interests: Economics of Education, Labor Economics, Econometrics, Time Use Analysis, Poverty and Income Inequality

My recent research focuses on out-of-school activities, specifically for high school and college students. One such paper focuses on physical activities for high school students. In our paper, "Does Sports Deter Bullying? Estimating the Causal Effect of Sports and Physical Activity on Bullying in High School," my co-author and I explore whether sports, P.E. classes, and physical exercise, in general, can be used as a policy lever to reduce in-person victimization (i.e., bullying) or whether those who are physically active, especially in sports, are more likely to be bullied. Using data from four nationally representative surveys, we estimate a series of causal regressions and find that general physical exercise reduces the likelihood of being bullied by as much as 20 percentage points. However, for those active in sports, and especially team sports and interscholastic sports, the results show quite the opposite: an increase in the likelihood of being bullied by 20-30 percentage points. These results are largely driven by males, with magnitudes much larger for males than females. Our findings show that increasing access to and encouraging physical activities such as sports can reduce in-person bullying in high school, but that without proper training and supervision, bullying may increase.

My research also extends to other activities, such as museum attendance, which provide cultural and intellectual opportunities for students outside the classroom. Using data from five nationally representative datasets, my co-author and I address the questions: Who attends museums and how often? We focus on K - 12 students to analyze the demographics, school characteristics, and location characteristics associated with museum attendance. Our key finding is that only 30% to 60% of students attend a museum (of any type) in a given year, indicating that 40% to 70% of students are not exposed to museums. Of these results, we find that students from lower socioeconomic households and minority students are substantially less likely to visit museums, specifically science museums, and that students from rural areas are significantly less likely to attend museums than students in urban areas. We find an interesting gender differential in science museum attendance, where females in the earlier cohorts (late 1980s) are attending science museums at a lower rate than males, but in more recent years (2009 cohort), female students are more likely to attend science museums than males. Our results, though intuitively unsurprising, provide magnitudes for the concerning discrepancies in museum attendance by race/ethnicity, income, and location. These findings suggest that, although museum attendance is associated with better academic and non-cognitive outcomes, many students are not being exposed to museums of any type during their primary and secondary education, and that policymakers, administrators, and parents should consider ways to increase museum attendance for all students.

The Relationship Between State-Wide Public Defense Systems and Legal Metrics Evaluating Incarceration Over Time

Thomas Hauk, '20



Faculty Mentor: Laura M. Crispin
Department of Economics

Supported by the SJU Summer Scholars Program

In 1963, the Supreme Court decided *Gideon v. Wainwright* and set the landmark precedent of American's right to counsel in criminal cases. Since this decision, various systems across the country have been established to ensure American's 6th Amendment Right is upheld. While state imprisonment numbers have consistently increased from 277,473 in 1976 to over 1.3 million in 2013 (National Prisoner Statistics Program, 2013), imprisonment rates have decreased to the lowest rates in the past decade, 417 per 100,000 residents of all ages (National Prisoner Statistics Program, 2013), which could be related to changes in the public defense system.

In my research, I explore this relationship by conducting tests with imprisonment rates as the dependent variable and proxy variables for each state-wide system's various attributes, using data from the Bureau of Justice Statistics Prisoner Series as well as the Census of Public Defender Offices and National Survey of Indigent Defense Systems. Proxy variables such as funding per attorney, cases per attorney, guidelines used by each state, continuing education for attorneys, and types of attorneys serve as explanatory variables to estimate this relationship. To minimize estimation bias, I also account for state characteristics using data from the U.S. Census; average income, education, population demographics, and urban density. I also use multiple years of imprisonment rates to estimate the lagged effects, since changes take time to become effective.

Using data from 22 states for the years 2007 and 2013, I find that there were improvements in funding and guidelines for public defenders. Specifically, funding per attorney increased from \$192,826 to \$231,391. However, seven states adopted caseload limits of varying degrees, while three others stopped using such limits. While these reforms have been made, imprisonment rates in 16 of these states has decreased during these years. Additions to continued education programs of public defenders in 10 different fields of law as well as these reforms have shown drastic changes to state-wide systems in just 5 years.

A strong relationship between the changing state public defense system and decreasing imprisonment rates could demonstrate improvements to a part of the justice system that has been historically overburdened, underfunded, and inadequate since it was created 56 years ago.



Mark A. Forman
Department of Chemistry
Saint Joseph's University

Ph.D. University of Pennsylvania

Research Interests: Strained and Theoretically Interesting Organic Molecules

The focus of my research program involves the synthesis and study of non-natural products that possess unique properties and enhanced reactivity as a result of forced deviations from their ideal geometries. In particular, my research group has been interested in studying the effects of bond angle distortion on the structures and properties of alkenes.

The carbon-carbon double bond of an alkene is made up of a sigma (σ) bond and a pi (π) bond as shown in Figures 1a-d. Maximum overlap between the p-orbitals of the π bond occurs when the axes of the p-orbitals are exactly parallel, as shown in Figures 1c and 1d. Any deviations from this ideal geometry are manifested in the form of enhanced reactivity and unique properties of the alkene. One type of distortion in alkenes is referred to as pyramidalization and results from a *syn*-folding of the R group substituents (Figure 1e). The degree of folding may be conveniently measured via the pyramidalization angle, ϕ , which is defined as the angle between the plane containing one of the doubly bonded carbons and the 2 substituents (R) attached to it and the extension of the double bond. Representative alkenes possessing pyramidalized double bonds include cubene (**1**) and pentacyclo[4.3.0.0^{2,4}.0^{3,8}.0^{5,7}]*non*-4-ene (**2**) (Figure 1f).

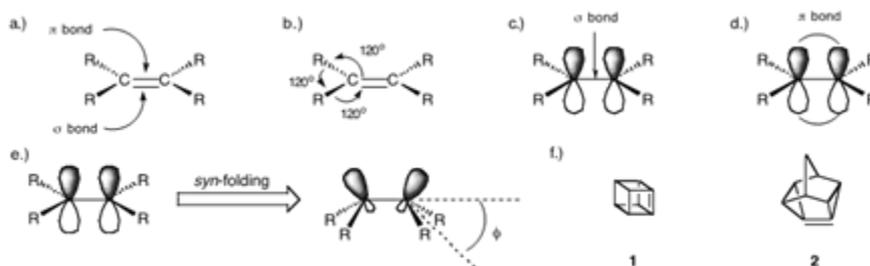
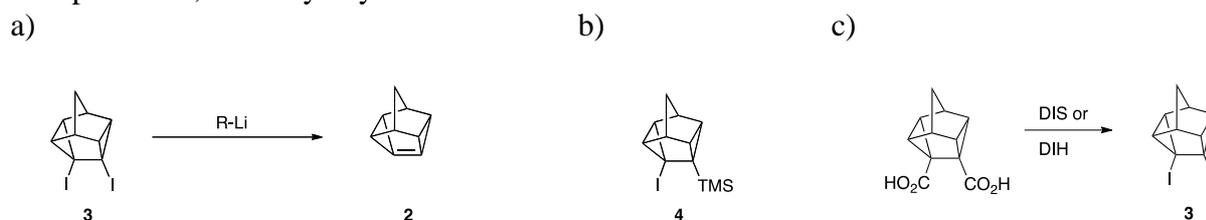


Figure 1

We have previously shown that alkyllithium induced dehalogenation of 4,5-diiodopentacyclo[4.3.0.0^{2,4}.0^{3,8}.0^{5,7}]*non*ane (**3**) leads to pyramidalized alkene **2**. This summer we investigated new synthetic routes to the precursor diiodide **3** and we also explored routes to a new precursor, trimethylsilyl derivative **4**.



The Synthesis of Pentacyclo[4.3.0.0^{2,4}.0^{3,8}.0^{5,7}]non-4-ene

Liam Browne, '21

Christina DeAngelo, '20



Faculty Mentor: Mark A. Forman

Department of Chemistry

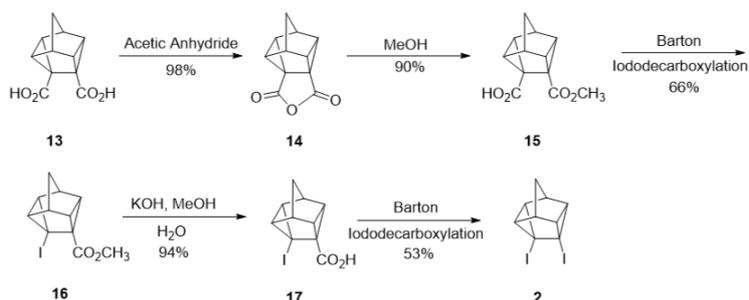
Supported by the Robert & Carla Conaty Research Fellowship and the SJU Summer Scholars Program

This summer, the Forman research group focused on the synthesis of precursors to “theoretically interesting molecules”. The Forman group performs a nine-step synthesis in order to reach a final product of pentacyclo[4.3.0.0^{2,4}.0^{3,8}.0^{5,7}]non-4-ene (shown below). The study of these products focuses on geometric derivatives of alkenes from their ideal structure, by means of bond angle distortion. The carbon-carbon double bonds that make up alkenes, normally form bond angles of 120°. However, pentacyclo[4.3.0.0^{2,4}.0^{3,8}.0^{5,7}]non-4-ene has a particular bond angle strain on the carbon-carbon double bond that changes it from its ordinary shape, resulting in an incredibly unstable molecule with a lifespan of a few milliseconds.



Due to the high strain on the molecules bonds, pentacyclo[4.3.0.0^{2,4}.0^{3,8}.0^{5,7}]non-4-ene experiences pyramidalization, resulting in a (close to) tetrahedral geometry instead of the desired trigonal planar geometry. This pyramidalization is a result of *syn*-folding the R group substituents on an alkene. Pyramidalized alkenes contain carbon-carbon double bonds with either one or both of the carbons attached to this double bond to not lie in the same plane as those three carbons attached to it. The degree of folding could be measured using the pyramidalization angle. The pyramidalization angle is the angle between the plane containing one of the doubly bonded carbons and the two substituents (R) attached to it and the extension of the double bond.

The focus of our project is to find an easier way to create our target molecule. In order to do so, an easier way to create the precursor, 4,5-diiodopentacyclo[4.3.0.0^{2,4}.0^{3,8}.0^{5,7}]nonane is also needed. A different group has previously used one reaction in order to create a molecule with a similar structure to ours, so our goal was to base our synthesis off of theirs and modify it by changing different variables such as the amount of time something was left to reflux, or the temperature at which different reagents were added. In doing so, we have been trying to maximize the amount of product after each reaction, as well as turning our original nine-step synthesis (steps 4-7 shown to the right) into a five-step synthesis, which turns the first molecule into the last.



The Synthesis of Pentacyclo[4.3.0.0^{2,4}.0^{3,8}.0^{5,7}]non-4-ene

Colette Makara, '21

Emily Schaeffer, '20

Faculty Mentor: Mark A. Forman

Department of Chemistry

Supported by the SJU Summer Scholars Program



This summer, the Forman research group focused on the study of theoretically interesting molecules, otherwise known as pyramidalized alkenes. The Forman research group attempted to produce pentacyclo[4.3.0.0^{2,4}.0^{3,8}.0^{5,7}]non-4-ene by modifying several synthesis reactions. Pyramidal alkenes possess unique properties and characteristics that make them different from ideal alkenes. Pentacyclo[4.3.0.0^{2,4}.0^{3,8}.0^{5,7}]non-4-ene differs from the structure of ideal alkenes in that it does not contain two carbons participating in a double bond in the same plane; they are not coplanar. Thus, the geometric arrangement of the alkene is altered from that of an ideal alkene.

Pyramidalization is a specific type of geometric alteration in alkenes that plays a role in its' enhanced reactivity and unique properties. Pentacyclo[4.3.0.0^{2,4}.0^{3,8}.0^{5,7}]non-4-ene undergoes pyramidalization, resulting in normal trigonal planar shape rearranging to form tetrahedral molecular geometry. Pyramidalization results from the *syn*-folding of the R group substituents which induces angle strain due to geometric constraints.

This summer, the focus of the Forman research group was to successfully synthesize the intermediate products of pentacyclo[4.3.0.0^{2,4}.0^{3,8}.0^{5,7}]non-4-ene. The main purpose of producing the intermediate products in high yields is to ensure that there is enough precursor molecules to allow for further research throughout the year. The main reaction I, Colette, focused on was converting an acid ester into iodoester by performing iododecarboxylation of the acid ester in benzene solution. The desired iodoester product was originally produced using an extremely tedious and time-consuming reaction. The new process for this reaction is much faster and the results are beginning to look promising with alterations being made. If this product could be produced in high enough yield, it can be used to continue further studies in the group's effort to make our strained alkene. Using the products made by the other group members, I, Emily, worked on reducing 4,5-Diiodopentacyclo[4.3.0.0^{2,4}.0^{3,8}.0^{5,7}]nonane, the precursor to Pentacyclo[4.3.0.0^{2,4}.0^{3,8}.0^{5,7}]non-4-ene, via electrochemical reactions in the ElectraSyn 2.0. The conditions allow for a milder reaction and the addition of less reagents when compared to the reagent-based approaches. In order to run this reaction under constant potential, a cyclic voltammogram is needed to discover the reduction potential of our vicinal diiodide. Due to many constrictions based on reactivity of the precursor, this has been proven difficult to do. We have been testing different conditions in which to run the cyclic voltammogram and will continue to do this throughout the school year in hopes of being able to run the electrochemical reactions. Our projects worked hand-in-hand in creating products to be used in future reactions that will continue to be studied in years to come.



Kristina M. Garvin
Department of English
Saint Joseph's University

Ph.D. Ohio State University

Research Interests: Multiethnic U.S. Literatures; Colonial and Hemispheric American Studies; History of the Book in the U.S.; the History and Ideology of U.S. Institutions

My areas of expertise include colonial U.S. and multiethnic literatures, with secondary interests in new media studies, particularly the film and literature of 9/11. I am completing a book manuscript drawn from my dissertation research, entitled *Past and Future States: Institutional Time and the Early American Serial, 1780-1820*.

Institutions have always loomed large in the American imagination, inspiring both reassurance and distrust. *Past and Future States* explores the genesis of this thinking by juxtaposing early American institutions with experimental literary forms. I argue that the serial narrative—a discrete literary form that flourished on both sides of the eighteenth-century Atlantic—was the centerpiece of intellectual life in early America. As people began to understand the corporate and legal infrastructure that would govern the nation across time, so too did authors evaluate this process from key temporal vantage points. Specifically, authors assessed how the nation's budding institutions might either provide stability or, more distressingly, become tyrannical relics of a past age. Regarding “institutional time” as a guiding force, authors considered how “immortal” corporate and institutional bodies might secure an enduring sense of national character. *Past and Future States* anchors the “temporal turn” in early American studies to a careful study of material texts, charting a formalist relationship between canonical works and non-literary texts, such as partisan journalism, Indian treaties, and other political documents.

My work is published in *Early American Literature* and *Early American Studies* and has received support from the American Antiquarian Society, the McNeil Center for Early American Studies and the University of Pennsylvania, the Massachusetts Historical Society, and the University of Virginia. My article, “Corporate Ties: *Arthur Mervyn's* Serial Economics,” received the Richard Beale Davis Prize in 2016. My second major book project, currently underway, explores an overlooked link between nineteenth-century literature and post-9/11 novels, films and poetry.

I will be presenting a paper at this year's conference of the Charles Brockden Brown Society, entitled “Forging and Fighting the ‘Deep State’: The Institutional Poetics of Early America.” This paper examines our current-day distrust of the “deep state” by looking at the mixed feelings early Americans harbored toward institutions.

Fukú and the Body: The Dominican American Immigrant Experience in Junot Díaz's Fiction

Jeanne Donohue, '20



Faculty Mentor: Kristina M. Garvin
Department of English

Supported by the SJU Summer Scholars Program

Junot Díaz is a Dominican-American essayist and Pulitzer Prize-winning fiction writer. He was named one of *The New Yorker's* “20 under 40” in 1999 and currently works as the fiction editor of the *Boston Review* and a creative writing professor at the Massachusetts Institute of Technology. Central to Díaz's work is the immigrant experience. Díaz, who at the age of seven moved from the Dominican Republic to New Jersey, writes about a “third-world childhood,” as he calls it, through Yunior—a recurring character who comes of age throughout Díaz's work. Díaz's laconic yet sensitive style, which weaves a mix of Spanish and English, seeks to present a holistic view of the Latinx immigrant experience in terms of class, race, and identity. Womanizing yet deeply sentimental, Yunior struggles with “machismo,” or the hypermasculinity to which he has been subjected during his Dominican upbringing. The culmination of my Summer Scholars research is a thesis paper that explores these topics.

Employing close reading and historical analysis of *Drown* (1996), *This is How You Lose Her* (2012) and *The Brief Wondrous Life of Oscar Wao* (2007), this project relates Díaz's concept of “fukú americanus” to his vivid portrayal of human bodies. “Fukú americanus”—Díaz's catch-all term for “the Curse and Doom of the New World”—consolidates the Dominican Republic's history of colonization, slavery, exploitation and oppressive dictatorial control into a personal affliction that stifles immigrants in their pursuit of the American Dream. Exploring fukú's ramifications by drawing attention to how characters inhabit their physical bodies, Díaz both particularizes and universalizes the immigrant experience, making his work relevant to a wide audience.

As Díaz's work is influenced by history, this project incorporates secondary sources, including Maja Horn's *Masculinity after Trujillo*. Horn argues that Dominican hypermasculinity became ingrained in the nation's psyche during the United States' military occupation of the Dominican Republic and its subsequent support for Rafael Leonidas Trujillo, whose brutal dictatorship shaped the nation's politics from 1930 to 1961. Informed by Trujillo's legacy of state-sponsored terror, my paper traces how Díaz uses bodily imagery to constitute the full range of the Dominican immigrant experience, from one's initial forced migration to his or her attempt to forge an identity in the United States—all while battling the intergenerational trauma known as “fukú.” The project concludes by discussing how “fukú” lingers, manifesting as a loss of bodily autonomy, and enduring as a toxic prescription for how the postcolonial subject should look, feel, and act.



Cheryl L. George
Department of Special Education
Saint Joseph's University

Ph.D. University of North Texas

Research Interests: Examining the Impact of Aerobic Exercise on the Behavior of Individuals With Disabilities

My primary research interest is improving the behavior and academic performance of children with disabilities (especially students with Autism Spectrum Disorder (ASD) and those with Emotional/Behavioral Disorders (E/BD)). To that end, I examine the effects of aerobic exercise on children with a variety of disabilities, but primarily those with ASD. My colleagues and I have conducted land-based after-school exercise studies as well as aquatic exercise studies. We have found improvements in sleep, arousal regulation, and academic responding following aerobic exercise in children on the Autism Spectrum. We have also found reductions in aggression, resistance to change, and specific fears following aquatic exercise.

For the last year, Dr. Elizabeth Becker, Associate Professor of Psychology and Director of Behavioral Neuroscience, and I have been studying the effects of aerobic exercise on adults with ASD (ages 20 and over) who attend the adult day program at the Kinney Center. Using an exercise technology intervention, we have been examining the impact of virtual reality biking on stress hormone levels and behavior in the adult day learners who participate. To date, there are no quality studies involving adults with ASD that examine these effects.

This Summer 2019, Mary Kate Sheplock and I have been completing the data collection phase of this year-long study. Mary Kate has also been assisting with the data analysis and literature review for this project. Mary Kate and I hope to present the findings, along with Dr. Becker and Amber Valentino, at either a state or national special education conference.

For her Summer Scholar project, Mary Kate is comparing the effects of virtual reality biking on cortisol levels and behaviors for non-verbal versus verbal adults with ASD. We are still analyzing the data to determine results. It has been my pleasure to work with Mary Kate this summer on these endeavors. I am also very grateful for the support provided by the Morris Grant and the Kinney Center to purchase the virtual reality bicycling equipment.

Biking Away Behaviors: Exploring Virtual Reality Biking as an Exercise Option for Individuals With Autism to Reduce Behaviors and Stress

Mary Kate Sheplock, '20



Faculty Mentor: Cheryl L. George
Department of Special Education

Supported by the SJU Summer Scholars Program

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder that can be categorized by deficits in social communication and social interactions, as well as taking part in repetitive physical behavior, interests, and activities. Individuals diagnosed with ASD are diagnosed on a spectrum of severity, meaning that it impacts each individual differently. Therefore, there are many individuals who are diagnosed as a low functioning individual with autism, meaning that they are impacted by the characteristics of autism in a more severe way. Many of the individuals diagnosed as having severe autism have certain maladaptive behaviors that impact their ability to have successful interactions with others. These are behaviors that directly impact the participants in this study, who are adults in the Kinney Center Day Program. Each individual who is participating would be categorized by having more severe characteristics of the diagnosis.

The purpose of this project is to see if there is a correlation between behaviors of concern, stress levels, and aerobic exercise for adults with ASD. The individuals involved with the study exercised twice a week on a stationary bike for twenty minutes while also wearing virtual reality goggles (unless the individual had a history of seizures). If the individuals could not wear the virtual reality goggles, there was a computer monitor showing what was on the goggles so they had the opportunity to watch. Throughout their day at The Kinney Center, their behaviors of concern were tracked by trained staff members. In addition, hair and spit samples were taken from the participants at the beginning of the exercise study (October 2018) and at the end of the study (July 2019) and will be tested for cortisol levels as a measure of stress.

I have chosen a particular area of the data to focus on as my personal summer scholar assignment. This summer, I will focus on the impact of the exercise on individuals who are verbal versus the impact on individuals who are non-verbal. I am hoping to find that exercise particularly decreases the behavior of concern in the individuals who are categorized as non-verbal; in addition, I am hoping that their stress levels based on their hair and spit samples will be decreased from the exercise. Currently, the data from the participants behaviors of concern and spit/hair samples are being analyzed.



WaQar I. Ghani
Department of Accounting
Saint Joseph's University

Ph.D. Drexel University

Research Interests: Managerial Incentives, Cooking the Books & Lessons in Business Ethics (Earnings Management, Non-GAAP Metrics, etc.); Capital Market Research, International Trade Agreements, Accounting Issues in Emerging Markets, Financial Statement Analysis & Valuation

A publically traded company's management has various incentives to "paint a...positive picture" of the enterprise. Troubles arise when these managers start "cooking the books" by engaging in manipulation of accounting numbers in order to window dress various GAAP and non-GAAP financial performance metrics that represent earnings power. The purpose of these financial shenanigans, of course are to enhance company's financial position and profitability profile in the eyes of various stakeholders, that include investors, lenders, financial analysts, and regulators.

Extant literature reports that managers manage earnings in order to: avoid violation of debt covenants (debt-covenant hypothesis), maximize their financial compensation and other perks (management compensation hypothesis), ward of harmful regulations (political cost hypothesis), and manage equity and bond markets expectations to reduce earnings volatility; to name a few.

Recent evidence shows that the reporting of non-GAAP measures by public companies have significantly increased in popularity. Management is selectively choosing the financial statements' numbers to formulate and then release these Non-GAAP metrics during quarterly and annual reporting occasions. The primary intent is to paint a much rosier picture of operations than the underlying facts portray. The argument is made that these non-GAAP measures carry value-relevant information over and above that of GAAP measures for decision makers.

We can use the above premise to generate multiple research questions, such as: 1) What are some of the attributes of high-quality and low quality non-GAAP measures? 2) What firm-specific factors influence managers to report non-GAAP measures? 3) Why some industries are more prone to reporting non-GAAP measures than are other industries? 4) What are managers' incentives to distort economic performance by reporting a set of very selective non-GAAP measures? 5) Is the use of non-GAAP measures automatically signify red flags? 6) Do unsophisticated investors use more of non-GAAP measures to make investment decisions than do sophisticated investors?

Recent Trends in Reporting Non-GAAP Metrics – Evidence From Pharmaceutical Companies

Anastasia Faia, '20



Faculty Mentor: WaQar I. Ghani
Department of Accounting

Supported by the SJU Summer Scholars Program

Over the last two decades, public companies have significantly increased the usage of non-GAAP metrics reporting. This increased usage rose from 59 percent in 1996 to 96 percent in 2016. Chris Gaetano, 2018 stated that healthcare sector has shown an unprecedented increase in reporting of non-GAAP metrics over the last decade. That is, this sector's use of non-GAAP metrics has increased from 77 percent in 2009 to 90 percent in 2014.

The purpose of this research is to investigate as to why there is such a high percentage of non-GAAP metric reporting in the healthcare sector. The Securities and Exchange Commission regulates the governing of non-GAAP reporting by public companies as per the guidelines and rules (see more on this in www.sec.gov). The SEC, recently, has taken the position that this high usage of non-GAAP metrics reporting is systematically misleading investors.

The first fiscal quarter of 2019 earnings release by pharmaceutical companies present some interesting evidence of use of non-GAAP financial measures. We provide examples of 12 pharmaceutical companies who reported non-GAAP measures and made the Fortune 500 2019 list: Humana, Johnson & Johnson, Merck, CVS, Cardinal Health, McKesson, UnitedHealth Group, UnitedHealthcare Inc, Centene, Anthem, Pfizer and Cigna as mentioned by Becker's Hospital CFO Report.

Executives are concerned about maximizing the companies compensation. As a result, they drive metrics to have favorable reporting. About 90% of companies in the S&P 500 have been reporting non-GAAP earnings with GAAP net income. In reality, companies are said to make up numbers which create the illusion of growth in profitability. It is indicated in the chart below the growth of non-GAAP reporting versus GAAP reporting over a certain amount of years.

The question that many investors have is that should they be surprised that non-GAAP numbers are misleading? The answer to this question is no. As mentioned earlier, executives manipulate earnings given that "performance-based" (Trainer,2016) bonuses are tax-deductible since 1993. This allows executives to compensate for favorable numbers to reach performance targets. With adjusted non-GAAP metrics, executives can achieve targets. One common non-GAAP metric used in hitting targets is excluding non-recurring charges. It is difficult for the SEC to call out this exclusion given that it is not a frequent expense.

Lastly, on a scale of 1 to 10 being the highest, the pharmaceutical companies see non-GAAP as a benefit to their company's reporting on a 10 basis. According to the pharmaceutical company's CEO, Bruce D. Broussard said "management believes that these measures, when presented in conjunction with comparable GAAP measures, are useful to both management and its investors in analyzing the company's ongoing business and operating performance. Consequently, management uses these non-GAAP (Adjusted) financial measures as indicators of the company's business performance, as well as for operational planning and decision-making purposes".



Peter M. Graham
Department of Chemistry
Saint Joseph's University

Ph.D. University of Virginia

Research Interests: CO₂ Activation

As part of nature's carbon cycle, photosynthesis converts atmospheric carbon dioxide into carbohydrates which provide cells with energy and the chemical building blocks needed to synthesize other compounds. The world economy continues to rely on fossil fuels to provide energy and the chemical building blocks needed for the manufacture of everything from plastics to pharmaceuticals. This reliance on fossil fuels has broken the balance of the global carbon cycle by concentrating carbon in the atmosphere. The development of alternative chemical processes that use carbon dioxide as a chemical building block would ease this imbalance. Not only would such processes decrease the reliance on petroleum raw materials, but they would also consume excess carbon dioxide by converting it to useful chemicals. This would provide an economically viable way to mitigate carbon dioxide emission by chemical industry, and could become an important facet of ultimately restoring balance to the global carbon cycle.

Carbon dioxide is an attractive alternative carbon starting material for a number of additional reasons. Unlike petroleum or natural gas, carbon dioxide does not have to be extracted from the ground, and does not require transportation across the globe in order to be used. It is also nonflammable and nontoxic. However, carbon dioxide's innate stability presents a major challenge, and only a handful of known chemical processes can make use of carbon dioxide as a starting material. Therefore, in order to effectively use carbon dioxide in chemical reactions, its chemical stability must be overcome.

In my laboratory, we are investigating transition metal complexes of tungsten, molybdenum, and rhenium that can overcome the stability of carbon dioxide. These metals strongly coordinate carbon dioxide and in doing so bend the normally linear molecule. This activates carbon dioxide towards otherwise impossible reactions. Gaining a better understanding of how such metal complexes interact with carbon dioxide and promote chemical reactions is critical to developing new catalysts for carbon dioxide activation. Such catalysts could convert carbon dioxide into carbon monoxide, formates, acrylates or dialkyl carbonates, all traditional chemical building blocks.

Synthesis of Tungsten Carbon Dioxide Complexes

Patrick Higgins, '22

Faculty Mentor: Peter M. Graham
Department of Chemistry



Supported by the SJU Summer Scholars Program

What will be the alternative to fossil fuels after they are completely used up? How will our world run without long-used energy sources like petroleum and natural gas? As alternative energy sources such as solar and wind power supplant fossil fuels, will they become increasingly expensive and scarce? These questions about future energy sources and future chemical starting materials are what have inspired the search for alternatives to fossil fuels. One of the Graham group's main goals is to replace the demand for fossil starting materials and instead use excess carbon dioxide in the atmosphere as a sustainable carbon source for chemical reactions. This project envisions a sustainable future that does not rely on fossil fuels. This over reliance on fossil fuels has put our world in a climate crisis. One way of helping to confront this crisis is to develop new ways of using carbon dioxide that has been removed from the atmosphere.

The Graham group is seeking ways to synthesize acrylates from carbon dioxide using tungsten and molybdenum complexes. Acrylates are common starting materials for many chemical products, including materials such as Plexiglas. The metal complexes being investigated in the Graham group are supported by four ligands that are attached to the metal center. These ligands are selected in order to allow the complex to coordinate a molecule of carbon dioxide. This summer I have synthesized a number of new carbon dioxide complexes of tungsten. The next step is to determine if these complexes will react with ethylene to form an acrylate complex. If acrylates can be synthesized in this way, it would represent a greener process for making materials that contain acrylates.

Reactivity of Molybdenum Carbon Dioxide Complexes

Jovany Loredo, '22



Faculty Mentor: Peter M. Graham

Department of Chemistry

Supported by the SJU Summer Scholars Program

Climate change has become a more pressing issue as of late. There can be no denial that if we do not mitigate our CO₂ emissions we will see more natural disasters that affect us in many ways. Climate change affects the weather and has led to even more disastrous weather systems that have wreaked havoc on places such as Puerto Rico. The change in climate also threatens many agricultural crops such as vanilla, coffee, and cacao which affects the economy.

We can mitigate our emissions by using alternative energies, removing carbon dioxide from the atmosphere, and by using energy more efficiently. The chemical industry is a huge contributor to the emission of carbon dioxide because it uses fossil fuels as a starting material. The purpose of my research project is to use abundant carbon dioxide as a feedstock for the chemical and pharmaceutical industries. Using carbon dioxide as an alternative to fossil fuel starting materials will not by itself be enough to combat the climate crisis, but it is an economically beneficial way of reducing carbon dioxide emissions.

This summer I have focused on reacting a molybdenum carbon dioxide complex, TpMo(NO)(PMe₂Ph)(CO₂) (Tp = trispyrazolylborate), with an alkene in attempts to form an acrylate via the coupling of carbon dioxide and an alkene. In order to coordinate an alkene, the phosphine must be labile, able to fall off. With this complex we have proven that heating in solution at 50 °C makes the phosphine fall off. However, the dissociation of the phosphine also causes the CO₂ to become labile, allowing the alkene to coordinate at that site. By IR and NMR spectroscopy, we can also see that a variety of other products are also formed. One of these products may be an acrylate. Over the summer, I have been testing a multitude of alkenes in order to find one that forms the acrylate as a major product. One other strategy that we have used is to dilute the solution of CO₂ complex so that it is less likely to dimerize rather than react with an alkene.

Synthesis and Reactivity of Molybdenum Alkene Complexes

Madelyn MacDonald, '20

Faculty Mentor: Peter M. Graham
Department of Chemistry



Supported by the Robert & Carla Conaty Research Fellowship and the SJU Summer Scholars Program

The conversion of carbon dioxide (CO_2) to useful hydrocarbon compounds is a plant's mechanism for storing energy. This process is limited to plants who use photosynthetic energy to overcome the inherent stability of CO_2 . Other strategies must be used in order to convert CO_2 into hydrocarbons in the laboratory. One approach is introducing an alkene to a heavy metal complex, in this case molybdenum, followed by coordination of a molecule of CO_2 . Introduction of CO_2 to the alkene complexes may then allow rearrangement and formation of an acrylate.

The main focus of my summer research has been introducing CO_2 to the Molybdenum complex, $\text{TpMo}(\text{NO})(\text{PMePh}_2)(\text{cyclopentene})$ (Tp = trispyrazolylborate). In order to react the PMePh_2 ligand must first be removed in order for the CO_2 to have a location to attach to the metal center. The lability of the PMePh_2 ligand was determined by heating the complex in solution. Once the proper temperature for the removal of this ligand was determined, CO_2 gas was introduced at a range of temperatures and pressures. With many of these reactions it appears as though the cyclopentene becomes labile as well as the PMePh_2 . This is problematic because it causes a variety of products to be formed, only one of which may be an acrylate. Continuation of this project hopes to optimize this reaction and isolate a single acrylate product. Another strategy which I have also begun to pursue is to react the analogous ethylene complex with CO_2 . Ethylene should be less labile than cyclopentene, allowing a single product to be isolated after reaction with CO_2 .



Ann E. Green
Department of English
Saint Joseph's University

Ph.D. SUNY at Albany

Research Interests: Creative Nonfiction, Theorized Narrative, Service-Learning, Medical Humanities, Pedagogy

Writers learn best by one-on-one exchanges with other writers. As an undergraduate at Sarah Lawrence College, half of my course work consisted of meeting individually with professors and talking about my "conference projects," independent projects that I developed in connection with course content, but based on my own interest. For example, as a sophomore I took a sociology course called "Rural Peasantry in Agrarian Societies," (a deep dive into Marxism, land, and rural culture) and ended up completing a conference project on Nigerian writers (Achebe, Emecheta, Soyinka) during the period of the Biafran Civil War (most of my courses were not so esoteric!).

As a first-generation college student, the time spent in professors' offices taught me how to think critically and creatively, revise extensively, and explore intellectually. Summer Scholars projects offer SJU students the same types of opportunities to grow as thinkers and writers, and I was privileged to mentor three very different projects this past summer: Hamill's "Thinking about Migration," uses service at a free clinic to explore immigration; Lendacky's "Becoming," explores poetry and feminism; and MacPherson's "Comfortably Drowning," reads spiritual memoir against her experience of conversion to Catholicism (co-directed with Dr. Paul Aspan).

My scholarship and teaching can be traced back to those conference projects at Sarah Lawrence. I write theorized narratives and creative nonfiction about how writers learn to write and how writing teachers teach writing, with particular attention to writers' and teachers' intersectionality (race, class, gender, sexuality, dis-ability). Often focusing on service-learning and community-engaged research, this work explores how those from marginalized groups can both find voice and be heard. Most recently, this scholarship has included reflections on teaching in prisons through Philadelphia's Inside/Out Program and articles that explore the medical humanities and service-learning.

I am currently writing an article that draws from my mother's experience of hospice care, the idea of slow medicine, and teaching the medical humanities course, "Hospital Stories." This piece explores how slowing down in the classroom mirrors the slow medicine of hospice, the period when a patient receives treatment and comfort care, but not curative treatment. (Mom has been on hospice off and on for more than three years. Like many folks on hospice, we believed she has lived longer than if we had pushed for more curative treatment). By writing about hospice and teaching, my research stream considers the possibilities of patients and caregivers speaking back to the medical system.

Thinking About Migration: Working at a Free Clinic

Ceili Hamill, '20



Faculty Mentor: Ann E. Green
Department of English

Supported by the SJU Summer Scholars Program

This summer scholars project evolved from my experience in "Hospital Stories," a medical humanities course offered by the English department and Faith/Justice Studies program. After completing a semester of service-learning at Inglis House (a wheel chair community) and reading and writing about medicine, I wanted to deepen my experience through additional service that explored the connections between immigration and medicine. With the current rise in immigration and the subsequent healthcare concerns related to the mass movement of marginalized groups, stories of medicine and immigration and their convergence are timely. To understand this relationship, and its current impact, I began by investigating how immigration and medicine have fueled or hindered one another in the past, and how we can collectively improve upon what's come before. This project resulted in three creative nonfiction essays.

My first essay detailed my experiences of volunteering at The Clinic, an organization in the Philadelphia region that provides healthcare to the uninsured, while cultivating an environment of respect and dignity for these individuals. At The Clinic, a majority of the patients are immigrants. My essay asked questions about how the US healthcare system works to meet the needs of the uninsured and disadvantaged. I also examined the concept of cultural humility, a process of self-reflection from the caregiver in which they are humble in their approach to patients who have different cultures and experiences. At The Clinic, I worked to hone my cultural humility. I presented this essay, titled "Finding Community: My Time at A Free Clinic," at the Jesuit Universities Humanitarian Action Network (JUHAN), in mid-June.

My second essay described medicine and immigration from the perspective of my grandmother. She moved from Ireland to England in the 1960's and became a nurse in a London hospital. After having multiple conversations with my grandmother about her experiences, I wrote an epistolary-style essay, imagining letters between herself, her mother, her sister, and her boyfriend, who would become my grandfather. This essay detailed her first six months in London, describing her adjustment to living in a new country and working on a hospital ward.



Florence Lambe, circa 1965, in her uniform

My third essay explores the on-going humanitarian crisis at the southern US border. I wrote a braided essay about my further experiences at The Clinic, juxtaposed against research about the immigrant border crisis. The purpose of this essay was to highlight the stark contrast between the treatment of immigrant patients at The Clinic and the treatment of immigrants detained at the southern border. Writing these essays has been humbling and transformative, helping me develop a better sense of the kind of physician I aim to be someday: a culturally humble physician who advocates for her patients, because she appreciates where they've been before and where they're going next.

Becoming

Anna Lendacky, '20

Faculty Mentor: Ann E. Green
Department of English



Supported by the SJU Summer Scholars Program

Through Summer Scholars I was able to grow as a writer by working with professional poets, by reading and writing, and by bringing my poetry to life as I read in front of audiences at poetry events. In taking these steps I was able to grow and find my poetic voice.

For my research, I read a wide range of feminist poets and analyzed their work from a feminist perspective. Each week I read a collection of poetry, took notes, reflected, wrote, edited, and revised my own poems while specifically keeping voice and form in mind. Each poet I read brought different perspectives, forms and energy for me to examine which enabled me to write my own poetry. Reflecting on the larger themes of marginalization and oppression connected me to my narrative in new ways and pushed me to strengthen my poetic voice.

While summer scholars provided me with time to read and write it also provided me with an opportunity to receive feedback on my poetry while working with professional writers from the greater Philadelphia area. In June, I attended Rosemont College's Writing Retreat where I took a class taught by a local poet which focused on voice and form. During the retreat I was pushed to refine my voice as I wrote poetry, received feedback and prompts, and read a piece during an open mic. This experience challenged me creatively, but also motivated me to think deeply about my passions and consider the ways in which I could turn them into a career. In addition to this experience I have also had "Suburban Disappointment" published in *Dovecote Magazine* and was able to read it at an event in Reading, Pennsylvania.



Summer Scholars has allowed me to grow in many unique ways as I have become confident in my poetry, my future, and my voice. Engaging with professional writers at Rosemont not only allowed me to refine my voice on and off the page, but I was also able to discuss my future desire to be a guidance counselor with graduate and MFA students. Overall, this program has given me the momentum I needed to share my writing outside of the Saint Joes community and I am excited to continue writing poetry, submitting my work to journals and magazines, and attending future poetry retreats and events.

Comfortably Drowning

Missy MacPherson, '20

Faculty Mentors: Ann E. Green and Paul F. Aspan
Departments of English and Theology & Religious
Studies



Supported by the SJU Summer Scholars Program

I expected this writing process to be difficult but filled with joy and unquestioned faith. However my project of writing a spiritual memoir, ended up being shaped by the loss of two family members and my mother's surgery. At times it felt too perfect that as I am trying to write about the "good christain" I have become, I am hurting and angry with God. That is apart of the mystery of faith though. The events this summer have made this project more difficult than expected, but at the same time my project has become something that is real and raw. Faith is not and should not be easy. We have to trust it and try our best to not let our anger shield our eyes from the work God is doing.

I grew up Methodist but drastically lost my faith in middle and high school. I was dealing with my declining mental health. Also, my older sister, who means everything to me, had a kitchen accident and caught on fire. It was during this time that I shut the door on my faith. It is ironic though that I ended up attending a Jesuit University, but to be fair that was only because I wanted to be on the crew team.

Something happened to me here at SJU though. My faith, which I thought was burned down to the wick was lit again. It ended up pushing me to convert to Catholicism, which was a 7 month long process filled with meetings, and a lot of personal reflection. The spark was small but over time the flame grew and took over inside me. That is why I wanted to spend my summer scholars experience continuing to read spiritual memoirs and to create my own. This process of finding my faith was long and this summer turned into an unexpectedly difficult period of writing, but it taught me a lot about myself and the type of religious person I want to be.

Spiritual memoirs are a different type of storytelling or personal account than a memoir just about someone's life in general. A spiritual memoir looks to cover a person's journey with spirituality. They highlight moments when it felt strong and moments where it felt weak. These memoirs are not just for one type of religion or spiritual belief system, but for all. This summer I have been tasked with reading all different types of spiritual memoirs in an attempt to learn more about this style of writing and also grow as a faithful person and as a writer. The books that have touched me the most summer were *A Grief Observed* by C.S Lewis, *In the Shelter*, by Pdraig O' Tuama and *Traveling Mercies*, by Ann Lamott. They all have their own unique style and are written in a way that allows for any reader to feel connected the their story.



Piotr Habdas
Department of Physics
Saint Joseph's University

Ph.D. University of Silesia

Research Interests: Glass Transition, Soft Condensed Matter, Rheology of Non-Newtonian Liquids

During summer of 2019 one Summer Scholar student worked in my laboratory, and two students volunteered for part of the summer. Francis Snyder '21 dragged a magnetic particle through colloidal gels studying its motion and hence probing the structure of these gels. Mike Jenkins '19 and Rui Zhang '18 worked on extracting properties of complex liquids by tracking motion of magnetic beads suspended in dilute and dense colloidal suspensions. Additionally, Michael Jenkins '19 studied dynamics of colloidal particles in dense suspensions with various strengths of inter-particle attraction and ways to extract particle trajectories using machine learning. Moreover, four high school students: Dariya Brann, Samantha Knoblauch (Mount Saint Joseph Academy), Bruke Baraki (Saint Joseph's Preparatory School), and Mathi Raja (Foothil High School) worked with my students and me on various projects studying particle dynamics in dilute colloidal suspensions and colloidal gels.

Gels are soft materials used in many branches of industry, cosmetics and food, to name a few. Francis dragged a magnetic particle through colloidal gels with a range of properties. Hence, he probed the gel structure on a microscopic level learning about the properties of gel structure. Our goal is to understand how gel structure changes and rejuvenates as the gel structure is locally perturbed by the magnetic particle.

Rui made samples with dilute colloidal suspensions and a small number of magnetic beads. Next, he constructed a motorized system next to a microscope in order to move a magnet near the sample and therefore exert a range of forces on the magnetic beads. From the motion of the magnetic beads one can extract properties of dilute colloidal suspensions. We have obtained preliminary results of how a magnetic bead moves through a dilute colloidal suspension. We plan to conduct systematic studies of magnetic beads moving with various speeds through colloidal suspensions of various concentrations.

Typically, data is collected in colloidal suspensions using confocal microscopy over several hours and then centers of colloidal particles are determined. The process of finding the centers of colloidal particles is time intensive. Recently, neural networks have started to be used in order to accelerate this process. Real time particle tracking can allow to determine if the data collection parameters are optimal or if there is something wrong with a sample. Mike has constructed a neural network that determines if the image has a colloidal particle or not. We hope to construct neural networks that will eventually allow for real time particle tracking.

Investigating the Structure of Colloidal Gels Using Microrheology

Francis Snyder, '21

Faculty Mentor: Piotr Habdas

Department of Physics



Supported by the SJU Summer Scholars Program

The study of soft matter physics concerns itself with things which are squishy. Such things do not fit under the classical distinction of a solid or liquid, despite being ubiquitous in nature, and their strange behaviors are of interest to scientists. Colloids are one such example of soft matter. A colloid is a system consisting of macromolecules dispersed throughout another substance. When a colloid consists of a macromolecule suspended in a liquid, we term these colloidal suspensions. Understanding these system's behavior is of interest to physicists, biologists, and chemists alike. While physicists find their behavior interesting in their own right; biologists and chemists seek to apply our understanding of their behavior to their respective fields. One such example is in drug delivery methods. Since blood is red blood cells suspended in plasma understanding the behavior of it as a colloidal system is vital to understanding how things move in the blood. To employ a drug delivery system which travels through blood you need to be able to understand how it will move around in the colloid it is in.

Colloidal gels are a type of colloidal suspensions. In colloidal gels a depletion attraction is induced between the colloidal particles through the addition of a polymer depletant of a much smaller size than that of the colloidal particles. Because of that attraction, colloidal gels form a series of strands of colloidal particles. The gels you are most familiar with; hair gel and Jello, are examples of chemical gels. These gels are formed by long strands of irreversible chemically bonded molecules wrapped around one another. Colloidal gels however are an example of physical gels. Their bond energy is usually of the same magnitude as their thermal energy so in any one moment bonds could break and new bonds could form. Research into the structure of gels is ongoing as new techniques of quantification of gel structure are developed. One way we can attempt to understand the structure of a gel is by seeing how the sample reacts to various stresses. This methodology is termed rheology. Most methods of rheology stress the entire sample in an attempt to see how it reacts. In microrheology however, we only probe a small portion of the sample. This allows us to use a smaller and simpler setup than would be required for traditional rheology. There is little research regarding the microrheological properties of gels.

Through the analysis of quantitative descriptors of gel structure such as bond angle distribution, topological cluster classification, and microrheological properties, we should be able to further the understanding of the structure of gels and how that structure reacts to stress induced through the probe. This summer I investigated ways of quantifying gel structure and worked towards collecting data on the fluorescent microscope and creating microrheology setup for the confocal microscope. This will allow us to extract data in three dimensions and better understand how the structure of the gel changes after being stressed. Two gel samples have been made so far one with weak depletion attraction and the other with strong depletion attraction. Data has been collected but data analysis is ongoing. We plan to make a third medium strength depletion attraction sample.



Emily K. Hage
Department of Art
Saint Joseph's University

Ph.D. University of Pennsylvania

Research Interests: 20th - and 21st-Century American and European Art; Magazines, Museum Studies, Art and Social Justice

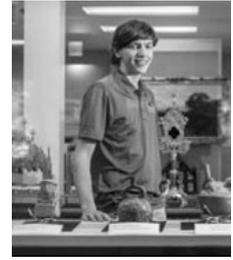
With a background in philosophy, political science, and economics, I am fascinated by the social, political, cultural, and financial contexts of Western art in the twentieth and twenty-first centuries. My research focuses on artists' manipulations on the magazine medium, from Dadaists' art journals from 1910s and 20s to artists' sustained involvement in *Fortune* magazine through the 1960s and punk zines in the 1970s. Although often overlooked, artists' involvement with print media constitutes some of their most direct and widespread effectiveness. The often subversive relationship between image and text in magazines and collages is especially compelling to me. My research on artists' magazines informs my analyses of 21st-c. artists' infiltration of mass media channels and questions about how present-day social media alter the landscape of artistic practice and activism.

Having worked in museums for years, I am committed to making cultural institutions accessible and engaging for a broad range of audiences and raising awareness of the importance of display design. Locally, I am involved in supporting artists in Philadelphia, whose work speaks to issues of social justice and contributes significantly to the increasingly globalized art world of the twenty-first century. I have worked with summer scholars on a variety of topics related to my research, including yarn bombing, representations of African Americans, and present-day Philadelphia artists' efforts to promote social justice.

Online Exhibition of Latin American Pottery

Collin Petersen, '21

Faculty Mentor: Emily K. Hage
Department of Art



Supported by the SJU Summer Scholars Program

In 1995, Saint Joseph's University acquired a number of pieces of Pre-Columbian Latin American Pottery. Due to a lack of information provided during the donation, not much was known about the pieces and they were eventually moved to the archives in the Drexel Library, where they remain to this day.

The primary goal of my project was to create an online exhibition of these pieces, which was to be accessed via the SJU library website. The purpose of this exhibition being available online was to allow for students and faculty alike to be able to easily find the information and to learn more about not only SJU's art collection, but also a lesser-explored area of art history as a whole.

Because Pre-Columbian pottery is not a well-documented area in the sphere of art history, research for this project was a process based in visual comparison. Searching through books and other museum catalogues, I looked for pieces that resembled those in SJU's possession and saw what had been written about those pieces to determine if any of that information could be applicable to the SJU collection.

In working with Carmen Croce, director of the Scholarly and University Press, and Christopher Dixon, Archival Research Librarian, we were able to get professional photographs of each piece. These photographs detailed multiple angles as well as any damages or repairs done to the pieces. The photographs had a twofold purpose: they serve as the images for my own exhibition and they are an updated set of images to be used for archival purposes at SJU.

A secondary goal of this project was to form a physical exhibition of these pieces. This goal seems to be likely, as there will be some space in the library to put some of the collection on display. My hope is that the physical exhibition will drive more traffic toward the online exhibition and spread some more awareness about the pieces that a purely online exhibition could not accomplish.



Steven R. Hammer
Department of Communication Studies
Saint Joseph's University

Ph.D. North Dakota State University

Research Interests: Rhetoric and Composition, New Media Art, Glitch and Dirty New Media, Sound Studies, Media Ecology

Media ecologist and public figure Marshall McLuhan famously observed that "we shape our tools, and thereafter our tools shape us." In other words, when we innovate, produce, and use technologies, they change us, our relationships, our bodies, and our experiences in the world. McLuhan was commenting on the rapid changes brought about by the television, but these observations hold true in many ways as our society has, with greater pace and scale, raced toward technological connectedness and instant communication. Our jobs as Communication and Media Studies scholars is to investigate these changes, their effects, and their consequences.

This summer, we mined our shared interest in music production for examples of the ways technologies shape our society. We began talking about genres of music, and found that many of those genres' sounds and identities are rooted in particular instruments. We dug further, researched the origin stories of movements like dub and the production styles of producers like J Dilla. We tried to learn how these movements and styles were born partially out of the affordances and limitations of tools available to these innovators. We learned a great deal about the history of music in the 20th and 21st centuries, and then put that research into practice, using a range of these composition tools to imitate what we heard and researched and also innovate with those same technologies.

Through this combination of reading, listening, discussing our own experiences as sound artists (but from different technological generations), and making, we were able to learn a great deal together and from one another, an outstanding example of what learning and research can look like with the resources of programs like the Summer Scholars Program.

A Study of the Phonograph Effect in Music

Noah Gansallo, '21

Faculty Mentor: Steven R. Hammer
Department of Communication Studies



Supported by the SJU Summer Scholars Program

The Phonograph Effect is the study of the relationship between technology and music and how the two shape each other. Different musical genres serve as timelines for technological advances, as we can hear new technology being implemented.

A prime example of this is the 808 drum machine, first implemented in the late 1980s. Due to its heavy and aggressive nature, it is no surprise that the 808 found a home in hip-hop music. Early 808s were quite rudimentary and produced a somewhat distorted sound. They also became less and popular in the early 2000s, but made a huge come back in the latter half of the 2010s, thanks to trap music. Our first experiment was to create a song with 808s, which proved to be quite easy due to the instruments pervasive nature.

Modern computing as we know it was also a huge leap forward for the music industry, especially creators. Thanks to modern computers, DAWs (Digital Audio Workstations) such as Logic, Ableton, Pro-Tools, etc. are more widely accessible to the average person. In fact, without a computer, DAWs wouldn't even be a thing! While the initial cost is still expensive - i.e. buying a laptop and the necessary software to go with it - these costs are relatively miniscule compared to what they used to be. Laptops and personal computers essentially democratized the music creation process.

Another project we conducted was testing out music creation on a 4 Track Tape Machine vs. a DAW. This was to compare and contrast the old technology directly with the new. As one might imagine, it was a lot easier to use the DAW to create and produce (although the Tape Machine produced quite a few interesting effects that could not be replicated elsewhere). The main downside of the Tape Machine was timing. Where a DAW can quantize MIDI information (quantize means to place exactly on beat), the Tape Machine has no such gimmick and one is left to one's own devices. It should be noted that this can create some really authentic sounding effect; however, this type of artistic touch is rarely found in today's popular music.

If you are interested in learning more about the Phonograph Effect in music, be sure to check out our 6 track EP where you can HEAR these concepts in actions. There are also liner notes for each track, which explain the concepts implemented for each track.



Karen M. Hogan
Department of Finance
Saint Joseph's University

Ph.D. Lehigh University

Research Interests: Corporate Restructuring, Corporate Effects of Cyber Risk

Cyber Security data breaches are an evolving major risk that corporations, public and private alike; have to contend with as part of their risk management scenarios. All companies, regardless of IT prowess, will at some point in their history experience a breach. Breaches to a firm's cyber security could have major adverse effects on firm value, and firm long-term viability. In addition, stakeholders of the firm (customers, employees, and those who are part of the supply chain) could also be negatively affected. In 2018, the White House Council of Economic Advisers estimated that the malicious cyber activity costs the U.S. economy as much as \$109 billion a year. According to a 2017 report by the Center for Strategic and International Studies and the cybersecurity company McAfee, the worldwide annual cost is estimated to be closer to \$600 billion.

Historically, the public associated cyber-attacks as events involving individual identity theft, usually the result of retaliation from a disgruntled employee or as a rite of passage from a disengaged teenager. However, over the past decade the landscape of bad actors in the cyber arena have been changing and is now home to a much more organized and orchestrated network of villains including, organized crime and nation states such as China, North Korea, and Russia. These bad actors often pay individual consultants to do their dirty work and carry out transactions using untraceable token currencies on the dark web where much of the data collections, including your own personal, private, and health data, are for sale to the highest bidders.

In addition to the inclusion of more nefarious characters, the types of cyber-attacks have also been changing. In a 2019 online report by Beazley, ransomware attacks, which either threaten to publish sensitive data and/or prevent access to the company's own system unless a ransom is paid, skyrocketed in the first quarter of 2019. This represented a 105% increase in the number of ransomware attack notifications against clients when compared to first quarter for 2018. According to the report, the average dollar demand was \$224,871, which was an increase of 93% over the price the year prior. Additionally, major cyber-attacks are becoming all too common with many of them originating out of supply chain networks, thus focusing the need for cyber readiness not just with your own company, but also the companies with whom you do business.

Our research looks at short term and long term effects to the valuation of public companies who have experienced a cyber attack. Companies need to address how to handle these risks and have a solid fluid plan for mitigating damages when they occur.

The Effects of a Cyber Breach on Shareholder Wealth

Dylan Vogt, '21

Faculty Mentor: Karen M. Hogan
Department of Finance



Supported by the SJU Summer Scholars Program

During the past 20 years, cyber technology has grown allowing businesses to conduct commerce with more ease, however, the growth has not come without a cost. Cyber breaches have been on the forefront as one of the most common disturbances to corporations with the introduction of cyber use in the business world. With the outbreak of malware, phishing, denial of service, along with a diverse set of other cyber breaches, many companies have tried to prevent and protect against the inevitable. These attacks not only can lead to a decrease in the value of the firm but can affect stockholders and personnel both directly within the organization or within the supply chain. From the \$4 billion Equifax breach in 2017 that exposed the personal data of 145.5 million Americans to the fact that 61% of breach victims in 2017 were companies with less than 1000 employees, cybercrime is a threat to all corporations no matter of size or monetary valuation. Projections by the annual Cybercrime Report states that the total cost of cybercrimes could reach as much as \$6 trillion within the next 2 years.

Attacks on business have evolved majorly with the introduction of technology, past popular attempts of crime before the boom of technology consisted of physically stealing hardware, data, or any sort of personal knowledge. With progressions in technology, criminals too have reaped the benefits, making their "jobs" easier. It has allowed offenders to obtain virtually any piece of information from a company quickly, efficiently, and effectively. It has also expanded the arena of players giving way to different parties from an independent shut-in hacker to large nation-states in the east such as Russia and China, these players all wish to wreak havoc on corporations and individuals using cybercrime. With readily available information and the introduction of the dark web, criminals can sell obtained classified personal data from a company or an individual containing payment data, authentication details, copyrighted material, and medical records to the highest buyer for personal gain.

With the popularity of cybercrime on the rise, companies have taken focus on collecting data to help improve and prevent the crimes committed against data. Using Advisen, a provider of data for insurance, we were able to gather information on both private and public corporations that have been experienced a cyber breach and draw conclusions on patterns and trends resulting from the frequency and severity of attacks with these corporations. From there we were able to take the companies Standard Industrial Classification or SIC codes and group together different types of industry sectors to evaluate patterns and trends of the attacks and in turn, measure the consequences both short and long term effects of the valuations of said companies and industry sectors.



Gerard M. Jacobitz
Department of Theology & Religious Studies
Saint Joseph's University

Ph.D. University of Notre Dame

Research Interests: Phenomenology of Religious Experience/ Environmental Theology

Contemporary theology is highly informed by the philosophy of disclosure, or "phenomenology" as it is called, a movement founded by the German philosopher Edmund Husserl and carried on by his star pupil Martin Heidegger. Heidegger famously made the distinction between beings and Being, proclaiming that the latter shows itself not when human beings assume a theoretical stance over and against the things of this world, but rather when they are vitally and skillfully involved in them. That which is one, true, good, and beautiful cannot be comprehended like a datum of the natural sciences, but it will, however, show itself incrementally in the insights gained with skillful performance. The Jesuit theologian Bernard Lonergan understood the human knowing subject as having achieved what he called self-appropriation when she had given up the need for theoretical certainty and had instead embarked on a path of insight appropriate to her own situation in life.

Both of my summer-scholar students this year have undertaken projects that examine the existential situation of North Americans in 2019. Luis Nuñez explored the critical self-appropriation that results from approaching the traditional religious retreat as an opportunity for learning skills of imagination that occasion insight, the method Saint Ignatius employs in the Spiritual Exercises. Elaine Estes read the essays, poems, and fiction of agrarian philosopher and activist Wendell Berry and tended the SJU Community Garden, all in an effort to better understand the global environmental crisis from the perspective of food production. The "interior" nature of the one project would seem to sharply contrast with the "exterior" nature of the other; however, both projects, at least from my point of view, were inspired by Pope Francis's 2015 encyclical, "Laudato Si': On Care for Our Common Home."

As a skilled practitioner of phenomenology, especially that of his mentor, the German philosopher Romano Guardini, Pope Francis warns that contemporary society has understood the life-world in terms of a reductive "technocratic paradigm" whereby human beings, animals, plants, and minerals no longer "extend a friendly hand to one another." His analysis is also highly informed by the pattern of the Spiritual Exercises, beginning with an examination of the environmental sins that so dominate our contemporary existential situation, and ending with the contemplation of the divine presence in all creatures.

It is my hope that all of our students at SJU will learn the skills involved in being persons for others, and that they will be inspired to enact solutions to the environmental crisis appropriate to their own situation in life.

Salvation Theology and Steps Toward the Agronomic University

Elaine Estes, '19



Faculty Mentor: Gerard M. Jacobitz
Department of Theology & Religious Studies

Supported by the SJU Summer Scholars Program

While completing a sequence of coursework led by Dr. Gerard Jacobitz on Catholicism, atheism, and post-modern approaches Christianity, I identified a series of suppositions about the world that laid the foundation for my involvement in further theological research. For one, religion is a universal phenomenon, and can be beheld as a lens through which to make sense of the world. Despite this, it is often contrarily viewed as a puzzling element of earthly life. What is more, I found that the human observation of harm, ruin, and loss has equal potential to yield both faith and lack of faith. With these antipathic conclusions in mind, I drew on my personal context to identify opportunities to unite and make sense of them. As a student at the Jesuit institution of Saint Joseph's University, I have borne witness to a wide range of approaches to religion in light of a diversity of contemporary life's stark realities, and wanted to explore how SJU as a community could save itself from potential future casualty using theology.

My work to uncover a salvation theology unique to SJU as a place was multi-faceted. The first component consisted of reading the Christian agronomist Wendell Berry's poetry, fiction, and non-fiction works in which he dwells on the need for the combination of honest, outward communication of experience and extended, good-willed membership of a place in order for that place to have lasting health. His position is taken in opposition to the capitalistic push to "get big or get out" of the modern era. Reading multiple forms of his discourse allowed me to view his ideology from multiple angles. In addition to Berry, I read an extended scholarly commentary written by faculty members of Spring Arbor University--a Christian college located in Michigan—on Berry's work and how it applies to universities in the United States. Their remarks included defining their appreciation for Berry's authentic relation of his lifetime efforts to balance his own intellectual growth with his affection for the land from which he was raised. The authors also suggested actions universities could take that would cultivate the same sort of local growth and affection in their own places. As implementing campus gardens was a suggested action step of the commentary, the literature review was combined with caring for the SJU Community Garden, which was revamped in the 2018-19 academic year through student effort. Garden tasks included daily chores such as weeding and pruning, orchestrating the donation of produce, including campus community members in the these processes when possible, and documenting and honing these practices in order to lay the foundation for a successful fall crop and future annual iterations. To unify these two aspects of my study, I created a framework for a university service-learning class—including daily lesson plan outlines, reading guides, activities, and assessment methods—that allowed me to digest the experience in a way that was meaningful to me as an education major. Finally, I wrote a short essay arguing the importance of a community garden to SJU in its particular circumstance in order to comprehensively report upon my efforts.

My toils in the garden alongside my scholarly study of locally conscious action combined my senses of faith and reason to embody the knowledge I was gleaming as an interested participant. Notably, my efforts instilled a gratifying sense of pride in myself after much hard work and patience, made me conscious of the organic matter I was consuming and wasting in all its forms, cultivated a much greater appreciation for the processes that bring food to me, fostered my membership within groups I would normally not associate with, generally widened my awe for natural phenomena, and increased my desire to share these findings with others. The garden thrived throughout the summer, and as of early August has yielded over one-hundred pounds of edible produce. Succinctly, this boils down to the conclusion that dedicated work in and with a place is a practical means to improve both the self and the place. There is much room to expand the garden and foster a continued symbiotic relationship between the SJU community and its grounds, and I hope to see that occur in the future. I feel it is important to note the history of the establishment of "the university" to support the logic of this desire. The term for the institution proceeds from the Latin *universus* meaning "turned whole;" the university itself originally designed to be a formative place where complete persons are formed. Without nutritious comestibles the biological existence of the person is not possible, and a drought of spiritual food would certainly result in a similar absence of vital force. Providing for these two diets, the creation of an agronomic university practically unites the development of the whole person.

Retreating the Retreat: Finding Spiritual Growth in the Ordinary

Luis Nuñez, '21



Faulty Mentor: Gerard M. Jacobitz
Department of Theology & Religious Studies

Supported by the SJU Summer Scholars Program

Historically, retreats have been organized to provide their participants an opportunity to rest. Furthermore, the word “retreat” comes from its Latin derivative, *retrahere*, which means “to draw back.” More specifically, retreats provide the chance to draw back from work, from school, and in a more general sense, from one’s everyday responsibilities. Moreover, retreats provide a rhythm of life that is usually the complete opposite to that of ordinary life. As a result, retreats have often come to be seen as an escape from the world. However, a retreat should not be about leaving, but rather coming into the presence of oneself and God. In other words, a retreat should be defined by what and who is encountered, not what is left behind.

After five and a half years of Jesuit education, participating in six retreats, and leading one, it has become apparent to me that retreats provide nearly immediate growth. Soon, however, an intense peak of happiness and ends at the place it once was before the retreat. As a result, this combination of retreat from ordinary life and extraordinary setting calls into question the long-term effectiveness of the retreat. Therefore, the purpose of this research project is to determine how we change retreats to be able to provide the participants the skills needed to live their faith out on a daily basis. Retreats provide an extraordinary experience in a setting that cannot be replicated at home; however, a majority of one’s life is filled with mundane experiences. For example, brushing one’s teeth, paying bills, and getting medical checkups. Therefore, to be able to live out a faith every day, finding spirituality within the ordinary is needed.

The methodology of the project is filled with theoretical analysis and practical experience. I have engaged with *A Search for God in Time and Memory*, by John S. Dunne, and my reflections and journals on past retreats. In addition, I have participated in the *Spiritual Exercises* of Saint Ignatius of Loyola, its prayers, meditations, and reflections. More specifically, the *Spiritual Exercises* entail a commitment of about an hour of daily prayer and journaling, and weekly meetings with a spiritual director. Through five weeks of daily meditation and contemplation of God’s boundless love for us in the Paschal Mystery of Jesus’ life, death, and resurrection, I have gained certain skills that would benefit retreat participants, specifically, the skills of being comfortable with the uncertainties of life, and appreciating the insights provided by the retreat, and allowing them to serve as a guide on a path to a personal creed.

Saint Joseph’s University provides thirteen different retreats through Campus Ministry. These retreats give approximately 350 students a time to withdraw from their ordinary lives every year. However, they become a temporary source of happiness, rather than a means to developing a faith that can be lived out every day. Through engaging with campus ministers on our very own campus, I hope to assist the spiritual journey that many of my fellow students are on by expanding the boundaries of the modern retreat.



Christopher E. Kelly
Department of Sociology and Criminal Justice
Saint Joseph's University

Ph.D. Temple University

Research Interests: Investigative Interviewing

Shortly after his inauguration in January 2009, President Obama signed Executive Order 13491 that created a Special Task Force on Interrogations and Transfer Policies to reevaluate the interrogation practices authorized by the previous administration. In August that same year, the Task Force recommended that a new interagency collaboration be formed, called the High Value Detainee Interrogation Group (HIG), and specifically recommended that in addition to its operational duties, the HIG also create a program of research to evaluate the best practices in lawful interrogation. I have been fortunate enough to be funded by the HIG for three studies.

To begin our work with the HIG, my colleagues and I developed a "taxonomy of interrogation methods," identifying three conceptual levels of increasing specificity: first, the broad macro-level categories historically used to describe the dichotomous approaches to interrogation, such as rapport versus control, information-gathering versus accusatorial, friendly versus harsh, or minimization versus maximization; second, a meso- or intermediate level consisting of six domains –rapport and relationship building, emotion provocation, context manipulation, confrontation/competition, collaboration, and presentation of evidence– that we believe encompasses and parsimoniously describes all interrogation methods (with the exception of torture); and third, the specific micro-level techniques that have been empirically evaluated or appear in well-known documents like the Army Field Manual and those of the "Reid Technique."

Since the publication of the taxonomy, I have focused on examining interrogation using the six domains in a survey of interrogators from 10 countries, a field experiment with the Philadelphia Police Department, and in several content analyses of recorded interviews. We have consistently found that the domains were reportedly used at significantly different rates, with rapport and relationship building being the most used domain and confrontation/competition the least. We found significant, positive associations between confrontation/competition, emotion provocation, and presentation of evidence in both sources of data, and these three domains were also significantly more likely to be used where the suspect denied involvement. Additionally, with respect to confrontation/competition, we found that use of these harsher methods significantly suppressed suspect cooperation for 15 minutes regardless of the other methods used in the intervening time period.

In addition to an on-going relationship with the LAPD, I have worked with the Philadelphia Police Department and the Las Vegas Metropolitan Police Department to examine various aspects of interrogation, including the effects the physical space of the interrogation room has on cooperation and effective methods at eliciting information (as opposed to those designed to produce a confession) from gang members.

Show 'em, Tell 'em, Bluff 'em: Presenting Evidence Reduces Suspect Cooperation

Margarita Parker, '20

Faculty Mentor: Christopher E. Kelly
Department of Sociology and Criminal Justice



Supported by the SJU Summer Scholars Program

The purpose of this project was to continue previous research of measuring and understanding the dynamics of criminal interrogations. Kelly and colleagues (2013) identified six meso-level domains, arguing that they consisted of conceptually related specific techniques. To test these hypotheses, Kelly et al. (2015, 2016) found that presentation of evidence (PE) is associated with suspect denials and lower levels of cooperation. These studies, however, may overlook the differences between the different techniques within the presentation of evidence domain and also presents the need for more analysis to truly understand the relationships between specific techniques and suspect behavior. There is a lack of literature regarding many of the PE techniques or of suspect cooperation; therefore, this project will extend existing research and understanding of the complex nature of police interrogations.

The data originated from the Robbery Homicide Division of the Los Angeles Police Department and was created by Kelly, Miller, and Redlich to test the meso-level framework they created. Of the sample of 29 interrogations, 70 specific techniques among the six meso-level domains were coded every five minutes resulting in a total of 519 5-minute intervals. Of these, at least one of the 10 PE techniques are present in 278 intervals. The ten techniques include actual evidence, bluffs, identifying contradictions, "We know all," statements from witnesses, visual aids, and criminal history; while fabricated evidence and polygraphs were excluded from analysis due to their low presence.

Among the techniques, actual evidence, visual aids, and bluffs were used most frequently, being observed a total of 109, 103, and 89 times respectively. The remaining techniques were observed between 18 and 40 times. Actual evidence, bluffs, identifying contradictions, statements from witnesses, visual aids, and criminal history have significant and negative correlations with cooperation. The one-way ANOVAs also showed that mean cooperation decreases when any PE technique is used compared to not using any techniques from the domain. Logistic regression shows that actual evidence, bluffing, identifying contradictions, visual aids, and criminal history reduce the odds of cooperation from the suspect. My findings demonstrate that the techniques within the presentation of evidence domain behave similarly to measure the same outcomes and that they significantly decrease suspect cooperation. This supports Kelly and colleagues' research in creating meso-level domains to identify various methods interrogators use on suspects. Interrogators should be cautious when using evidence during an investigation since the PE techniques are correlated to resistance from suspects.

While these findings are helpful, there is still more work to be done concerning the strategic use of evidence in an interrogation. The relationship between the time at which a technique is used and its effect on suspect cooperation needs to be examined. By continuing the study of suspect's responses, we can identify what methods work best for increasing positive outcomes and at which time during the interrogation they should be used.



Christina King Smith
 Department of Biology
 Saint Joseph's University

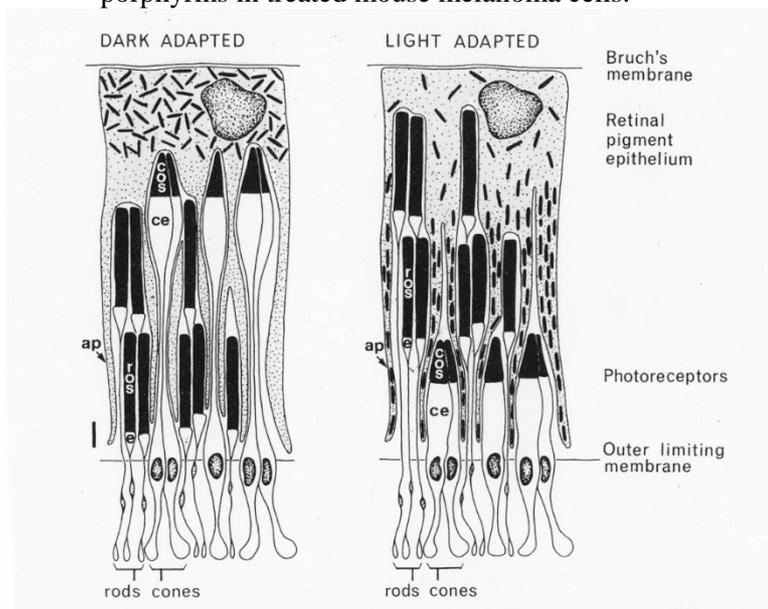
Ph.D. University of Maryland, Baltimore County

Research Interests: Cell Biology, Cytoskeleton and Cell Motility

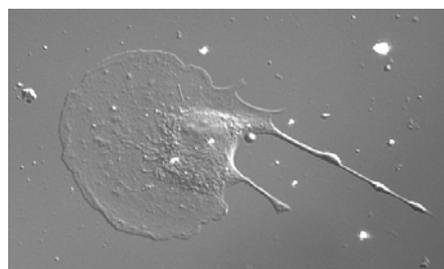
Research in my laboratory centers on questions concerning cell motility in eukaryotic cells (cells having a membrane-bound nucleus and membranous internal organelles). The cell cytoplasm is very crowded, packed full with organelles and macromolecules. Cells therefore require a transport system to move cargo from one part of the cell to another. We use retinal pigment epithelial (RPE) cells from the vertebrate eye as a model system to study cargo transport. RPE cells line the back of vertebrate eyes, and contain numerous black pigment granules that in fish eyes, undergo mass migrations in response to light. RPE cells can be isolated from the eyes of fish, dissociated, and cultured as single cells. In culture, aggregation and dispersion of pigment granules can be triggered by adding different chemical signals, allowing us to tease apart the mechanisms involved in pigment granule transport.

Our work has shown that pigment granule movement in RPE cells requires a protein polymer called actin, which can form tracks along which motor proteins “walk”, to pull organelles through the cell. Actin filaments can also form branched networks, which may act as a net, capturing pigment granules like fish, drawing them into the cell center.

Extension of actin networks is also responsible for cell crawling, both the “normal” cell movements in healthy organisms, and also invasive cell motility involved in cancer. We are using mammalian cultured cells to study the use of chemicals called porphyrins in a type of cancer treatment called photodynamic therapy. Our research centers on investigating the subcellular localization of porphyrins in treated mouse melanoma cells.



Left: Section through a vertebrate eye showing the rod and cone photoreceptors and the RPE (shaded grey). In light adapted eyes, cigar-shaped pigment granules disperse into long apical projections. In the dark, this motility is reversed and granules aggregate into the cell body. **Below:** a single mouse melanoma cell (strain: B16F1). The fan-shaped structure on the left extends across the substrate and allows cells to crawl, by assembly and disassembly of actin filaments and other protein polymers.



Burnside and Nagle, *Prog. In Ret. Res.* Vol 2, 1983

Testing Localization of Porphyrin TMP in B16F1 Mouse Melanoma Cells and its Role in Photodynamic Therapy

Martyna Habdas, '20

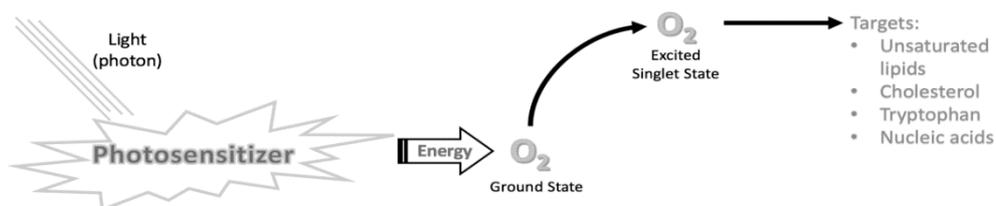


Faculty Mentors: Christina King Smith and Piotr Habdas
Departments of Biology and Physics

Supported by the SJU Summer Scholars Program

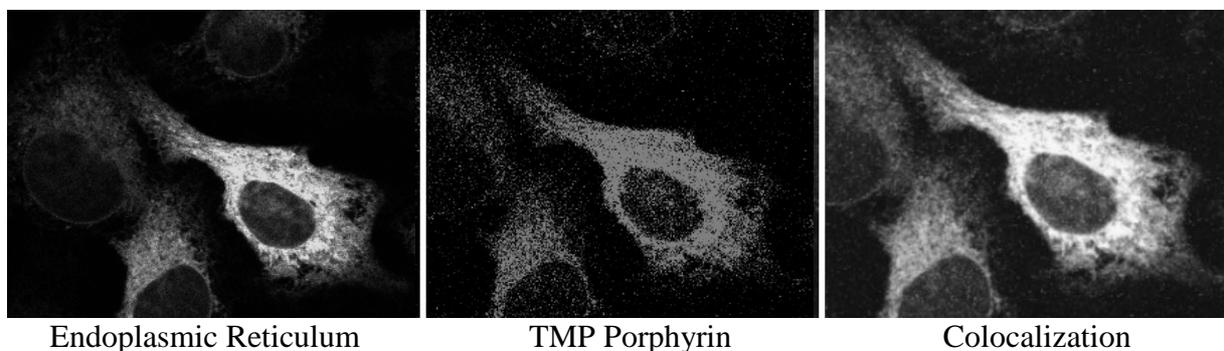
Photodynamic therapy (PDT) is a treatment that uses special drugs, called photosensitizing agents, along with light to kill cancer cells. The drugs only work after they have been activated by certain kinds of light. The effectiveness of PDT depends on the localization of the photosensitizing drug inside cancer cells. The ideal drug delivery should enable the selective accumulation of the photosensitizing drug within the diseased tissue and the delivery of therapeutic concentrations of drugs to the target site, with little uptake by healthy cells.

Photodynamic Therapy



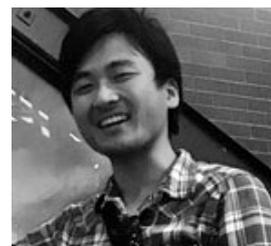
Hudson, R. and Boyle, R. (2004). *Strategies for selective delivery of photodynamic sensitizers to biological targets*. Journal of Porphyrins and Phthalocyanines.

Photosensitizing porphyrins, are a typical choice for the photosensitizing agents. In this study, we tested novel porphyrin-peptide conjugates. Specifically, we tested a porphyrin called TMP and we used confocal microscopy, which provides two- and three-dimensional views of samples, allowing us to study the localization of the porphyrin in B16-F1 mouse melanoma cells. We expected that various porphyrin-peptide conjugates, due to various properties of the end groups, will accumulate in different parts of cancer cells and hence, have a range of effectiveness in photodynamic therapy. Our results concluded that TMP is able to enter the cell over 1-hour at a TMP concentration of 3 $\mu\text{g/mL}$ and that it localizes inside the endoplasmic reticulum. By continuing the study, we can test the effectiveness of TMP in PDT by varying porphyrin concentration, light intensity, and duration of the light exposure.



Effect of Inhibition of Actin Nucleation on Pigment Granule Aggregation in Retinal Pigment Epithelial (RPE) Cells

Taiki Tashiro, '20



Faculty Mentor: Christina King Smith
Department of Biology

Supported by the SJU Summer Scholars Program

The cytoplasm of eukaryotic cells is very crowded, so organelles cannot diffuse easily. Therefore, cells have motility mechanisms to move organelles from one part of the cell to another one. Actin filaments are cellular polymers of the protein, actin, that contribute to intracellular transport and cell shape. New actin filaments are polymerized by a protein complex called Arp 2/3. As a model system to study motility, we use RPE cells from fish eyes, where black pigment granules within cells act like a moveable curtain, to help the eye adjust to light. Actin filaments are required for pigment granule aggregation, but the mechanism of granule transport is unknown. CK-666, a drug that inhibits actin nucleation, was used to ask the question, does inhibition of actin nucleation affect pigment granule aggregation?

Isolated RPE cells were treated with cyclic adenosine monophosphate (cAMP) to trigger pigment granule aggregation in the absence or presence of CK-666. Cells were imaged using time-lapse microscopy, or fixed and pigment granule position was quantified. The result was that CK-666 treated cells appeared to aggregate normally (Fig.2). Therefore, nucleation of actin filaments does not appear to be required for aggregation of pigment granules.

Future experiments will test whether CK-666 affects the rate of pigment granule movement through analysis time-lapse videos.

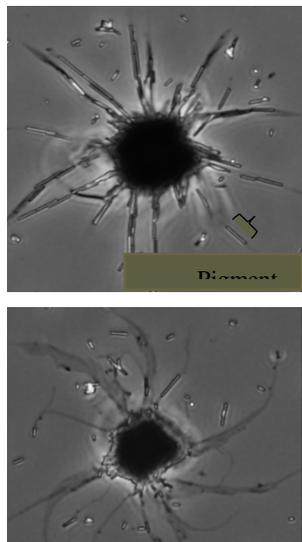


Fig.1 RPE cells in culture. Pigment granules migrate toward or away from central cell body. (top: dispersed, bottom: aggregated).

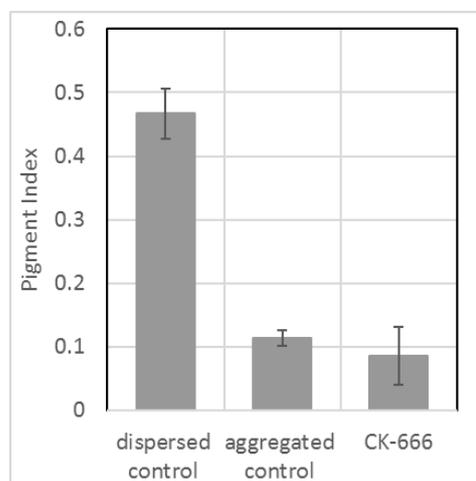


Fig.2 Effect of CK-666 on pigment granule aggregation in RPE cells.

Pigment position was quantified from micrographs using the pigment index (PI). PI of near 0 indicates that pigment granules are fully aggregated, while a PI greater than about 0.5 illustrates that pigment granules are fully dispersed.



Joseph M. Larkin
Department of Accounting
Saint Joseph's University

Ph.D. Temple University

Research Interests: Internal Controls, Budgeting and Job Expectations/Requirements of Accounting Majors and Recruiters

When Joe approached me about collaborating on a Summer Scholars Project with a specific issue to study and explore, I was impressed! Clearly, he had researched the issue and had a clear, well-defined research agenda. His interest in Business Ethics aligns so closely with my interest and concerns about fair, truthful reporting of the financial results of organizations. I gladly accepted his request of collaboration.

Joe has discussed three research questions: 1) Are enough ethics being taught? 2) How can ethics be integrated into business education? And 3) Can, in fact, ethics be taught?

This research project focuses upon the Professional Services business realm. Namely – the Big Four...PwC, KPMG, Deloitte and Ernst & Young and the ethical dilemmas and, sadly, their failures. Specifically, the failure of the firms leadership teams to adhere to the standards of conduct established by the American Institute of Certified Public Accountants.

Regarding, the research questions, he concludes that an increased level of business ethics teaching is appropriate, and business ethics are, in fact, being integrated into business education and finally, and most importantly, ethics can be taught!

After documenting the failures of these firms, the study provides useful, valuable suggestions as to how the profession can move forward to increase the public's trust that not only accountants, but also, corporate leadership can and will take the ethical road to fair financial reporting.

Impact of Business Ethics in Modern Accounting

Joseph Faia, '21

Faculty Mentor: Joseph M. Larkin

Department of Accounting



Supported by the SJU Summer Scholars Program

The accounting industry is continuously changing and looking for ways to improve financial procedures, however an aspect that has remained unaffected throughout the years is ethics in the workplace. The goal of this research was to discover what impact ethics truly has on accounting firms reporting and if it affects how firms operate.

The first section of the research focused on the past and present unethical actions that have occurred within companies and the impact these actions have had on industry regulations. Additionally, I provide information about the current state of ethics in the accounting industry, such as the evolution of institutions like AICPA, which is responsible for enforcing ethical behavior among CPAs and the requirements implemented by SOX. I examine the improvements these organizations have made in accounting behavior such as the increase of communication between auditors and employers and weaknesses of the rules in place like a decrease in whistleblowing. I draw attention to an overall shift in the industry from a professionalism style of working to a commercialized style, resulting in current ethics being taught simply to follow the rules, instead of looking out for public interest.

The next section of the research focuses on the standard of ethics within the Big 4 accounting firms compared to smaller firms. Aspects such as company culture and the credibility of the firms that influence the ethical behavior in the business. There is also a review of the influence that public companies could have on Big 4 firms and smaller firms' ethical decision making. Since Big 4 firms tend to have a significant control of auditing for specific industries and how due to their size smaller firms have an increased likelihood of adjusting earnings when pressured by clients. I explore the shift of the GAAP rules in becoming more principle based and how corporate governance of companies that works with accounting firms

The final part of the research looks at the future changes in the industry and any additional improvements that could be made to strengthen the training of ethics. The main focus of this section is to look at the benefits that a shift to an action-oriented style of teaching ethics can result in higher confidence in employees when handling dilemmas and normalizes ethical issues, which produces better solutions. I supply a basis that would be the best foundation to structure strong ethical standards across the accounting industry and examine the possibility of offering incentives for ethical behaviors. Finally, I look at the possible change that the AICPA could make by requiring students who are pursuing a CPA to use their additional credits to take stand-alone ethics courses.



Edwin Li
Department of Biology
Saint Joseph's University

Ph.D. University of Rhode Island

Research Interests: Membrane Protein Structure and Assembly; Protein-Protein Interaction

My research area focuses on understanding the physical and chemical principles governing the interaction of membrane proteins. The membrane proteins that I study belong to a class that elicits the response to the extracellular signal by forming complexes with other membrane proteins. These complexes are often composed of two proteins interacting with each other, forming a stable new structure. In this context, dimerization, refers to the process in which two monomers (single proteins) come together to form a dimer.

Dimerization of membrane proteins is often one of the initial steps in a series of events that triggers cellular responses such as movement, division, and even cell death. Diseases in living organisms may arise because their cells cannot function properly if dimerization is out of control. The specific disease that may result depends on which membrane protein is affected. For example, unregulated dimerization of a membrane protein may result in unregulated cell growth and division, eventually leading to the formation of tumors. In some other cases, unregulated dimerization of another type of protein may lead to abnormalities during development such as cranial disorders. These are just a few examples highlighting the important physiological roles of these proteins and the medical relevance of studying membrane protein dimerization.

The main focus of my laboratory is to elucidate the physical and chemical principles behind the interaction of membrane proteins. This information will facilitate the design of better therapeutics targeting these proteins.

Characterizing the Dimerization of Mucin 1 (MUC1) and Mucin 16 (MUC16)

Nicole Butch, '21

Robert Murphy, '21



Faculty Mentor: Edwin Li

Department of Biology

Supported by the Nicholas & Susan Nicolaides Research Fellowship and the SJU Summer Scholars Program

Cancer is one of the leading causes of disease in North America. Approximately 1.8 million individuals within the United States have been or will be diagnosed with cancer in the year of 2019 alone (*National Cancer Institute, 2019*). Cancer can be present in many forms, all greatly impacting the regular cellular functions of the human body. Mucinous carcinomas are just one example.

Mucinous carcinomas can be broadly defined as cancers that affect bodily tissues and produce molecules called mucins. Mucins are proteins produced by epithelial cells that provide the skin and organs with a protective mucous layer. The primary function of this mucous layer is to protect the body from toxins such as viruses, bacteria, or debris that could come in contact with cells from the environment. When produced at normal levels, mucins fulfill their role as a protective barrier. However, when overproduction of these proteins occur, they potentially can give rise to diseases such as cancer.

Cancers such as breast cancer and ovarian cancer can arise from the overproduction of mucins, such as mucin 1 (MUC1) and mucin 16 (MUC16), respectively. These mucins are normally found embedded in the membrane of epithelial cells. When two of the same mucins are in close proximity to each other, these proteins can interact with each other forming a dimer. The dimer can be trafficked to the nucleus, where it can induce genes associated with cell growth. Our goal is to learn how dimerization occurs in the transmembrane domain regions (TMD) of mucins, specifically MUC1 and MUC16. This will allow us to better understand how the overproduction of mucins contribute to the growth of cancer cells.

The dimerization of MUC1, MUC16, and other transmembrane proteins is studied by using the ToxR assay. In the ToxR assay, we express the TMD of the protein of interest (e.g., mucins) in the cell membrane of bacterial cells. Upon expression and dimerization of the proteins, and the addition of other chemicals, a yellow color is produced, which is a result from the interactions between the TMDs to form a dimer. The intensity of this yellow color produced over time can be measured and used as an indicator of the propensity of interactions for that given TMD to dimerize.

Our preliminary data shows that MUC1 and MUC16 undergo similar dimerization. From this data, we also learned that dimerization for MUC1 is mostly dependent on covalent (strong) interactions in its TMD. Likewise, for MUC16, its dimerization is dependent on covalent interactions in the TMD. However, it seems that other noncovalent (weak) interactions may also contribute to the dimerization of MUC16.

Our next focus is to investigate which residues in the amino acid sequence of MUC16 TMD participate in noncovalent interactions during dimerization. Additionally, we are trying to determine if multiple covalent interactions are needed for MUC16 to dimerize or if there is only one. By gaining this information on what interactions are responsible for MUC16's dimerization, we hope to provide researchers with insight on how to develop drugs to prevent and treat diseases such as mucinous carcinomas and other forms of cancer.



Susan P. Liebell
Department of Political Science
Saint Joseph's University

Ph.D. The University of Chicago

Research Interests: Political Theory and Public Law

As a political theorist, I am fascinated by political ideas: how we create them? what impact do our founding ideals have on our contemporary politics? In previous research, I've looked at environmental degradation, the toleration of minorities, and the relationship between science education and democratic citizenship. Since the killing of Trayvon Martin, I have been focused on how our national narrative on guns focuses on the freedom of the individual to use guns to "stand your ground" rather than the importance of the rule of law -- which insists that may not be judges in our own cases but must rely on the police (as law enforcement) and courts (as those who determine punishment). I have use dusty (and scanned) books from the 12th, 17th, 18th, and 19th centuries to explore how guns affect our democratic values and practices. I've also comb through FBI records from the late 1960s and listen to oral histories to understand why African-Americans (who felt the police were not protecting civil rights workers) took up arms to create the Deacons for Defense and Justice.

My summer scholar, Hannah Anderson, worked with me as I completed an article on how the Supreme Court's Second Amendment decision, *District of Columbia v. Heller* (2008), endorses a patriarchal theory of armed self-defense that threatens women's self-preservation and equal citizenship. Justice Scalia famously promote originalism (we should understand the Constitution as the framers and voters did in the 18th century). But I noticed that Scalia did not look at a crucial historical context: common-law coverture (husbands are the rulers of married women; they may discipline them and control all their financial assets). To justify a constitutional right to own a handgun, Scalia wrote about the danger posed by strangers to the home but he ignored the internal dynamics of power within the home: relationships of subordination that have disproportionate effects on women. Because Scalia treats the home as "safe," the Supreme Court leaves women without a constitutional right of armed self-defense against the people who threaten them the most: husbands and acquaintances. Building on research that I did for two conference papers and a presentation at Columbia University, I analyzed feminist legal theory, women's history, data on domestic violence, and other Supreme Court opinions to demonstrate how *Heller* leaves women as unequal citizens and propose an alternative interpretation.

I am extremely proud of how Hannah expanded her ability to use legal databases, find statistics, and handle legal texts from various centuries -- as well as her focus on the Violence Against Women Act to create the blueprint for a website.

The Relationship of Gun Violence and Domestic Violence Against Women Within the Home

Hannah Anderson, '21

Faculty Mentor: Susan P. Liebell
Department of Political Science



Supported by the SJU Summer Scholars Program

I started my summer by working with my mentor, Dr. Susan Liebell, on her paper on feminist legal theory in application to the Second Amendment and the D.C. v Heller Supreme Court case. With help from Catherine Collins, I broadened my knowledge on finding and interpreting credible statistics, reading legal documents, and using legal databases such as Westlaw. These research skills helped me to shape my own passions and focus on a project that uses a gendered perspective when looking at the Violence Against Women Act and the steps that have been taken to prevent domestic violence within the United States.

A gendered lens is not used by lawmakers and gun rights groups when evaluating the causes of domestic violence, which is reflected by the loopholes in laws and legislation that try to combat gun violence. While guns have been seen to protect a citizen's right to defend their home from intruders, this fails to incorporate the insecurity and violence partners, especially women, face when a firearm is present within the household. The understanding that a firearm can be a tool to protect the home was backed by the majority opinion in D.C. v Heller. However, victims of domestic violence are five times more likely to be killed if their partner is a gun owner.¹ Gun rights do not make women equal or promote public safety, but rather make the home, which is supposed to be a safe place, insecure. Realizing that there are problems in how domestic violence is addressed, I created an outline of a website that includes information on current laws, resources for people experiencing domestic violence, and statistics.

¹ <https://lawcenter.giffords.org/gun-laws/policy-areas/who-can-have-a-gun/domestic-violence-firearms/>



Aisha D. Lockridge
Department of English
Saint Joseph's University

Ph.D. Stony Brook University

Research Interests: African-American Literature, Black Women's Studies and Black Popular Culture

Aisha Damali Lockridge received her undergraduate degree in English from City College of New York and her Ph.D. in English from Stony Brook University. Aisha's research focuses on African-American Literature, Black Women's Studies and Black Popular Culture. She has written a detailed study – *Tipping on a Tightrope: Divas in African American Literature* – which traces the trajectory of the Diva figure in African American literature. Currently, Aisha is working on a book length project about the transformation of the Magical Negress figure in Black literature and popular culture.

Most recently Aisha has offered courses on the African American Post-Soul Imagination, Black Popular Culture, and Caribbean Literature in English. Her teaching style encourages students to make their own intellectual discoveries by engaging meaningfully with Black texts and interrupting spaces of privilege and power.

“And I’m Telling You Neither That I Have All the Answers Nor That I Know How to Swim:”

Explorations of Race, Gender, and Socioeconomic Status in Creative Nonfiction

Kaila Mundell-Hill, '20



Faculty Mentor: Aisha D. Lockridge
Department of English

Supported by the SJU Summer Scholars Program

Although words like “race”, “gender”, and “class” seem to be buzzwords in contemporary debates surrounding social justice issues, these words can and often are integral to a person’s identity. How people are perceived by themselves and others all play a role into how they navigate their lives.

The goal of my project was to explore how contemporary black women writers address race, gender, and socioeconomic status in creative nonfiction, specifically in literary essays and memoirs. I analyzed the craft and thematic elements of these works to explore the way black writers use their differing voices and experiences to tell stories rooted in the truth of their own lives. I was mainly interested in how black writers connect with their readers, and the details they share when trying to portray intersecting identities connected to race, gender, and socioeconomic status.

Each body of work I read was different in terms of language and style, and even in the specificity of the unifying themes of race, gender, and socioeconomic status. Writers like Samantha Irby, author of “Meaty: Essays” utilize comedy, mainly self-deprecating comedy as part of the anecdotes which fill her essays. Although the essays jump around chronologically, they are unified by the thematic elements of race, gender, and socioeconomic status and her comedic writing style. Kiese Laymon, author of “Heavy: An American Memoir”, utilizes a pseudo-letter format as the body of work is written to his mother, offering a vulnerable glimpse into their complicated relationship.

Additionally, as a young black woman who recently traveled to South Africa I was granted the opportunity to meet and speak with storytellers from different walks of life. One of our readings for the trip, written by a black South African woman, outlines the raw reality of apartheid that I was able to learn about while in South Africa. Furthermore, meeting with storytellers and getting the chance to tell stories, though in a different medium than a nonfiction essay, I was able to analyze, practice, and engage in different modes of storytelling firsthand.

Ultimately, in exploring how black writers address various aspects of their identity, I therefore began to explore how race, gender, and socioeconomic status factor into my own identity. Since each of the authors’ works usually centered around specific anecdotes, I worked to hone in on a specific event or experience as the foundation of my pieces. I experimented with diverse styles and tones, trying comedic, earnest, and rather abstract writing in each piece. My essays focus on my experiences in a way that will hopefully strike a chord not only with people similar to me, but those far different than me.



Thomas R. Martin
Department of Interdisciplinary Health Services
Saint Joseph's University

Ph.D. University of Delaware

Research Interests: Health Informatics and Information Technology,
Health Policy, Digital Health

The healthcare sector continues to be a latent adopter of information technology services. Many factors influence the rationale for adopting technology into healthcare practice with a major driver being health policy and managerial decision-making. Recent health IT policy initiatives and legislation include the Health Information Technology for Economic and Clinical Health Act (HITECH) and the 21st Century Cures Act passed in 2009 and 2016 respectively. These investments created a nationwide infrastructure to keep and maintain vital health information in digital format. A major result is the formation of Health Information Exchanges (HIEs) to facilitate rapid exchange of information at both a regional and national level.

In 2018 the VA MISSION Act set forth changes to "access standards" - certain criteria which must be met - for veterans seeking care from institutions outside the VA healthcare system. Several requirements must be met including wait time, location, and service needed. While the Veterans Affairs Department is a large and complex healthcare delivery system, limited research provides details on how transitioning from VA centered care to independent externally provided care will be reconciled. Important information should be sent back to the VA system and HIEs represent an important tool to effectively aggregate information from community care providers outside the VA system.

Our ongoing research project seeks to identify the current national capability for regional and national HIEs to effectively exchange information with the VA. By engaging HIEs the VA stands to better achieve goals outlined by the MISSION Act and changes to access standards. The effective exchange of information back to the VA system utilizing HIEs presents the potential to reduce unnecessary cost and to ensure effective communication between care teams.

Investigating the Correspondence Within Various Veterans Affairs Health Integration

Gabriella Pirrotta, '21



Faculty Mentor: Thomas R. Martin
Department of Interdisciplinary Health Services

Supported by the SJU Summer Scholars Program

The U.S. Department of Veterans Affairs utilizes an EHR called VistA across 1,243 facilities. The VA Department is widely expected to move services to a large scale commercial platform in the near future. The VHA is a large integrated healthcare system, but many patients receive care or procedures in other institutions as well. The process for accessing outside service is overseen by a formalized process called "Access Standards". More recently, a shift has occurred in that veterans now have expanded options to seek and obtain care outside the VA system as a result in change to Access Standards. However, follow up services and continuity of care are important aspects to consider as Veterans seek care in private institutions. Health Information Exchanges (HIEs) represent the best service to enable care outside the VA network while ensuring reporting back to VA systems via structured reporting or provider-initiated queries.

Through a nationally conducted survey we hope to understand the current levels of engagement between VA systems and regional HIEs. Further, the goal of this project is to understand and evaluate potential best practices by identifying "beacon HIEs" with advanced understanding of VA process and policy.

The survey's initial question asked respondents if they were able identify the number of individuals in their area eligible to use VA services and health systems. More than 60% of responses indicated that they would have difficulty determining this, while only 9% could pinpoint the number of individuals in their area. When asked if HIEs have communicated with a local or regional VA to establish connections for health exchange, 90% of HIEs indicated an attempt at outreach. Furthermore, of that 90%, only 50% were able to successfully engage and communicate effectively with the VA. When asked to provide the date of their most recent contact with the VA, HIE responses ranged from as far back as June 2017 and then followed by some more recent in June 2019. In addition, survey respondents indicated the number of VA hospitals for which HIEs could support. Over 95% responded that one or more VA hospitals resided within the HIEs coverage area. Only 27% of HIEs indicated exchanging patient information with all VA hospitals in their region, while the remaining were only in contact with some. A very important final question was asked. HIEs were asked about any barriers preventing them from sharing information with the VA. Responses varied by respondents ranging from technical issues to others indicating communication or loss to follow up issues. One respondent from the survey stated, "Requiring VA patients to opt in is not effective. We locate patients on a regular basis but are unable to share information because they have not opted in".

This ongoing research seeks to explain and inform the importance of Veterans seeking care between private providers and the VA. By effectively engaging HIEs, the VA system can better expand Access Standards while providing high quality care.



Joseph P. McCleery

Department of Psychology

Kinney Center for Autism Education & Support

Saint Joseph's University

Ph.D. University of California, San Diego

Research Interests: Autism Spectrum Disorder and Related Co-Occurring Conditions

I am Assistant Professor in the Department of Psychology, and Executive Director of Academic Programs in the Kinney Center for Autism Education and Support, Saint Joseph's University. My research is focused along three major themes. The first theme involves examining and elucidating the mechanisms of social processing and perception in infants, children, and adults with and without Autism Spectrum Disorder (ASD). The second theme concerns the examination of genetic impacts on brain functioning, through the study of the relationships of normal genetic variation and rare genetic syndromes (e.g., mutations, microdeletions) with brain and behavioral functioning. The third theme involves the evaluation and development of behavioral and cognitive-behavioral interventions for individuals with ASD.

Current research projects in my laboratory include examinations of the impacts of aerobic exercise and relaxation experiences on stress, cognition, social, and communication functioning in children and adolescents with and without ASD; examinations of the relationships among particular communication skills deficits and challenging behaviors in young children with ASD; and examinations of the impacts of virtual reality based cognitive-behavioral intervention on conversational skills in adolescents and adults with ASD.

Effects of Exercise on Social Functioning: Relationships to Stress, Anxiety, and Executive Functioning in Children with Autism Spectrum Disorder

Bridget Cichon, '20



Faculty Mentor: Joseph P. McCleery
Department of Psychology

Supported by the SJU Summer Scholars Program and the Kinney Center for Autism Education and Support

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder with marked impairments in social communication and interaction. Moreover, individuals with this diagnosis exhibit restrictive and repetitive interests. In addition to these impairments, individuals diagnosed with ASD, including children, exhibit high stress levels and deficits in their executive functioning abilities. Executive functioning is a series of complex mental processes that allow individuals to control their behavior and understand the point of view of others. It is likely that the social functioning of individuals with ASD is negatively impacted due to these higher stress levels and deficits in executive functioning. Previous research in Dr. McCleery's laboratory has shown that an increase in aerobic exercise can benefit individuals with ASD through reducing stress levels and improving their executive functioning abilities. There are reasons to believe that both anxiety and executive functioning deficits produce negative impacts on social interaction in individuals with Autism. My study seeks to determine if exercise improves social functioning for these individuals by reducing stress and improving executive functioning. The goal of this line of research is to determine the pathways in which social functioning may be improved, through directly evaluating aerobic exercise effects on stress, anxiety, and executive functioning.

To examine this question, Dr. McCleery and I developed and planned a study in which children aged 8 to 17 years old participate in an exercise condition and non-exercise condition, each followed by a computer-based task session. The computer-based tasks are programs which test an individual's stress and anxiety levels, likelihood to orient to social stimuli, executive functioning abilities, and ability to switch attention between their own perspective and that of a social partner. To prepare for this study, I submitted an Institutional Review Board proposal, which explained the purpose, methods, and other intricacies of the project. Additionally, I created forms for the project including intake assessments, consent forms, and recruitment materials. This summer, I continued developing this project. More specifically, I programmed multiple computer-based experiments in E-Prime, a software program for behavioral research, and learned how to properly process and analyze the corresponding data. Before I began recruiting for this experiment, I learned how to administer and score standardized psychological intake assessments, including assessments of adaptive functioning (e.g., Vineland Adaptive Behavioral Scales III) and intelligence (i.e., the Wechsler Abbreviated Scale of Intelligence). Finally, this summer I had the opportunity to begin participant recruitment and initiate testing of children and adolescents with and without Autism. Testing participants and analyzing the outcomes of the tasks I created will continue throughout the 2019-2020 academic year as part of my senior honors thesis under the supervision of Dr. McCleery.



Julie M. McDonald
Department of Philosophy
Saint Joseph's University

Ph.D. University of Notre Dame

Research Interest: My current research interests include moral theory, cosmopolitan theories of justice, and the broad area of food ethics. These areas of research are significantly informed by my work in feminist theory. While I am drawn to what might be called “applied ethics,” my work has always been animated by a more theoretical question about the source and nature of moral obligations, and particularly the question as to whether a moral agent, through no fault of her own, might face incompatible, conflicting obligations, and be unable to handle these moral demands without being blameworthy, in her own eyes or that of others.



Elizabeth A. Linehan
Department of Philosophy
Saint Joseph's University

R.S.M., Ph.D. Fordham University

Research Interest: My central teaching and research interests are ethical issues in criminal justice, and restorative justice. I've taught in SJU's Inside Out Prison Exchange Program at six correctional institutions in the Philadelphia area. I'm also a volunteer facilitator in the Alternatives to Violence Program at the State Correctional Institution at Graterford/ Phoenix. Other research interests include philosophy of art and American philosophy.



Jenny Spinner
Department of English
Saint Joseph's University

Ph.D. University of Connecticut

Research Interest: My research and teaching are focused on journalism, creative nonfiction, and women's essays, in particular. In my most recent book, *Of Women and the Essay*, I examine the neglected history of women essayists from the 17th century to the present and show how women constructed their own tradition in the essay genre from its modern beginnings in the late 16th century. Many women in earlier ages struggled to authorize themselves, or be authorized to, write personal essays. That they found the courage and conviction to do so anyway make their contributions to the history of the essay genre all the more valuable. From them, I continue to understand the importance of all women—and this includes Julia--giving voice to their own stories and experiences.

Restorative Justice in Theory and in Practice: "My Muse Showed Up in a Fast SUV on City Avenue"

Julia Furey-Bastian, '21



Faculty Mentors: Julie M. McDonald, Elizabeth A. Linehan
and Jenny Spinner
Departments of Philosophy and English

Supported by the SJU Summer Scholars Program

The concept of restorative justice (RJ) is best understood when contrasted with that of retributive justice, which is often associated with the expression “an eye for eye.” One particular point of contrast is that retributive justice systems typically focus on a government’s duty to punish the offender, often with little thought given to the victim. In general, theories of retributive justice don’t perceive the victim to be an important key stakeholder, nor do they pay much attention to the victim’s family members and her larger community.

My research has shown that restorative justice projects take many different forms. In general, a distinction is drawn between *diversionary* RJ programs and *therapeutic* RJ programs. There are also many different variations within these two categories. *Diversionary* RJ programs have received a lot of attention of late, particularly those involving juvenile offenders charged with relatively minor offenses. These diversionary programs attempt to use practices of victim-offender conferences (VOC) or peace circles in lieu of formal justice procedures involving fines, supervision or incarceration. (A number of school districts are attempting to replicate these practices in lieu of formal punishments such as suspension or expulsion.) In contrast, *therapeutic* RJ programs are typically initiated *after* the formal trial, conviction, and sentencing processes have been completed. They are intended to supplement the formal criminal processes and penalties, which may include sentences of “life without parole.” They invite victims, their family members, offenders, as well as other stakeholders, to engage in processes to seek some sense of healing.

Of course, some RJ projects don’t fit this simple binary classification. My own case resists this simple classification. I decided to ask that the driver in my case receive the most minimal punishment – less than 72 hours of imprisonment. In return, he voluntarily agreed to engage with me and my family in answering some important questions relevant to the processes of RJ.

As part of this project, I interviewed family members and friends in order to learn about their views of my accident, its aftermath, and my decision to enter into a RJ process with the driver. These interviews have helped me to better understand the questions and reservations some family members have about RJ. Later this year, I hope to continue the RJ process by way of mediated conversations, organized by Don Haldeman and Betsy Linehan, involving my family and friends, the driver who struck me, his family and members of his community.



Scott P. McRobert
Department of Biology
Saint Joseph's University

Ph.D. Temple University

Research Interests: The Genetic, Ecological and Evolutionary Foundations of Animal Behavior; Conservation and Animal Rescue

Research in my laboratory involves the examination of animal behavior through studies on rare, exotic and, in many cases, endangered species of fish, reptiles, amphibians, and insects.

Our work with fish involves analysis of shoaling, or grouping behavior. My students examine the factors that fish utilize when choosing shoal-mates, including coloration, pattern, size, shape and shoal composition. In almost all cases, fish shoal with individuals that have features similar to their own. This may benefit them through the 'Confusion Effect' in which predators have difficulty identifying and attacking an individual within a group of phenotypically similar fish. We have examined shoaling in a number of different species and are now looking at the effect of experience and learning on shoaling behavior.

Our work with *Drosophila* involves an examination of the invasive species *Drosophila suzukii*. This true fruit fly is a major agricultural pest that had been introduced to the United States. My students are surveying the local *Drosophila* community for the presence of *D. suzukii*, and our laboratory work is aimed at understanding the sexual behavior of this species.

Our work with amphibians and reptiles is focused mainly on conservation. We house many rare and endangered species, and we run a yearly study on baby diamondback terrapins as part of a program to increase the population size of this local, threatened species.

Population Survey of *Drosophila* Community in the Philadelphia Area

Ave Burleigh, '20



Faculty Mentor: Scott P. McRobert
Department of Biology

Supported by the SJU Summer Scholars Program and Sigma XI

In 2013 our laboratory conducted a year-long survey of the *Drosophila* species living in the Philadelphia area (Tiffany and McRobert, 2013). This survey was part of an ongoing research effort to study an invasive Asian fruit fly known as *Drosophila suzukii*. Most members of the *Drosophila* genus, commonly known as fruit flies, are not actually fruit flies at all. Most *Drosophilids* are pomace flies, meaning they feed, and lay eggs in, rotting vegetable matter that has fallen from the plant. True fruit flies, on the other hand, feed and lay their eggs in live fruit that is still on the plant. The activities of true fruit flies lead to the destruction of fruits and these animals are often considered agricultural pests. *Drosophila suzukii* is a true fruit fly which, since it's accidental introduction to the United States, is causing tremendous damage to agricultural crops such as blueberries, raspberries, and peaches.

Many laboratories are actively engaged in projects to understand the biology of *D. suzukii*. This year-long project will allow us to describe the *Drosophila* populations, and the relative size of each population found in the Philadelphia area in 2019. This survey will also provide updated information on the time of arrival, and size, of the invasive *D. suzukii*, and note changes to the ecology of this species with reference to earlier surveys. We feel that this work will add valuable information to the growing body of literature on *D. suzukii*.

Since June traps have been set up on the grounds of the Barnes foundation, near the rain garden at Saint Joseph's, and at a compost pile in Bryn Mawr. The trap design consists of a red plastic cup baited with a banana-yeast mixture. Fly collections and the addition of new bait take place on Monday, Wednesday, and Friday of each week. Flies are collected from the cups by placing a vial on top onto the cup and shaking the flies into a vial, which are then transported to the laboratory. All flies are anesthetized with carbon dioxide and identified using the dichotomous key of North American *Drosophilids*. Some flies are then used to establish laboratory cultures for future studies.

So far during our 2019 survey, we encountered eight *Drosophila* species, six of which were found in the 2013 survey. We have found an increase in *D. hydei*, which didn't make an appearance in the past survey. An interesting observation was the appearance of *D. suzukii* as early as July compared to the 2013 survey where *D. suzukii* didn't arrive until August.

The Effects of Mixed-Shoals on Shoaling Behavior in Platyfish (*Xiphophorus maculatus*)

Sean McDermott, '21

Samantha O'Connell, '20



Faculty Mentor: Scott P. McRobert

Department of Biology

Supported by the SJU Summer Scholars Program and Sigma XI

Shoaling is a social behavior exhibited by many fish species in which fish of similar phenotypes aggregate in order to evade predators, find food, and find potential mating partners. Shoaling is a separate phenomena from schooling, as schooling implies coordinated and polarized movement, while shoaling is a loose aggregate of individuals with less coordination. Individual fish are known to seek out shoals of phenotypically similar individuals, in both body color and pattern and relative size of the shoal's members. This grouping of phenotypically similar fish creates the Confusion Effect, making it difficult for predators to single out one individual member of the shoal. On the other hand, a fish that is phenotypically distinct from the rest of the shoal is statistically more likely to fall victim to predation, a phenomena known as the Oddity Effect.

To study shoaling behavior fish, a shoaling assay must be set up. A shoaling assay consists of a 20 gallon tank (74 cm x 31 cm x 31 cm) divided into 3 chambers by glass. The two end chambers, which will hold the shoals, follow the dimensions 18 cm x 31 cm x 31 cm and the center chamber, which will hold the test platyfish, will follow the dimensions 38 cm x 31 cm x 31 cm. Two preference zones are then marked about 2 body lengths of the test fish from each end of the center chamber. One preference zone is given a designated score of (+1) and the other a score of (-1), while in between the two zones is designated as (0). For ten minutes, the location of the test fish is scored depending which area of the center chamber it occupies at the end of each minute.

A study was published in 2007 by a group from Boston University (Buckingham et al., 2007), in which they tested whether or not female green swordtails (*Xiphophorus helleri*), a relative of the platyfish, were able to distinguish between two different sized groups presented in ratios of 2:1, but not in ratios of 1.5:1. For example, the test fish showed a statistically significant preference to a shoal of 8 against a shoal of 4, but showed no statistical preference towards the shoal of 6 against the shoal of 4 fish. This data concludes that the test fish are not counting the exact numbers of fish in the shoals, but rather making a quick judgement about "larger" versus "smaller" relative to the presented shoals.

In our study, the red platyfish (*Xiphophorus maculatus*) test fish were presented with mixed-phenotype shoals of both red and blue platyfish. For example, for a 2:1 ratio they were presented with a shoal made up of 6 red fish and 3 blue fish versus a shoal of 6 blue fish and 3 red fish. While, to present a 1.5:1 ratio, the test fish was presented with one shoal of 6 red fish and 4 blue fish and one shoal of 6 blue fish and 4 red fish. Our results resembled the swordtail study, in that the test fish made a statistically significant preference to the shoal with a larger number of red fish when presented in a ratio of 2:1, but made no statistically significant preference towards either shoal when presented shoals in a 1.5:1 ratio.

Currently, we are working on replicating this study with blue platyfish test fish in the same manner in which we tested the red platyfish. Another future direction we are looking to complete is a study on gender in shoaling behavior, as our original study with red platy fish randomized gender. In this study we will present a either a male or female platyfish with shoals completely of the same phenotype, but both shoals will be strictly composed of one gender, one being entirely male and the other entirely female.



Randall M. Miller
Department of History
Saint Joseph's University

Ph.D. Ohio State University

Research Interests: War and Society, Race, Slavery, Regionalism, Politics, Religion, Civil Rights, and American History Generally

During my time at Saint Joseph's my work as a historian has covered much conceptual, geographical, and temporal terrain. I view history holistically – that is, trying to understand all matters of context from place to time to persons and more – in order to understand how, why, and with what effect(s) people believed and acted as they did. Such an approach has led me to explore subjects as varied as settlement patterns and encounters of different peoples during America's colonial period, slavery in various locations and iterations, government-making from the colonial period to today, immigration and ethnicity, religion as belief and practice among diverse peoples, many aspects of the American Civil War and Reconstruction, competing meanings of "freedom" in the American experience, civil rights, mass media, regionalism, and political parties and politics in both national and local contexts.

All that said, one of my more recent lines of inquiry has been examining the formation and reformulation of political identities and organizations, especially political parties. Much of my focus has been on nineteenth-century developments, which in many ways established the basic terms of American political engagement. I have especially looked at the creation and then breakdown of the Second American Party System that sustained the uniquely American two-party arrangement until the slavery issue broke it apart and the Civil War came, through which a new two-party system emerged. As a so-called political analyst and commentator for radio, television, and print outlets, I also have followed recent developments in party identity(ies) and interests.

It is in that last context that Miguel Hurtado-Parra's work drew my attention. He wanted to understand the dynamics by which a small state – Delaware – developed a politics of moderation as its special "way." He asked how and why a one-time Republican-controlled state became a Democratic one. He asked if it was changes in national politics that shifted and shaped local politics, or vice versa, or combinations of such, and used the Delaware case to find out. Much of what is written on that question focuses on large states, so a study of small-state politics promised a new perspective. In his research Mr. Hurtado is discovering patterns of "real estate" politics and political moderation as essential within a small-state context, where people expect to meet and know public officials and those officials seeking their support to know them. Such a conclusion is significant in defining American political culture and practice, for it suggests that, amid our preoccupations with the media-driven world of national and big-state politics, a more direct, personal politics still has currency and consequence. It also invites studies of other small states to see if the Delaware case is unique. Delaware might be "small" and not worth much attention in presidential politics, but it and other small states cannot be discounted as inconsequential. After all, Delaware has the same number of U.S. senators as California. In our federal system and not fully homogenized America, it has meaning. And if all politics in America are local, as the adage goes, we need to discover and understand those local politics. Mr. Hurtado is helping us do that.

Explaining Delaware: The Political Culture and Drift to the Political Left

Miguel Hurtado-Parra, '21



Faculty Mentor: Randall M. Miller
Department of History

Supported by the SJU Summer Scholars Program

The politics of small states are very understudied, and Delaware is no exception. Most research focuses on large states, such as New York State or Texas, and in particular key swing states like Pennsylvania or Florida. It was during a conversation with a classmate that I decided to pursue this project. He asked me why I believed Delaware is a “blue state.” I could not provide a concrete answer, so I spoke to Dr. Miller and he offered some possible reasons but suggested that if I was truly interested in answering this question, I should consider summer scholars.

Throughout the summer, I encountered the limitations of studying a topic that hardly anyone has explored before. By looking at local newspaper articles, I was able to get a sense of the priorities Delawareans have when voting. The project transitioned into not only explaining Delaware’s drift to the political left but also exploring Delaware’s unique form of politics, where bipartisanship and consensus-style governing thrive. What surprised me was that this style of governing originated only in the late 1970s during the administration of Governor Pierre “Pete” DuPont, and before his administration, bitter partisanship and political stalemate characterized state government in Delaware. The question remains whether this style of governing is limited to Delaware, or whether other small states (both geographically and in terms of population) such as Rhode Island follow this brand of politics. Former Vice President Joe Biden captured the spirit of Delaware politics when, at the signing of the Beau Biden Gun Violence Prevention Act, passed by the Delaware Legislature unanimously, he boldly stated that “This uniqueness of this state, we know one another, we know one another, more than anyone fully understands.” In a time where the American public feels a 76% disapproval rating according to the most recent Gallup poll in regards to the United States Congress, it is important to look to places like Delaware where bipartisanship and a healthy political culture allows important legislation such as the Beau Biden Gun Violence Prevention Act to receive broad bipartisan support.

In doing my research, I consulted not only local newspaper stories but also *Democracy in Delaware* by University of Delaware professor Carol Hoffecker and *Only in Delaware* by journalist Celia Cohen. Both women’s works were instrumental in learning about the political culture of the state. I also interviewed a variety of individuals, including Governor John Carney, Lieutenant Governor Bethany Hall-Long, former Delaware State Senate President Pro Tempore Patricia Blevins, former House Majority Leader Wayne Smith and former Secretary of State Ed Freel, among many others.

Finally, and most importantly, I discovered that the reason why Delawareans have supported the Democratic Party more in recent elections is tied to both national and local trends. On a national scale, the Republican Party became more conservative, particularly on social issues, and while this appealed to conservative downstate voters, many upstate, wealthy Republicans or former DuPont workers resented this trend and began supporting Democratic candidates even if they did not necessarily register as Democrats. Governor Carney and every Republican I interviewed mentioned the loss of Republican support in the Brandywine area (a wealthy suburban area north of the city of Wilmington) as a fatal blow to the Republican Party of Delaware. While the south became more Republican, the north, which is the center of population, became Democratic. For all these reasons, Democrats in Delaware hold all statewide seats as of 2019.



Todd C. Moody
Department of Philosophy
Saint Joseph's University

Ph.D. Temple University

Research Interests: Philosophy of Mind, Metaphysics of the Person, Philosophy of Religion

I came to Saint Joseph's University in 1983, after finishing my PhD at Temple and doing some part-time teaching at other area institutions. My areas of interest gradually coalesced around a set of questions concerning the mental life of persons and other sentient beings. How is thinking even possible? I realized that historically this question had impressed most philosophers in terms of the "powers of the human mind," that is, our intellectual capabilities, such as abstract reasoning, logical inference, and the like. These seemed, to many, to be the distinctive marks of the human mind. But in more recent philosophy, as artificial intelligence has emulated at least some of those powers, attention has turned to the more basic characteristic of mind that we have in common with all sentient beings: consciousness itself.

My first book, *Philosophy and Artificial Intelligence*, looked at both parts of the mind: the cognitive part and the conscious part. It became clear that, whatever one might think about the purely "intelligent" part of artificial intelligence, such as it was in the early 1990s when I wrote the book, consciousness itself remained deeply mysterious. Branching off from this core mystery are other questions, such as the nature of the will and whether it is free, and the problem of personal identity: what it means to be the same person over time.

At the same time, I developed an interest in the problem of the existence of God. This question had not been part of my training in graduate school, but when I started teaching at SJU I wanted to be able to deliver the best possible presentation of the arguments. This led to my second book, *Does God Exist? A Dialogue*, now in a second edition. These two streams of philosophical interest gradually merged, with a third book, now written and submitted for publication. This book, *Life and Death*, deals with the metaphysical issues of mind and self as they intersect the big questions of what it means to be alive, whether there could be anything after this life, and why that matters.

An Investigation in Free Will From the Starting Perspective of Impossibilism

Angelica Porro, '20



Faculty Mentor: Todd C. Moody
Department of Philosophy

Supported by the SJU Summer Scholars Program

Philosophy consists of a broad range of different topics and areas of study, but one thing that touches all other issues, at least in my study of philosophy, has been free will. It connects back to the mind-body problem, responsibility and punishment, theological issues like salvation and the problem of evil, and to practical issues of how one should live their own life.

To start delving into this large topic I began with two incompatibilist stances, impossibilist and libertarian, to see the ways in which these two stances reject the compatibility of free will with determinism and the ways in which they are different. With an impossibilist position, the issue is that there is no way, in that framework, for one to cause themselves to be how they are. Therefore, one cannot be responsible for what they do because one's actions flow from who they are. This perspective conjointly rejects free will whether or not the world is deterministic or indeterministic. Libertarians on the other hand argue that determinism is incompatible with free will because it lacks a genuine possibility of an agent being able to choose otherwise but think free will able to exist in an indeterminate universe.

A common issue that seemed to arise with the positions that find free will possible, both compatibilists and libertarians, is that they both seem to be struggling with this tug of war between having a robust sort of freedom-where one is not compelled into action-and the idea that thoughts, decisions, and all of the natural world, is understandable and explainable. Ultimately, most people have a strong internal sense of both concepts, which do seem at odds. This for the compatibilist leads to the issue of possibly being compelled by one's own reasons, possibly compromising freedom. For the libertarian this leads to the idea that there is no ultimate reason for why someone chooses one choice over the other, therefore compromising the ultimate ability to explain all of one's actions. In a sense, the compatibilist chooses understanding the world as a priority and the libertarian chooses freedom as the priority.

Since this issue comes up against belief, we delved into belief as a concept and the role it plays into truth and philosophical debate in general as well as the free will debate in particular. Simply, to put forward any belief is to have a belief that truth exists, and to undermine truth-and instead believe all is subjective-would be to undermine the process of reasoning itself. The question then becomes about whether a concept like freedom can be thought to be true because of belief, possible even like a self-fulfilling prophecy, like how people who have a strong internal locus of control, at least from a practical vantage point, often seem to have more control over their life compared to someone who doesn't think they control their life.

It is these concepts and other facets of the free will debate that I plan on continuing exploring this upcoming year for my Honors Thesis with the continuing mentorship of Dr. Moody.



Matthew D. Nelson
Department of Biology
Saint Joseph's University

Ph.D. New York University

Research Interests: Behavior and Genetics

Every animal on earth sleeps or displays quiescent behaviors that resemble sleep. Humans spend greater than a third of their lives asleep but, amazingly, fundamental questions about sleep remain unanswered including: What is its function? And; How is it regulated at a molecular and genetic level? In fact, sleep remains one of nature's greatest biological mysteries.

Simple animals such as fruit flies and nematodes have become key tools in the sleep biology field. These animals are called "model organisms" because many of the same genes and molecules that drive their biology also controls ours. The nematode *Caenorhabditis elegans* is a microscopic, free-living worm that has been widely used in the lab as a model for understanding development and behavior. *C.elegans* displays sleep behaviors at regularly timed intervals during larval development and in response to stressful environmental stimuli. But, why study sleep in a microscopic worm? First, *C.elegans* is a powerful genetic system that we can manipulate with ease. They are transparent and grow from an embryo to an adult in 4 days, thus allowing for fast genetic alteration and experimentation. Because of their simplicity, we know the location of every one of their cells and the connection of every neuron in its simple nervous system (Only 302 neurons!). My lab takes advantage of this amazing animal in hopes to further our understanding of sleep. Specifically, my research focuses on the following: 1) Identification of sleep regulating neurons and how they communicate as neural circuits to control sleep behavior and; 2) Characterize the mechanisms of how signaling molecules called neuropeptides regulate sleep. We use a combination of techniques common in the following disciplines: genetics, molecular biology, neurobiology and behavior.

Studying the Mechanisms of the NLP-14 Neuropeptides During Stress-Induced Sleep in *Caenorhabditis elegans*

Kristen “Kay” Buscemi, '20



Faculty Mentor: Matthew D. Nelson
Department of Biology

Supported by the Peter & Dorothy Kowey Research Fellowship and the SJU Summer Scholars Program

Neuropeptides are proteins that act as neuronal messengers to regulate sleep/wake cycles. The essential nature of neuropeptides can be seen across the animal kingdom from jellyfish to humans. In particular, the microscopic nematode, *Caenorhabditis elegans*, are exemplary models in characterizing neuropeptide activity during sleep. *C. elegans* experience two distinct types of sleep (Trojanowski *et al* 2015); first they sleep during a period called lethargus, which precedes each of the four molts (Raizen *et al.*, 2008), a behavior termed developmentally timed sleep (DTS). Second, they sleep following exposure to environmental stressors that are damaging to their cells; this is a behavior called stress-induced sleep (SIS) (Hill *et al* 2014). UV irradiation and heat shock are the two most common methods of inducing stress-induced sleep in animals in the lab. While these means of stress applied to the animals are artificial, they induce the natural physiological state of SIS that is experienced in the wild.

SIS is entirely regulated by a single neuron, the ALA, making it ideal to study in lab. Once the animals are exposed to an outside stressor, the ALA will release a cascade of neuropeptides, which regulate behaviors during this time of cellular repair. The neuropeptide that is of central interest to the Nelson lab is the NLP-14 peptide. NLP-14 peptides share striking sequence similarity with orckinins, a class of highly conserved peptides found in the Ecdysozoa clade. Previous studies show that the injection of orckinins into the accessory medulla of the cockroach brain resulted in a circadian phase shift (Hofer and Homberg, 2006). Our data shows that the NLP-14 peptides are necessary in inducing SIS in *C. elegans*. This sleep-like state is characterized by the inhibition of basic behavioral functions, such as locomotion and defecation.

The *nlp-14* gene encodes for 11 NLP-14 peptides, 5 of which are distinct. My ongoing project seeks to determine which of the 5 distinct NLP-14 peptides regulate defecation quiescence and which induce locomotion quiescence during SIS. By creating transgenic animals we were able to ectopically over-express the entire NLP-14 complex, as well as individual peptides in combination or singularly. This over-expression of *nlp-14*, inducible by heat shock promoter, allowed us to identify NLP-14 peptides A, B, and C as being principally involved in regulating the defecation pathway during SIS, while NLP-14 peptides D and E were found to be mainly involved in provoking locomotion quiescence.

To further interpret the involvement of these peptides during SIS in *C. elegans*, we created a set of loss of function mutants this summer using the CRISPR/Cas9 system. We began the process by obtaining a strain carrying a deletion allele *tm1880*. Through RT/PCR and sequencing, we were able to determine that *tm1880* animals possess a mutation which encodes for only 5 of the 11 NLP-14 neuropeptides: B, D, and E. Additionally, we created a new mutant, *nlp-14(stj10)*, using the CRISPR/Cas9 system which results in a truncated pre-protein that only encodes for NLP-peptides A, B, and C. Most recently, a null mutant was created by the same means, by which CRISPR/Cas9 was employed to produce a strain that does not encode for any of the NLP-14 peptides. Furthermore, three rescue lines of the *tm1880* strain were obtained by PCR. These derivatives of the *tm1880* strain were rescued through the ALA neuron.

N2, wildtype animals, deletion mutants, and rescue lines were all exposed to UV shock and quantified for behavioral phenotypes of SIS 90 minutes post shock. Locomotion quiescence was tracked via the automated tracking system, Wormotel (Churgin *et al.* 2017). Defecation events, a multi-step process, was observed manually by measuring number of events during a 5-minute cycle.

Results demonstrate that NLP-14 peptides A, B, and C are main players in regulating defecation during SIS, as well as locomotion quiescence. However, NLP-14 peptides D and E were found to be chiefly involved in inducing locomotion quiescence during SIS but failed to show essential involvement in regulating the defecation pathway during this sleep-like state. Data from the null mutant suggests that the NLP-14 peptides are indeed necessary in inducing sleep-like behavior in *C. elegans* during SIS due to a display in suppression of both locomotion and defecation quiescent behavior post UV shock. Finally, rescue strains of the *tm1880* allele showed a significant recovery in locomotion and defecation quiescence during SIS. This supports the theory that the ALA neuron regulates SIS and subsequently releases the NLP-14 peptides in response to environmental stressors.

Characterizing the Behavioral Effects of Potassium-Channel Mutants in *Caenorhabditis elegans*

Maura Flynn, '21



Faculty Mentor: Matthew D. Nelson
Department of Biology

Supported by the John P. McNulty Scholars Program and the SJU Summer Scholars Program

Sleep is essential for life but surprisingly the molecules and signaling pathways that regulate sleep are still largely not understood. *Caenorhabditis elegans* is an ideal organism for studying sleep since the pathways identified to promote sleep in this animal have proven to be conserved in human sleep. Sleep in *C. elegans* is characterized by lack of locomotion and feeding and an increased threshold to arousal. *C. elegans* has periods of developmentally timed sleep during their larval stages and stress induced sleep (SIS) when affected by unfavorable environmental conditions such as a lack of resources or fluctuating temperatures.

The gene *twk-16* in *C. elegans* codes for a two-pore inward-rectifying potassium leak channel that presumably stabilizes resting potential of neurons prior to action potentials. To characterize the function of *twk-16*, the Nelson lab created a mutant strain expressing the *twk-16* allele, *stj13*, which introduces a premature stop codon in the 4th exon of the gene, truncating the protein and likely making the channel nonfunctional. We found that this mutation leads to an increased stress induced sleep phenotype. In order to confirm this hypothesis, my project aimed to create a second allele with a premature stop codon in the second exon (allele: *stj16*), using CRISPR/Cas9 gene editing. Surprisingly, the new allele, *stj16*, did not show reduced stress induced sleep, however these data are preliminary.

Another characteristic behavior of sleep is defecation quiescence. In *C. elegans* the defecation cycle has three characteristic movements: a posterior body contraction, followed by an anterior body contraction, and then an expulsion. We determined that the *twk-16(stj13)* worms have a significant reduction in their defecation rate during the L4 stage, compared to wild type animals. When wild type copies of the *twk-16* gene are introduced into the *twk-16(stj13)* mutant background, this defecation defect is rescued. Thus, *twk-16* is required for normal defecation outside of sleep. Future work will focus on a role for *twk-16* during defecation quiescence, during sleep. Because *twk-16* is conserved to mammals, this work may shed light on the genetic basis of behavior in more complex animals, even humans.

Exploring the Role of Various *frpr*- Receptors During Sleep in *Caenorhabditis elegans*

Jordan Oleginski, '21



Faculty Mentor: Matthew D. Nelson
Department of Biology

Supported by the National Institute of General Medical Sciences at the National Institutes of Health (1R15GM122058-01, PI: MDN) and the SJU Summer Scholars Program

In all animals, secreted molecules called neuropeptides communicate from cell-to-cell by signaling through G-protein coupled transmembrane receptors (GPCRs) to regulate a diverse set of physiological processes, such as sleep. To understand how these pathways regulate sleep, the Nelson lab studies the genetically tractable nematode *Caenorhabditis elegans*. The *C. elegans* genome codes for greater than 100 neuropeptide GPCRs, however, the function of most of these receptors is unknown. Neuropeptides and GPCRs regulate sleep in all animals, thus, characterizing the function of these molecules in *C. elegans* will shed light on sleep in more complex animals, even humans.

The GPCR FRPR-4 is one receptor that has been implicated in sleep regulation in *C. elegans* (Nelson et al. 2015). Sleep-promoting neuropeptides coded by the gene *flp-13*, signal through FRPR-4 in order to regulate behavioral quiescence and locomotive posture. Overexpression of *frpr-4* leads to sleep like behaviors such as locomotive and feeding quiescence along with exaggerated body bends. The exaggerated bend posture requires *flp-13* neuropeptides that are released from the ALA neuron, a neuron required for sleep (Hill et al. 2014). Loss of function of *frpr-4* results in a minor feeding quiescence defect during sleep, which is surprising because of the strong overexpression phenotype. One explanation for the minor effects of *frpr-4* loss-of-function is genetic redundancy. Supporting this, is the fact that *frpr-4* is highly similar in sequence to the GPCR coded by *frpr-6*, however, the function of *frpr-6* is unknown.

To determine if *frpr-4* and *-6* function redundantly during sleep regulation, I created loss-of-function mutants for both *frpr-4* and *-6* using a DNA editing technology called CRISPR/Cas9. I determined that neither single *frpr-4* or *frpr-6* mutants had significant sleep defects. This was expected because these two receptors have nearly identical sequences and may function redundantly. This led me to creating a double mutant that lacks the function of both genes simultaneously. Future work will focus on quantifying sleep in these double mutant animals. Following that, I will create mutant strains for the four other GPCRs with striking sequence similarity to *frpr-4* and *-6*, eventually making mutants that lack all six receptors. This work will allow us to better understand the mechanisms of GPCR signaling during sleep *C. elegans*, ultimately teaching us about how sleep is regulated in even more complex animals, like humans.

A Role for the TWK-16 Potassium Channel During Sleep Regulation in *Caenorhabditis elegans*

Lauren Yoslov, '20



Faculty Mentor: Matthew D. Nelson
Department of Biology

Supported by the National Institute of General Medical Sciences at the National Institutes of Health (IR15GM122058-01, PI: MDN) and the SJU Summer Scholars Program

For all animals, sleep is essential and the mechanisms that control it are conserved. However, a detailed understanding of the pathways that regulate sleep is lacking. The genetically tractable nematode *Caenorhabditis elegans* is a powerful model for studying sleep pathways with cellular and molecular precision. In *C. elegans*, sleep states are defined by behavior characterized by a lack of movement and feeding with an increased threshold for arousal. Sleep occurs during a life stage called lethargus, which is the transition between larval stages and adulthood; this type of sleep is called developmentally time sleep (DTS). As adults, worms typically do not sleep, however, if an animal encounters an environmental stress, such as extreme temperatures, ultraviolet irradiation, injury or infection, they will sleep in response to it. It has been proposed that sleep allows for recovery from any injuries, analogous to sleep during sickness in humans; this sleep is called stress induced sleep (SIS).

The molecular pathways that regulate SIS are beginning to be more well understood. First, after the worm senses an environmental stress, the ALA interneuron releases a collection of sleep-promoting neuropeptides, which are protein molecules that act like hormones. These molecules that bind to G-protein coupled receptors downstream induce the behaviors associated with SIS. However, it is unknown how these events affect other genes downstream involved in sleep regulation. Our lab recently showed that cells expressing the gene *twk-16* are wake-promoting and function in the SIS pathway (Cianculli et al. 2019. *Genetics*). Thus, the objective of this project was to characterize the role of TWK-16 during SIS regulation.

The *twk-16* gene codes for a two-pore inward rectifying potassium channel, which regulates neuronal excitability during action potentials by stabilizing resting membrane potential. Using CRISPR/Cas-9 gene editing technology, we constructed a mutant allele of *twk-16* that inserted a premature stop codon in the 4th exon of the gene, which results in a truncated TWK-16 protein, removing one of the potassium pores. We determined that these *twk-16* mutants exhibit heightened SIS in comparison to wild type animals. Using optogenetic manipulation of cyclic adenosine monophosphate (cAMP), we determined that TWK-16 is functioning downstream of the cAMP/Protein Kinase A (PKA) pathway during SIS. Additionally, we noticed that the *twk-16* mutant displayed other behavioral phenotypes and specifically focused on their rhythmic defecation cycle.

The defecation cycle of *C. elegans* consists of three distinct phases: a posterior body contraction, followed by an anterior body contraction, and then an expulsion event. We found that there was a significant decrease in expulsion rates between *twk-16* L4 larvae and wild type animals. Future work will further characterize these defects and focus on understanding how TWK-16 regulates SIS. More broadly, two-pore potassium channels are conserved to humans, however, their function is poorly understood. By studying TWK-16 in *C. elegans* we hope to shed light on the function of these conserved molecules in all animals.

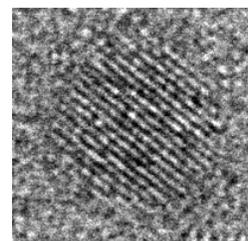


J. Scott Niezgoda
Department of Chemistry
Saint Joseph's University

Ph.D. Vanderbilt University

Research Interests: Nanotechnology, Materials Chemistry, Semiconductor Nanocrystals

I am constantly fascinated by all things tiny. The world dictated by quantum fluctuations and indeterminate probabilities is like a nonsensical mystery that we can actually experience through experimentation. This interest in the atomic world led me to the field of colloidal semiconductor nanocrystals; miniscule pieces of crystal suspended in liquid that we can rather easily synthesize and characterize in lab. These little crystals are so small, in fact, that when imaged with a high-resolution electron microscope, one can often see the individual atoms or rows of atoms that make up the crystal (as seen in the inset image). Furthermore, because these crystals inhabit size scales that are so small, their electronic properties are heavily influenced by quantum mechanics, which is why they are usually referred to as "quantum dots" (QDs). If one held a chunk of cadmium selenide (CdSe) crystal in their hand and shined a UV light on it, the material would emit a very dark red light. However, a materials scientist can controllably synthesize QDs of CdSe that emit any color from violet to red, just by changing the size of the individual crystals. Their electronic tunability, strong fluorescence and liquid stability has made QDs exciting candidates for applications in LEDs, solar panels, biological imaging agents and solution-processed transistors, to name a few. This material is no longer in its infancy; one would be in the midst of QDs during any trip to the local electronics store with the sales of QD-LEDs TVs. For the future, imagine being able to use a laser printer to print a solar panel from quantum dot ink, or imaging tumors *ex vivo* using IR-emitting QDs!



Regardless of the specific QD material, in order to preserve the stability of the nanocrystals in solution they must be coated with soap-like surfactant molecules known as "ligands". Generally, these ligands have a polar head group that binds to the QD surface and a fatty carbon chain that solubilizes the crystals in organic solvents. A major thrust of my research involves the customization and on-particle alteration of these ligands. By utilizing chemical techniques to transform or alter the ligands on the surface, we can tune the solubility, electronics and interparticle spacing properties of the QDs to our liking. For instance, by synthesizing QDs with long fatty ligands containing an engineered glycol group within the carbon chain, we are able to cleave, or snip, these ligands to shorter chain aldehydes. This cleaving spontaneously changes the solubility and interparticle distance of the QDs. We are also striving to create methods for creating materials with artificial "memory". For instance, if we can tie the colors of light emitted from a sample of QDs to whether or not they have been heated above a certain critical temperature at some point in their past, we can engineer materials that "remember" their temperature history through their fluorescence.

Solution-Based Forster Resonance Energy Transfer Characteristics of QD-Fluorescent Dye Through Chemically Bound Dimers

Jordan Butt, '21



Faculty Mentor: J. Scott Niezgoda
Department of Chemistry

Supported by the SJU Summer Scholars Program

Quantum dots are small particles of only a few nanometers size. As a result, they display different physical properties than most LED devices. Quantum dots can emit certain types of light when a specific electronic frequency is applied to them. Larger quantum dots emit larger wavelengths of visible light (red, orange), while smaller quantum dots emit shorter wavelengths of visible light (blue, violet). Quantum dots are required to be coated with organic materials in a ligand shell. This allows for transfer of hydrophobic particles into an aqueous solution.

Forster resonance energy transfer (FRET) is a process that involves the transfer of energy in the form of a “virtual” photon from an excited chromophore to a ground state chromophore. The rate of transfer in this process is inversely proportional to the sixth power of the distance between the chromophores, and is therefore extremely sensitive to the separation between light sources.

Recently in the Niezgoda lab, we have proposed and begun to investigate a new mechanism for exploring FRET. The Diels Alder Reaction is a famous and well-researched reaction among two organic molecules, a “diene” and a “dienophile.” In the Niezgoda lab, we wish to demonstrate that two organic ligands, bearing the necessary properties, if attached to the surface of a quantum dot can undergo the same Diels-Alder reaction, which would occur spontaneously at room temperatures. Once bound, the connection between the two ligands would allow FRET to be observed between the two dots. When bound, heating to high temperatures would break apart the Diels-Alder linkage; in this scenario, FRET would stop at high temperatures, allowing one to notice when the chemical change has occurred. Throughout the summer, I have worked to synthesize the Quantum Dots necessary to begin the synthesis. Forming the desired product has proven difficult, but I am slowly observing my reactions step-by-step to ensure that eventually I can synthesize the desired result. I have utilized FTIR, UV-Vis, and Photoluminescence techniques to determine if I have synthesized the desired products. I plan to continue this research throughout my junior and senior year, and if time permitting, expand on its properties as well.

The results from this project are expected to form a part of a bigger thrust in the Niezgoda lab that is underway to demonstrate the usefulness and applicability of spontaneous reactions, such as click chemistry, in the QD community. We strive to develop a library of spontaneous reactions which can be utilized to synthesize a plethora of QD systems and result in the extension of these techniques that is not limited to a certain subset of QD types.

On-Particle Ligand Modification of Quantum Dots

Erica Litle, '20



Faculty Mentor: J. Scott Niezgoda
Department of Chemistry

Supported by the Robert & Carla Conaty Research Fellowship and the SJU Summer Scholars Program

Quantum dots (QDs) are tiny particles that have properties that vary from their bulk material counterparts. These particles are coated with ligands that determine some of their most important characteristics. Generally, these ligands are long fatty carbon chains, which render the QDs soluble in nonpolar media. On-particle ligands can cause many variables in the solubility, spacing, and optoelectronic properties of the QDs. Presently, quantum dots are made with ligands such as oleic acid that are known to produce stable dots. Further modification of the ligands occurs through solution-based ligand exchange, in which the original ligand is entirely removed from the QD and replaced with a preferred one. Oftentimes, this technique results in a reduction of the photoluminescence of the dots, a feature greatly valued. Our research strives to custom tailor a ligand for QD synthesis and then cleave the ligand while it is attached to the dot.

This past year, my research succeeded in forming a synthesis for the production of our desired ligand, dihydroxystearic acid (DHSA), our cadmium:dihydroxystearate precursor, and CdSSe quantum dots with DHSA ligands. This summer began with the ultimate goal of our research: to cleave a ligand while it is attached to a quantum dot. The chemical we used for cleavage is lead tetraacetate (LTA), a strong acid commonly utilized in glycol cleavage. To begin, we focused upon cleaving DHSA before it was attached to the quantum dot. To do so, I dissolved equal molarities of LTA and DHSA in THF and stirred the solution overnight, with FTIR spectra confirming the identity of the solution. Additionally, the purchase of nonanal, an expected byproduct of the cleavage, was instrumental in confirming the successful cleavage of DHSA, which displayed the same aldehyde peak, shown in figure 1.

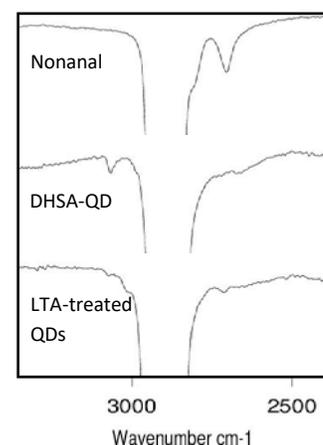


Figure 1. FTIR spectra showing emergence of aldehyde peak after on-particle cleavage of native diol.

After confirming that DHSA could be cleaved with LTA, our research moved to the cleavage of CdSSe QDs. These trials involved varying the solvent, concentration of QDs and LTA, stir time, and temperature of the reaction. After many trials, 1 mL of 6 μ M LTA dissolved in THF and 2 mL QD solution were stirred at 80 $^{\circ}$ C for 5 hours. The dots were then cleaned with hexanes and redissolved in chloroform. The cleavage of the dots was confirmed through FTIR spectroscopy, with the same aldehyde peak present in nonanal and the LTA-treated dots lacking in the untreated dots, shown in figure 1. We have now gathered enough data that we feel confident in beginning to write in the hopes of future publication.

Alkyne-Azide Huisgen Cycloaddition Reaction Between Alkyne Terminated Quantum Dots and Azide Terminated Substrates

Lucas Tortella, '22



Faculty Mentor: J. Scott Niezgoda
Department of Chemistry

Supported by the SJU Summer Scholar Program

Quantum dots are small semiconductor nanocrystals, only a few nanometers in size. When semiconductor crystals are reduced below the Bohr radius, they are considered quantized, hence the term quantum dots. This extremely small size not only gives them a cool name, but also changes their electronic properties. When these semiconductor crystals are exposed to ultraviolet light, electrons gain energy, and move to a higher energy orbital. The electron then relaxes back to its original energy level, emitting a photon, or visible light. The unique thing about quantum dots is their tunable band gap, meaning smaller quantum dots emit higher energy blueshifted light, while larger quantum dots emit lower energy redshifted light. Unlike conventional bulk semiconductor, which emit fixed energy light, semiconductor nanocrystals can emit different colors of light. In order for these crystals to remain stable in solution, the nanocrystals are coated in organic molecules called ligands.

These ligands change the surface chemistry of the dot, changing solubility, and substrate interaction. Ligands are delicate, restricting the possibilities of surface chemical reactions. This summer I focused on making cadmium sulfoselenide quantum dots using 10-undecynoic acid, an eleven-carbon fatty acid ending in an alkyne group as a ligand. This alkyne group is very reactive allowing for specific type of chemical reactions to take a place involving click chemistry. This click reaction, an alkyne-azide Huisgen cycloaddition, occurs between an alkyne and an azide, a three chain nitrogen with a triple bond. A copper catalyst is used to convert the azide and alkyne groups to a triazole. Click chemistry is ideal for quantum dots, because it is thermodynamically favored, insensitive to oxygen and solvents, and results in high chemical yields. The cycloaddition reaction is extremely favorable and durable.

The novelty of this research stems not from synthesizing quantum dots, but from using alkyne-azide Huisgen cycloaddition to cement quantum dots to various substrates and eventually other quantum dots. Currently there is no way to attach dots securely to substrates and maintain integrity of the ligand shell. Click chemistry provides a way to secure dots to substrates without disturbing the ligand shell.

This summer, I synthesized soluble CdSSe with 10-undecynoic acid as a ligand, but they do not fluoresce. Originally my dots neither fluoresced nor dissolved. One part of the puzzle is solved, hopefully the other piece is nearby.



Jo Alyson Parker
Department of English
Saint Joseph's University

Ph.D. University of California, Irvine

Research Interests: Eighteenth-and Early Nineteenth-Century Novel, Women's Writing, Gender Studies, Narrative Theory, Narrative and Time, Speculative Fiction

Although my research interests encompass a variety of areas, what ties them together is my fascination with narrative. As Paul Ricoeur states in his landmark work *Time and Narrative*: ". . . [T]ime becomes human time to the extent that is organized after the manner of a narrative; narrative, in turn, is meaningful to the extent that it portrays the features of temporal existence." The stories that we tell help us make sense of our experience—whether it is nineteenth-century writer Jane Austen exploring the conflict between love and money in her society, contemporary author David Mitchell experimenting with temporal structure in order to deal with climate change, or *Westworld* creators Lisa Joy and Jonathan Nolan addressing the connection between self-narration and consciousness. The two scholars with whom I have worked this summer have both considered the hows and whys of such story-telling—one analytically and one creatively.

In her research paper "I am not Miss March, I'm only Jo': A Queer Reading of *Little Women's* Jo March," Maggie Nealon provides a thought-provoking analysis of key gender issues in Louisa May Alcott's beloved nineteenth-century novel, focusing particularly on the character of Alcott's semi-autobiographical character Jo. Recent critical assessments of *Little Women* have dealt with its importance to the American literary canon and its exploration of gender expectations in the nineteenth-century, and Maggie has taken such assessments into account as she has advanced her original argument that Jo is constrained by the imperative of compulsory heterosexuality pervading her society. Maggie's paper serves as one chapter in the Honors thesis that she is currently writing, one that addresses issues of gender and sexuality in key literary texts.

Nathan King's *Pearl's Edge* is a novella comprising five linked stories all taking place in the fictional seaside town of Pearl's Edge. Inspired by David Mitchell's ground-breaking *Cloud Atlas*, Nathan employs multiple perspectives and different genres—a journal, a first-person narrative that plays with time, a stream-of-consciousness sequence, an email and text exchange, and a frame narrative—to tell a story of mounting horror. In doing so, Nathan has crafted a compelling experimental fiction, one that highlights the connection between the teller and the tale and that uses horror to explore significant themes.

Pearl's Edge: A Novella

Nathan King, '20

Faculty Mentor: Jo Alyson Parker
Department of English



Supported by the SJU Summer Scholars Program

Pearl's Edge is a horror novella in five parts; it follows a series of narrators who live in an East Coast beach town following a local calamity that sends ripples of tragedy into the community. The novella's goal is to use unique narrative devices in each section to play with readers' perceptions of each story. A primary inspiration for the structure of this work is the novel *Cloud Atlas* by David Mitchell. Some inspirations for the novella's content include *Slade House*, also by Mitchell, and television shows like *The Haunting of Hill House* (based on the novel by Shirley Jackson) and *Black Mirror*. The novella explores themes including grief and loss, sexuality, and perception of reality, and it asks the question: What if the real world is ultimately more disturbing than anything lurking around a fictional corner?

The novella opens with "Harvest," which is told through a psychiatrist's journal entries. The narrator works at an inpatient facility and recounts her experiences with a particularly troubled patient named Eugene Kang, who has been orphaned by a sudden and grim accident. As she learns more about Eugene, misfortunes from her own past—as well as his—crawl into the forefront of her mind. The doctor questions her sanity as something dark awakens within her charge, but by the time she comes to terms with how bent her reality has become, her plight may be irreparable.

In "Synchronicity," Desi Varghese recounts the final week of her life. Still reeling years after the death of her father, she starts to see him wherever she goes after being forced to house-sit for her mother. Her relative isolation challenges her lucidity; this section is told in a fragmented chronology, which starts at her end and goes on to illustrate how she approaches her limit and veers off the edge. Her unreliable narrative raises questions about which events are real and which are imagined, asking readers to choose for themselves what to believe.

The third section, "Finger Bones," details only a few hours in the life of Leo Williamson. He wakes up drugged in a cage in the middle of the ocean. Free indirect discourse takes the reader directly into his head as his memories interplay with his surviving in the present. He attempts to flee an ancient evil from the depths of the ocean, and he recalls a painfully one-sided relationship and his experience as a gay athlete—themes that intersect and may point him toward salvation by the section's conclusion.

"Further Contact" combines horror and science fiction. Maya Hendrick has just lost her mother in a mysterious incident, but through an on-the-rise service that can fabricate consciousness, she is able to continue contact. When this counterfeit mother starts to feel too real, Maya has to decide between killing her again or allowing whatever evil has taken her over to persist. This segment is told exclusively through electronic communications such as emails and text messages.

Finally, "Third House From the Sun" is the account of Crystal Torres, a girl on holiday with her family in Pearl Beach. She is a witness to many of the events of the previous stories, and the evil force that has latched onto the town starts to lay waste to her vacation. It is later revealed that her story is one that she's dreamt up in an attempt to spook her grandchildren, but when she can't "remember" what's supposed to come next, a shadow of doubt is cast on the relative authenticity of the other tales.

“I Am Not Miss March, I’m Only Jo”: A Queer Reading of *Little Women’s* Jo March

Margaret Nealon, ’20



Faculty Mentor: Jo Alyson Parker
Department of English

Supported by the SJU Summer Scholars Program

Louisa May Alcott’s *Little Women* has been hallmarked as a classic American novel for generations. Alcott’s multifaceted narrative is ripe with opportunities for analysis through different literary theories, with special attention paid to queer theory in recent years. With this project, I wished to explore a modern queer theory reading of *Little Women*, particularly emphasizing the concept of compulsory heterosexuality, to explain why the subversive heroine of Jo March ultimately settles for a life of domesticity and heteronormativity at the end of her tale. As a member of the LGBTQ+ community, I find myself fascinated by the influence of more modern concepts in queer theory (like compulsory heterosexuality) as observed in the lives of characters like Jo, as there would be no such words to express such a phenomenon centuries ago.

This literary project was broken down into two main segments, comprehensive research and self-written analysis. During my research period, I explored texts from several experts in the field of queer theory, with special attention paid to the writings of famed lesbian essayist Adrienne Rich. I also examine research dealing with gender performance, specifically within lesbian women, as Jo’s character is repeatedly noted for her tomboy appearance. Lastly, I examined some texts that broke down the queer politics to be found in the varying relationships within *Little Women*, noting the differences in male and female relationships. With this research completed, I had several concrete themes to explore in my writing, as well as evidence to build a claim for the effects of compulsory heterosexuality.

In writing my analysis, I broke down the effects of compulsory heterosexuality on Alcott’s writing into four main themes – Jo’s gender performance as a tomboy, Jo’s relationship to the women in her life, Jo’s relationship to the men in her life, and lastly, the autobiographical elements that reflected the same occurrences in Alcott’s own life. I began by first looking at these autobiographical aspects to be noted in Alcott’s writing, as indeed the character of Jo is based upon Alcott’s own personality. Alcott had wished for Jo to remain a literary spinster like herself, yet ardent fans of the novel pressured Alcott into creating a husband for Jo to marry, demonstrating how compulsory heterosexuality affected not only Alcott’s characters, but Alcott herself.

As mentioned before, I also did some extensive research into Jo’s identity as a tomboy, as the concept of the “tomboy” is one that is heavily rooted within LGBTQ+ culture. Jo appears to use her tomboy nature as a sort of protective identity, masculinizing herself in an attempt to compensate for her lack of heterosexual attraction. In the beginning of the novel, Jo certainly sets out to separate herself from her impending womanhood, perhaps also separating herself from the heterosexual life she is seemingly destined to.

As this project set out to explore the queer themes to be noted in Jo’s life, I also examined the relationships Jo has with the women in her life, particularly her relationship to her mother. There remains to be a stark difference in the devoted, unconditional love that Jo holds for her mother and sisters, and the awkward, almost nonsensical love Jo has for the men in her life. With this considered, I lastly set out to explore the most evident effects of compulsory heterosexuality to be found in Jo’s life, in the two relationships she possesses with men in the novel. Jo March, overall, demonstrates a strong female heroine whose potential queer undertones were unfortunately squashed by an oppressive sense of compulsory heterosexuality.

The main purpose of this project was to begin a narrative of queer theory that would then continue further into my Senior Thesis, involving similar research in other similar texts. This project will act as one “chapter” within a greater project to be completed. The secondary purpose was to implement more modern understandings of queer theory into classic literature, as we now have available a more extensive list of terminology to use in literary analysis. With this project, I hope to demonstrate that LGBTQ+ identities have existed, and have also been suppressed, for far longer than we often like to consider. I hope this can become an ongoing topic of study for my research in the months to come.



Kersti Tarien Powell
Department of English
Saint Joseph's University

D.Phil. Oxford University

Research Interests: Contemporary British and Irish Literature, Archives and Modern Manuscripts, Authorship and Publishing, Science and Literature

My teaching and research center around 20th and 21st-century British and Irish literatures. In other words, I study and teach authors who are still very much alive, and are busy producing literature under our very eyes.

It is thrilling to work with texts that demonstrate how authors react to the issues, trends, and ideas that are part of our own existence. Writers do not live in a vacuum, and contemporary literature is living, growing proof that literary authors are real human beings who react with pain and anger, joy and sorrow to the political and cultural events that determine our local and global realities.

Contemporary Irish literature is a case in point here. Ireland's recent history is a true roller-coaster ride of ups and downs: from the late 1990s until the fall of 2008 the country witnessed an unprecedented economic growth, a phenomenon that was dubbed the Celtic Tiger. During these energetic and affluent boom years, the Irish national identity went through significant changes: from the struggling and not-so-cool country that so many young people were fleeing from, Ireland became the poster child of the European Union. But after the boom came the crash when the global economic downturn of 2008 brought the Tiger to its proverbial knees. I have studied how Irish writers dealt with the affluent Tiger years and reacted to the economic austerity that followed the crash. In a way, one could say that contemporary Irish fiction demonstrates how a global economic catastrophe can invigorate the novel format. The Irish authors who so far have interested me most are Tana French and John Banville. I am also working on a book that involves the works of John Banville, Tom Stoppard and John Fowles.

The Fall of the Celtic Tiger and Irish Literature

Karleigh Lopez, '20

Faculty Member: Kersti Tarien Powell
Department of English



Supported by the SJU Summer Scholars Program

My research for this project began with an acute study on the history of Ireland's political governance as well as an overview of the more recent state of economic insecurity following the collapse of the Celtic Tiger Era. As a small country with little fiscal independency, Ireland faced decades of destitution. The history of Ireland's economy has been predominantly catalogued by poor executive judgment. Economic collapses caused by the insufficiency of Irish government were unforeseen by Irish citizens, as eras of prosperity—namely the Celtic Tiger era—encouraged citizens to invest in covertly deteriorating industries, such as the housing market.

Associated with sustained economic success, Neoliberalism as an ideology and policy model, allowed for Ireland's flourishing Celtic Tiger Era. A key way to conceptualize Neoliberalism as an economic policy theory which is not wholly a policy model, instead, Neoliberalism is categorized more as a shift in political and social ideologies which advocates economic liberalism and free-market ideologies. Within a neoliberal economy, it is stressed that markets are the best way to promote the distribution of goods and services throughout the country. Ireland achieved rapid economic growth by basing the structure of the economy around Neoliberalism, but collapsed after the Neoliberal model was poorly executed and several markets were exploited. When the fall of the Celtic Tiger era began, the inadequate actions of Irish government, were not enough to undo years of damage.

I decided to focus the works of Tana French, Mike McCormack, Donal Ryan, and Claire Kilroy. I was able to analyze how the novels depict Ireland's compromised economy, as well as, how each author uses character relationships as commentary on the failed Irish economy. As my research has confirmed, novels set in Neoliberal societies often take on characteristics of the gothic novel. Building on what I have found, I am composing an analysis paper on examining the presence of Neoliberal gothic tropes and in these novels, how they influence the syntax of suspense and themes of detachment.

Additionally, I will be continuing my partnership with Dr. Powell throughout the Fall 2019 semester to build on this project to also be published as a senior thesis paper.



Rommel G. Regis
Department of Mathematics
Saint Joseph's University

Ph.D. Cornell University

Research Interest: Optimization

My research is focused on developing algorithms for the optimization (i.e., minimization or maximization) of mathematical functions of several variables possibly subject to constraints on the variables. One application is in aircraft wing design where engineers would like to determine the setting of design variables that minimize the mass of the wing while ensuring that the aerodynamic stresses on critical wing components do not exceed some threshold values. In many applications, the optimization problem is given in the form of a computer program whose inputs are the numerical values of decision variables and whose outputs include the quantity to be optimized, called the objective function, and also measures of how well the constraints are satisfied. When this program is run, a time-consuming simulation is performed that could take a few minutes to many hours before the outputs are obtained. In this case, the problem is referred to as black-box in the sense that the mathematical relationships between the inputs and the outputs are not explicitly known. An optimization algorithm determines the values of the input variables that optimize the value of the objective function while satisfying the constraints. In some cases, multiple objective functions are to be jointly optimized and the goal is to find what is called a Pareto optimal solution that provides a trade-off among conflicting objectives.

Simulation-based black-box optimization problems are found in many engineering applications, including aerospace, automotive, environmental and medical applications. Because the simulations that yield the objective and constraint values are computationally expensive, only a relatively small number of them can be performed when attempting to find the optimum setting of the input variables. The challenge is to design efficient algorithms that are able to find good solutions given the limited computational budget. In this case, a natural approach is to build inexpensive approximation (or surrogate) models for these functions. These surrogate models are surfaces in multidimensional space that are used to guide the search for optimal solutions. For over a decade, I have been developing optimization algorithms that use Radial Basis Function (RBF) surrogate models, including those that can be mathematically proved to converge to an optimal solution in a deterministic or probabilistic sense. My research spans various areas of Mathematics and Computer Science, including Linear Algebra, Multivariable Calculus, Probability, Statistics, Operations Research, Scientific Computing and Machine Learning.

Investigations in Probability: Mixed Probability Distributions

John Glasser, '22



Faculty Mentor: Rommel G. Regis
Department of Mathematics

Supported by the SJU Summer Scholars Program

In undergraduate probability courses, mixed distributions are typically only briefly mentioned. Mixed distributions are particularly challenging to work with as they involve both discrete and continuous components. A discrete distribution is described by the probability mass function of a discrete random variable, which is a random variable that takes values from finite sets (such as the set $\{0, 1, 2\}$ representing, say, the number of heads in two tosses of a coin) or countably infinite sets (such as the set of natural numbers, which can be placed in a sequence). A continuous distribution is described by the probability density function of a continuous random variable, which takes values from uncountably infinite sets (such as an interval of real numbers like $[1,3]$). Due to the complexity of mixed distributions, the mathematical proofs of many commonly understood properties of probability distributions are usually not provided for mixed distributions in introductory probability textbooks. However, in the context of Actuarial science mixed distributions have several important applications, such as in modeling insurance claims and also in policy limits and deductibles, making a full understanding of such distributions an important part of the education of those studying to be Actuaries.

The primary goal of this project is to explore the properties of mixed distributions and prove important theoretical results about mixed distributions using mathematics accessible at the undergraduate level. One such result of particular interest is the Survival Function Method or Darth Vader Rule which is used to find the mean or expected value of a function of a random variable. Over the course of this project I verified that the survival function of a mixed distribution is a weighted combination of the survival functions of its discrete and continuous parts, and also proved that the general form of the Survival Function Method works in the mixed distribution case. The proof relies on a well-known mathematical result that the ordinary Riemann integral can be calculated for functions with a countable number of discontinuities.

A secondary goal of this project is to explore mixed distribution applications using the example of daily rainfall in a given month. Data was sourced from the NOAA (National Oceanic and Atmospheric Administration) daily summaries of the Philadelphia International Airport, PA, US station and the month of April was selected. Based on prior literature researching rainfall, the gamma probability distribution was selected to model the continuous part of the distribution. The discrete part, which models the event of no rain, is the random variable that takes the value 0 with probability 1. Moment matching was utilized to find the parameters of gamma distribution of the continuous part.



Mark F. Reynolds
Department of Chemistry
Saint Joseph's University

Ph.D. University of Wisconsin

Research Interests: Heme-Based Gas (NO, CO and O₂ Sensing Proteins); Studying the O₂ Sensing Mechanism of FixL, a Heme-Based Sensing Protein From *S. meliloti*

My research is in the areas of biochemistry and inorganic chemistry because I study the role of metal ions in biological systems. My particular area of research interest is the heme-based gas sensor proteins that sense either carbon monoxide (CO), nitric oxide (NO), or oxygen (O₂). These gas sensor proteins have a sensing area that receives the signal and communicates the information to a transmitter domain that sends out the amplified biological signal. These proteins are involved in many important biological signaling processes such as blood pressure regulation, neurotransmission, gene transcription and chemo taxis in a wide variety of mammals and bacteria. However, the detailed mechanisms by which many of these proteins function are not yet well understood.

In my research laboratory we study FixL, which is an oxygen sensing heme protein from the bacterium *Sinorhizobium meliloti* that regulates nitrogen fixation in the symbiotic root nodules of legumes and is part of the heme-PAS and histidine kinase family of sensors. The kinase activity of FixL is “off” when oxygen is bound to the heme sensor but “on” under hypoxic conditions in the root nodules when oxygen is not bound to the heme sensor. FixL is an excellent model for both the heme-PAS family and the two-component histidine kinase family of response regulators because there is a wealth of biochemical data available to us.

This summer our research team (Amy Troutman '20 and Nazeim Brahme '20) looked at the role of conserved proximal residues in the oxygen sensing domain of FixL using variant proteins, where individual amino acids are replaced to probe their function. In particular, we looked at the role of three conserved amino acids in the heme sensor region of the protein that binds oxygen, arginine 200, tyrosine 197 and arginine 214. Past research student had made a variety of site-directed mutants and found that several gave stable variant proteins with interesting properties.

This summer my students grew up the *E. coli* cells of six of these variant FixL proteins (R200A, R200E, R200H, R200Q, Y197A and R214A) and the native WT protein and purified them using column chromatography in our large cold closet.

We began to characterize these novel mutant SmFixL proteins with a wide variety of techniques such as SDS-PAGE, pyridine hemochromagen assays, gas binding studies with UV-vis spectroscopy and kinase activity assays in our lab. Based on our initial studies we propose that R200A and Y197A will have impaired kinase activity because they are important for oxygen sensing. This fall we will test out this hypothesis using oxygen binding assays and a new kinase assay with our purified variant proteins. The lessons we learn from the oxygen sensing mechanism of SmFixL can be applied to other important signaling proteins in the heme-PAS and histidine kinase families of enzymes.

The Biochemical Mechanism of the Heme-Based Oxygen Sensor FixL From *Sinorhizobium Meliloti* and the Identification of Radioiodine Concentrations

Nazeim Brame, '20

Amy Troutman, '20



Faculty Mentors: Mark F. Reynolds and Usha Rao
Department of Chemistry

Supported by the SJU Summer Scholars Program

Sinorhizobium meliloti is a nitrogen-fixing bacterium found in the root nodules of alfalfa plants. Our focus of study this summer was on FixL which is found in *Sinorhizobium meliloti*. Our first project's research focused on the growth, purification, and study of the biochemical mechanism of FixL, which is a heme-based oxygen sensing protein. FixL contains a heme component as well as distinctive amino acids to the PAS domain which characterizes FixL as a member of the heme-PAS family.

Heme-PAS proteins are also found in most gas sensing proteins. In addition to being a member of the heme-PAS family, FixL is also a member of the histidine kinase family. Therefore, the protein has both a heme and a protein kinase domain. FixL's kinase domain is in the "off" state when the heme component is oxygen bound and in the "on" state when the heme is not bound to oxygen.

In order to better understand the oxygen sensing mechanism of FixL, variants were made using site directed mutagenesis on conserved amino acids within the heme domain which is believed to be crucial in both oxygen sensing and binding. Alongside wildtype FixL, the mutants studied were R200A, R214A, Y197A, R200H, R200E, and R200Q. The first letter of each mutant signifies the original amino acid, the number designates the location of the residue, and the last letter signifies the last amino acid. The variants are expressed through *Escherichia coli* cells which are grown up and plated using Luria Broth with ampicillin. Once grown up, the cells are treated with lysozyme and sonicated in order to lyse the cells. Once the cells are lysed, the protein is collected through centrifugation. After the protein is collected, it is then purified through a diethylaminoethyl anion exchange column. A salt gradient was then used to separate the purified protein based upon its concentration. Using ultraviolet-visible spectroscopy, each mutant was scanned to determine whether they were in the oxy, oxidized, or deoxy state. The mutants were also introduced to argon gas as well as dithionite in order to observe each mutant in the reduced state.

Our second project's research consisted of identifying the concentrations of radioiodine in the sediments of Lake Ontario which formerly housed a nuclear fuel reprocessing facility. The nuclear fuel facility contaminated the area due to leaks during its years of operation. The concentrations of radioiodine still present were measured with respect to the stable iodine isotope. Calculations were performed to calculate the ratio of radioiodine to stable iodine as well as radioiodine's dry and bulk density. Such calculations help to better understand what happens after a nuclear accident.



Katherine A. S. Sibley
Department of History
Saint Joseph's University

Ph.D. University of California, Santa Barbara

Research Interests: American First Ladies, US-Soviet Relations in the Twentieth Century (Trade, Espionage), Presidential History

While my research interests over the last two decades, from my 1996 book on Soviet-American trade to my 2016 volume on First Ladies, may seem rather divergent, I have found there are some links; one in particular is the way in which compelling stories are often overlooked in the traditional narratives of modern American history. Thus, what initially got me interested in Soviet-American relations in the 1920s was the discovery of little-known trade deals between the two nations during a time commonly thought to be one of isolation and hostility. And there was another story; in the 1920s Russians began actively spying on American industry, a practice which only expanded further in the ensuing decades, culminating in their espionage on the atomic bomb in World War II.

Meanwhile, one of the overlooked presidents of the 1920s, Warren G. Harding, was married to an often scorned First Lady, Florence Kling Harding, who, as it turned out, made significant contributions to raising the profile of her office, and well before the better known Eleanor Roosevelt: Florence made the cracks in the mold that Eleanor broke with her concerns about women's political activism and social justice issues. At present, I am working on a new study of Southern first ladies—these women, too, from Martha Washington to Laura Bush, have had an outsize role in shaping the office of First Lady, as well as in their own activism.

My work on First Ladies in general, and in Florence Harding in particular, stemmed from the opportunity to teach courses here in women's history and in the Progressive era. Chelsea Smith '20, a double history and IR major, took the Progressive Era course with me last fall, and wrote a creative research paper which focused on little-known suffrage activist Rose Winslow, drawing on Winslow's writings. In her summer scholars project, Chelsea decided to further pursue the history and actions of women in the Progressive Era, first to determine what happened as a result of their pioneering activism in that period (especially in regard to women's rights), and what remained stubbornly the same. This summer her research has been wide ranging, and gone beyond women's rights activism to touch on eugenics, race, and maternalism in this period. The story is a complicated one and her work has unearthed several little known chapters, from anti-lynching dramas to treatment of women in maternity wards.

Writing Women Into the Sequel: Exploring the Impact of Progressive Era Science on Women

Chelsea Smith, '20



Faculty Mentor: Katherine A. S. Sibley
Department of History

Supported by the SJU Summer Scholars Program

Prior to taking Dr. Sibley's course on the Progressive Era I could not have identified Rose Winslow, and I was a lesser person for it. Rose Winslow was both an immigrant and a factory worker, making her an outlier amongst the privileged leaders of the women's suffrage movement. She was arrested as a result of her activism and underwent a hunger strike while imprisoned, at which point she was subjected to daily, agonizing, force-feeding. Beyond this simple background, there is little known about Ms. Winslow despite the immensity of her contribution to our national history. This realization, however frustrating, caused me to contemplate just how often individuals are written out of our national history and the consequences of their being omitted. This summer scholars project was undertaken to rectify this shortcoming by recovering the under-researched histories of underrepresented women.

I chose to focus on the Progressive Era, which encapsulates the latter decades of the 19th and earliest decades of the 20th century, as many of the transformations impacting women then, remain relevant today. Modern debates regarding family planning, birth control, women's rights, and woman's roles all have roots in the Progressive Era. Thus, capturing the experiences of women during this formative period in American history provides vital context for understanding the intersectional challenges facing modern women. Furthermore, I narrowed the scope of my research to the impact of science and medicine on women. The professionalization of the scientific and medical fields began around the turn of the 20th century, and their implementation at this time was largely reflective of pre-established biases based on sex, race, and class. As such, the impact of science and medicine on the lives of women during the Progressive Era provides an excellent lens for discerning the varied experiences of women across racial and class-based lines.

My research covered topics including eugenics, maternal care, anti-lynching dramas, better baby contests, and medical sterilization. The findings of my research suggest that what were considered valid scientific facts and sound medical practices during the Progressive Era were often biased. While many of these practices would be simply unthinkable today, racial biases (implicit or otherwise) continue to impact the medical care received by women of color. This conclusion is not offered as a condemnation of science or medicine. Rather, I offer it to the American people as a demonstration of the pervasiveness of racism in our history and, regrettably, our modern society. My hope is that, by confronting discrimination in our collective past, we will be better able to recognize it in the present and prevent it in the future.



George P. Sillup

Department of Pharmaceutical & Healthcare Marketing
Saint Joseph's University

Ph.D. The Fielding Institute

Research Interests: Media Coverage of Ethical Issues About the
Pharmaceutical Industry; Levels of Care in Nursing Homes

Prior to joining the full-time faculty at Saint Joseph's University in 2004, Dr. Sillup worked in the diagnostic, pharmaceutical and medical device industry for 28 years and held positions from salesman to COO. He worked in major corporations, such as Johnson & Johnson, as well as in start-up businesses, where he sold products, conducted research and launched several new medical/pharmaceutical businesses into global markets. Dr. Sillup has attained favorable reimbursement coverage and coding for pharmaceuticals, medical devices and drug-device combination products with international regulatory authorities and with U.S. authorities, to include the FDA and CMS (Centers for Medicare & Medicaid Services). He is and has been a member of several boards of directors, e.g., Daemion Counseling Center, American Heart Association.

In 2018, he and colleagues, Dr. Eileen Sullivan, College of Arts & Sciences, and Dr. Ronald Klimberg, Haub School of Business, have published an article in the *International Journal of Behavioural and Healthcare Research* entitled "Reduction of Agitation and Anxiety Observed in a Clinical Study of People with Dementia Using the Timeslips™ Creative Expression Program". Additionally he and Dr. Stephen J. Porth published their 13th consecutive audit of the newspaper coverage of ethical issues affecting pharmaceutical industry in *Pharmaceutical Executive* entitled "Pharm Exec's 13th Annual Press Audit: Pharma in the Spotlight as Media Coverage Increases" and are working on the 14th with the Haub School of Business's Reference Librarian.



Stephen J. Porth
Department of Management
Saint Joseph's University

Ph.D. Temple University

Research Interests: Strategic Management, Leadership and Ethics in the Pharmaceutical Industry

Dr. Stephen Porth is Professor of Management at the Haub School of Business, Saint Joseph's University (SJU), Philadelphia, PA, USA. He also serves as the Senior Editor of the *Journal of Jesuit Business Education*. Steve has chaired three academic departments at SJU and served for 17 years as Associate Dean and Executive Director of Graduate Business Programs. He is the university's Faculty Athletic Representative to the NCAA and has served as chair of the Atlantic 10 Conference Council of Faculty Athletic Representatives (FARs).

Steve's research and teaching interests are in the areas of strategic management, leadership and ethics. Steve provides consulting services specializing in leadership development and strategic management programs. He has written two books, one which is now in its fifth edition and has been translated into Chinese, and he has published extensively in management journals.

Steve serves on the Executive Committee of the Board of *Colleagues in Jesuit Business Education* and on the Governance Board of *IgnitEd*, the platform to support Jesuit higher education. He serves on the Board of Directors of *Nutritional Development Services* and is a former trustee on the Board of *Sacred Heart Academy*, Bryn Mawr, PA.

The Portrayal of the Pharmaceutical Industry in the Media

Kerry Faust, '22



Faculty Mentors: Stephen J. Porth and George P. Sillup
Departments of Management and Pharmaceutical & Healthcare Marketing

Supported by the SJU Summer Scholars Program

In today's digital world, the media is always one click away. With healthcare as a hot topic, the media publishes many articles that put the limelight on the pharmaceutical industry. These sources are read by many, including doctors, business executives, and potential investors, which makes the industry a stakeholder to the media. Although some say "Any publicity is good publicity", one negative article covering a company can put them in financial jeopardy. Through the Summer Scholars Program, I had the opportunity to analyze how the top five newspapers in the United States- *New York Times*, *Wall Street Journal*, *Washington Post*, *The LA Times*, and *USA Today* portray the pharmaceutical industry. Through my research, I sought to evaluate in an unbiased manner whether these articles were positive, negative, or neutral for the industry, and why they are deemed as such.

The project, led by Dr. George Sillup and Dr. Stephen Porth and in collaboration with SSP students, Caitlyn Landau '20 and Tyler Pham '20, requires teamwork to accurately summarize the data of which we are investigating. Before we began our research, the SJU Reference Librarian, Cynthia Slater, combed through research databases by using key words (ex. "High Drug Prices") to locate the most fitting articles for our project. She sent the selected articles to Dr. Porth, who then sent them to Tyler, our EthicsTrak™ Administrator, to distribute among Caitlin, himself, and I. Using a Microsoft Excel spreadsheet, I read, summarized, and analyzed my articles. I followed our team's standard process of reviewing each article. First, we would read the headline and determine if it was positive, negative, or neutral for the industry. The body of the article would then be analyzed separately and determined if it was positive, negative, or neutral. If there were any companies or products mentioned in the publication, we copied them in our spreadsheets to later look for trends among the articles. We also tracked any ethical issues to recognize the big pharma issues of the year. As another degree of research, we followed *Google Trends*, *NBC*, and *NPR* to broaden our data and compare trends.

As proved by our *Google Trends* statistics through 2018-2019, the issues of high drug prices and opioid addiction were frequently covered in the media. In the eyes of a pharmaceutical executive, articles from a prominent newspaper slandering high drug prices in the United States would be very negative for business. Although there are reasons for such high drug prices, the media sometimes portrays high drug prices as a one-sided, corrupt problem. The purpose of our research was to understand the impact an article like that can have.

I have gained so much knowledge through SSP. By keeping my mind active in the summer on the core of my major, I have established a much bigger passion for Pharmaceutical & Healthcare Marketing. The very broad variety of topics I have touched upon through my research has transformed me into a very open-minded student. I believe the toughest obstacle I had to overcome for this project was to believe in my own ability to make an informed decision. I am so grateful to have had this experience and I hope to continue to be a part of it.

What Media Says About the Pharmaceutical Industry: An Analysis

Caitlyn Landau, '20



Faculty Mentors: Stephen J. Porth and George P. Sillup
Departments of Management and Pharmaceutical & Healthcare Marketing

Sponsored by the SJU Summer Scholars Program

This year I was granted the opportunity to conduct research with the Summer Scholars Program (SSP) by investigating the portrayal of the Pharmaceutical Industry in the Media. The project, led by Dr. Sillup and Dr. Porth, and in collaboration with SSP peers, Tyler Pham '20 and Kerry Faust '22, was a great way to educate myself about the industry, as well as allow me to theorize my beliefs about the industry. Our research starts with SJU's Reference Librarian, Ms. Cynthia Slater, who sifts through research databases by keywords to identify articles for our project. The articles are then sent to Dr. Sillup, who sends them to Tyler, the EthicsTrak™ Administrator, who distributes the articles among himself, Kerry, and me. Our job is to analyze the top five newspapers in the United States- *New York Times*, *LA Times*, *Wall Street Journal*, *Washington Post*, and *USA Today*.

Our analysis is based upon a protocol that helps us determine whether a specific article and its headline portray the pharmaceutical industry as positive, negative, or neutral. The article is also analyzed for specific pharma companies and/or their products and whether the article identifies them. Tyler, Kerry, and I separate the articles into the categories of Big Pharma and Healthcare. The purpose of the analysis is to notice trends among the media coverage and recognize the big pharma issues of the year. We also look at *Google Trends*, *NBC*, and *NPR* to see how they portray the industry and compare it the other trends.

As this is my second year working on this research project, I can notice the changing topic trends regarding the articles. Together, we discuss how the focus of the articles has shifted and new subject matters. Last year, the US opioid crisis was the star of the show. While opioids are still mentioned in the articles, the focus has shifted to high drug prices, as well as some other search terms. It is important when we analyze these issues, that they are looked at through the lens of a pharmaceutical executive, to decide from the industry perspective.

Through the SSP, I have gained significant insight about hot topic issues and trends in the pharmaceutical and healthcare industry. This is important because, through the research, I have gained knowledge of the industry for which I plan to work upon graduation. The part two summers has taught me to open my mind to all sides of a topic and to make informed opinions about them. I know that what I have learned from this research project will be helpful with my future endeavors in the medical industry.

Portrayal of the Pharmaceutical Industry by Newspaper Coverage

Tyler Pham, '20



Faculty Mentors: Stephen J. Porth and George P. Sillup
Departments of Management and Pharmaceutical & Healthcare Marketing

Supported by the SJU Summer Scholars Program

When it comes to the media, the pharmaceutical industry is not always represented in a fair manner. The media has been known to advertise the pharmaceutical industry in a negative tone merely to make a profit rather than report the entire truth. As a result, businesses, potential investors, and consumers who read these publications, may fall victim to bias against these pharmaceutical companies which in turn would be unfair to the companies at hand. There may, of course, be some truth in the negative articles that must be reported; nevertheless, our focus consists of evaluating whether or not the positive information about the industry is also being reported.

For this project, we used an excel spreadsheet to classify, summarize, and review pre-selected articles from five different newspaper sources - *The Los Angeles Times*, *The New York Times*, *The Washington Post*, *USA Today*, and the *Wall Street Journal*. Reference Librarian, Cynthia Slater, searches through a database using keywords to find articles related to our research. These articles are then sent to Dr. Sillup to be formatted and Dr. Sillup sends the articles to me, the EthicsTrak database administrator. I am then responsible for distributing the articles evenly between my partners, Caitlyn Landeau, Kerry Faust, and I. Once we receive the articles, our job is to analyze the articles in numerous ways. First, we analyze the title/headline of the article and determine whether it is positive, negative, or neutral from the point of view of the pharmaceutical industry. While reading the article, we look for any pharmaceutical companies that are mentioned and/or any specific drugs mentioned. After reading the article, we determine whether the article itself was positive, negative, or neutral again from the point of view of the pharmaceutical industry. We also look for whether or not the article represented the pharmaceutical industry's perspective and look for any ethical issues that appear in the article. All of our findings are recorded into an excel spreadsheet that is then sent to Claudia to be entered into the database. This year we also implemented a new form of research consisting of recording the number of articles about the two most popular ethical issues, opioids and high drug prices within NBC Nightly News, NPR All Things Considered, and Google Trends. We did this to further validate that the issues appearing in newspapers are consistent with the issues being reported by other media outlets.

I have learned a lot through the Summer Scholar's Program. This year besides analyzing the articles, I was given the task to be the EthicsTrak database administrator, as well. This job consisted of not only distributing articles to my partners but also creating numerous tables and graphs that organize all of the information we have analyzed throughout the summer. I worked a lot with Microsoft Excel and Microsoft Access and was able to learn the ins and outs of each program. Similar to the past two years, throughout this summer I have learned so much about the industry and the way it is perceived through the media. Overall, the Summer Scholar's Program has been an amazing learning experience and I hope to continue to be involved in the program in the years to come.



Alexander J. Skolnick
Department of Psychology
Saint Joseph's University

Ph.D. University of Georgia

Research Interests: Emotion, Disgust, Gender and Emotion, Health Challenges & Stress

Life's path is often nonlinear. As a kid I loved learning about different animals and would go to the American Museum of Natural History, the Bronx Zoo, and Aquarium in New York City as often as I could. Then in college and graduate school I was drawn to the behavior of primates and studied orangutans in zoos, capuchins in group colonies, and rhesus monkeys on an island off Puerto Rico. My PhD focused on the biopsychology of social relationships in primates. Then life's twists and turns led me to focus my research on stress and emotions in humans! Who knew that humans were so interesting? My scientific path led me to specifically examine the emotion of disgust in all its icky glory. Since disgust is the only basic emotion that animals do not express, it might be an odd research choice for me. However, this pathway was possibly inevitable as I have come to discover (and research) the relationship between nature and disgust, as the two are intricately linked. What things gross people out the most? All the things found in nature: things that are rotten, decayed, slimy, squishy, moist, and things related to death, sex, food, animals, and yes, things that bodies produce (blood, mucus, poop). Therefore, disgust is the greatest emotion to study (if one is not too queasy)! Why do these things disgust humans? They can all be related to contagious agents in the environment and disgust might help keep us safe. I study this relationship and how and why men and women differ in their disgust. I am also fascinated by the ways that disgust influences people's lives, for example, affecting food choices, occupations, politics, or even moral decisions. Recently, we have focused our research on how one's disgust personality (being low or high in sensitivity to disgust) relates to being healthy.

This year two Summer Scholars students worked with me. Last year Emily Vance's project followed up on research from my Lab and examined whether a positive relationship exists between how easily disgusted someone might get and their anxious attitudes about their own health. Using two measures of health anxiety Emily showed a fairly robust positive correlation confirming a disgust-health relationship. This summer Emily followed-up last year's project to investigate the ways that people either high or low in health anxiety use different emotion regulation strategies and coping skills. Also, this summer Christina Nunno examined how people with chronic headaches use certain coping strategies to adjust to their situation and manage to go to school or work. Christina's project is ongoing in the fall given the difficulties of obtaining a large-enough sample of people with a specific type of headache diagnosis.

Strategies for Coping With Headaches and Migraines in the Workplace

Christina Nunno, '20



Faculty Mentor: Alexander J. Skolnick
Department of Psychology

Supported by the SJU Summer Scholars Program

98% of people have experienced a headache at some point during their lives; yet most of these headaches do not require medical attention. However, as many as 18% of women and 6% of men in the United States experience various forms of headache and migraine diagnoses. Many individuals within this population experience headaches at a chronic rate; meaning that they have a headache 15 days or more per month. Psychology and society are interested in this topic because of the potential familial, social and financial effects headaches can cause society. One study found that headache related absenteeism costs the US over 21 million dollars per year. Thus, we were curious to see how headache pain influences absenteeism and productivity in the general public. We also wanted to examine how certain coping strategies might influence such negative outcomes as being able to work or study, to address the kind of skill that might mediate how headaches impact society.

Based on this understanding, we proposed that individuals with a headache diagnosis will cope more with their headache pain compared to individuals in the general public. Coping styles, emotional reactions, days missed of work and activities, and the number of pain relievers taken were used as measures of how people cope. Coping efficiency was measured using the Brief Cope Scale; a shorter version of the Cope Scale which can identify 14 coping styles. We also found it important to understand the severity to which our participants were experiencing headaches. Information surrounding an individual's diagnosis was measured using the Headache Impact Test, the Headache Needs Assessment test, and the Brief Headache Screen. Specifically, we were interested in noting the individual's headache diagnosis and the number of severe headaches experienced compared to the number of days of work missed, the number of leisure activities missed, as well as the degree to which the individual felt his/her daily function was limited by the headaches. To recruit such a specific population (those with diagnosed headaches) I contacted various neurologists' offices as well as utilizing social media. Participants completed the survey with a paper copy if done in a doctor's office or online through Qualtrics if done through social media. Thus far, a total of 50 headache patients participated in the survey and 40 individuals without a headache diagnosis were used as a control group.

At this stage in our research we found a statistically significant correlation between whether an individual had a headache diagnosis and the number of days missed from work ($p=.04$). This finding may suggest that individuals with headaches experience their headaches to a degree that makes them unable to work or are significantly hindered by their headaches. We also found that when an individual engages in one positive coping method they tend to adopt other positive coping methods as opposed to negative coping methods. This rule also applies to negative coping methods. These results reveal a negative correlation between positive and negative coping methods.

These are the general findings of the first 90 respondents, although this research will continue into the Fall and Spring semesters, due to the difficulty of sampling diagnosed headache sufferers. With a larger number of participants, I hope to statistically explore the strengths and weaknesses of various coping strategies. Additionally, I hope to gain a greater number of headache patient participants as well as a larger number of participants with other chronic pain disorders for comparison.

The Relationship Between Disgust Sensitivity, Health Anxiety, Emotion Regulation Difficulties, and Coping Methods

Emily Vance, '20



Faculty Mentor: Alexander J. Skolnick
Department of Psychology

Supported by the SJU Summer Scholars Program

Disgust is a basic emotion that is characterized by a feeling of revulsion or disapproval that is aroused by something unpleasant and is characterized by disgust sensitivity (DS). This emotion may be related to other traits in individuals. One of these proposed traits is health anxiety (HA), which is characterized by a fear of contracting a serious disease or illness, with the absence of a professional diagnosis, and persistent worrying about one's health. Our previous research indicated that individuals high in DS are more likely to be high in HA. Given that DS and HA are both emotional experiences, we wanted to investigate how one may regulate emotions and cope with stressful experiences. Emotion regulation is conceptualized as the process by which individuals influence which emotions they experience, when they experience them, and how they experience and express them. Coping, which is defined as cognitive and behavioral efforts to manage a challenging person-environment relationship, is believed to have two main functions. The first function is to regulate distressing emotions and is known as emotion-focused coping. The second function is to tackle the problem that is causing the distress and change it for the better; this is known as problem-focused coping.

Regarding these characteristics and constructs, we predicted that a person high in DS or HA will have more emotion regulation difficulties because they may be more easily emotionally perturbed and have less control over their emotional experience. In that vein, we also predicted that individuals high in DS or HA would use cognitive reappraisal strategies less, and when imagining a stressful situation, would be more likely to cope using methods that mostly remove the person from the situation quickly.

We measured levels of DS, HA, emotion regulation difficulties, predominant emotion regulation strategies and coping processes in 113 participants recruited via social media. We found support for most of our hypotheses. Individuals that were high in either DS or HA had increased emotion regulation difficulties. Usage of cognitive reappraisal as an emotion regulation strategy was significantly negatively related to HA, such that health anxious individuals cognitively reappraise less. Interestingly, cognitive reappraisal was unrelated to DS. Regarding coping methods, individuals with high DS tended to use escape-avoidance and accepting responsibility coping processes. Individuals high in HA tended to use escape-avoidance and planful problem-solving coping processes. Remarkably, these traits did differ with respect to age (18-74 years old). Older participants had lower disgust sensitivity and health anxiety, and less emotion regulation difficulties. They were also more likely to use cognitive reappraisal as an emotion regulation strategy. Another interesting finding was that individuals with increased emotion regulation difficulties were significantly more likely to use expressive suppression, but less likely to use cognitive reappraisal to regulate their emotions.



Karen M. Snetselaar
Department of Biology
Saint Joseph's University

Ph.D. University of Georgia

Research Interests: Plant Biology, Plant Diseases

I am interested in plants and fungi, and especially in the interactions between these two groups of organisms. For many years the major focus of my lab has been a system involving corn (maize) and the plant pathogenic fungus *Ustilago maydis*. The disease caused by this fungus is known as corn smut, and it's generally known to people who grow corn all over the world. It has been fairly easy to breed smut-resistant corn plants, so our reasons for working on this fungus aren't so much about trying to stop this particular disease. Rather, we study corn smut because it is a very useful model system. Corn plants that are just a week old can be reliably inoculated with fungal cells that are easily grown in culture. We can study the progress of disease in many ways, using a variety of different kinds of microscopy. In addition, because the entire genome of *Ustilago maydis* has been sequenced, we have access to well-characterized mutants and other tools that can help us link form with function. One current project is characterizing mutants that can't begin the infection process properly.

Another area of research has involved experiments trying to figure out how the fungus overwinters in the soil, between times when the host plant is available. Students have carried out experiments to look at the survival of fungal cells in different types of soils, also varying temperature and moisture conditions.

As a broadly-trained botanist, I also have some more general interests in the distribution of plants and fungi. Lately this has taken the form of studying the distribution of plants and microbes on the green roof that was planted on top of the science center several years ago.

Graduate and undergraduate students are involved in all of these projects.

Growing Huitlacoche, the Maize Mushroom

Cordella-Jane Ingram-Noel, '20



Faculty Mentor: Karen M. Snetslaar
 Department of Biology

Supported by the SJU Summer Scholars Program



Huitlacoche, also known as corn smut, is a foreign food for most North Americans, but has been around since the pre-Columbian period in Central & South America and is a delicacy in Mexican cuisines. Huitlacoche consist of edible black galls, that replace the kernels in corn that are infected by a fungus called *Ustilago maydis*.

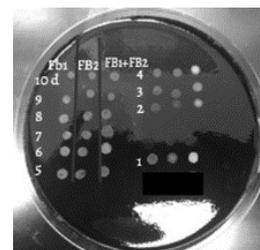
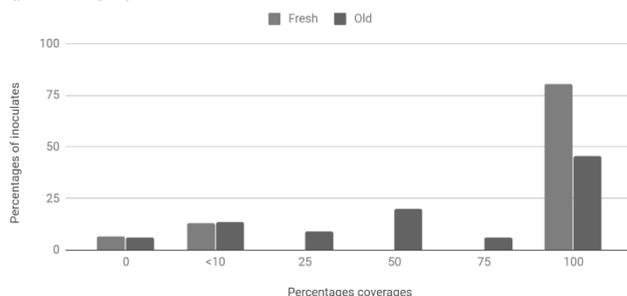
Ustilago maydis infects all parts of the plants, but infection in the ear is most desirable for huitlacoche. *Ustilago maydis* has an unusual life cycle (heterobasidiomycetes) and is dimorphic. *Ustilago maydis* has three distinct life stage, a non-infectious saprophytic stage, a parasitic dikaryotic stage and a diploid teliospore phase, which forms the galls.

Galls can be produced on ears using a lab technique called silk-channel inoculation. This technique calls for a suspension of compatible haploid strains into the silk-channels of the ears. These compatible haploid strains can be easily propagated in vitro. Previous summer scholars also showed that preventing pollination, also promotes better gall formation.

We partnered with Alewife Farms in Kingston, New York, to find a dependable and efficient method of producing huitlacoche in the field, thus making it practical to grow as an alternative crop. The main problem was determining how to store cultures before inoculation, since in lab trials cultures are used immediately after preparation. A preliminary test using a charcoal assay showed that although fresher cultures formed infection structures more quickly, cultures more than a week old still formed them eventually.

A field study using fresh cultures and cultures that stored before transportation to the field successfully induced galls in about 94% of all ears, although the stored cultures resulted in fewer ears with all kernels converted to galls. All the ears were sold to restaurants in the New York City area and were reported to highly valued by the chefs. I will continue to work with Alewife farms to collect more data, we plan on inoculating about 500 corn ears this season.

The Coverage of infection using Fresh inoculum and Older inoculum (percentages)



Investigating the Ability of *Ustilago maydis* to Enter the Roots of *Zea mays* and Provide Resistance From Future Infections

Teena Simon, '20



Faculty Mentor: Karen M. Snetselaar
Department of Biology

Supported by the Nicholas & Susan Nicolaides Research Fellowship and the SJU Summer Scholars Program

Ustilago maydis is fungal pathogen that can either hang out in the soil or infect *Zea mays*, corn plants, depending on what part of its life cycle it is in. In order for this fungus to infect corn plants, two compatible haploid cells have to come together and form an infection filament. Additionally, *U. maydis* is a model organism of fungi that are obligate parasites, which are parasites that need their hosts to survive. This is because most obligate parasites are difficult to study on their own without their host, but because *U. maydis* has a part of its life cycle when it lives as a haploid without a host, it can be studied.

It was previously observed that *U. maydis* might be able to enter the roots of *Z. mays* and possibly cause infections that may even have the potential of allowing it to form an “immunity” against future infections. Before this theory could even be tested, there had to be a method that allowed for *U. maydis* in the roots to be observed. The objective of this research was to develop effective methods for being able to observe the fungus in the roots of corn plants.

Z. mays plants are grown in an axenic condition, a sterile condition, in which the surface sterilized corn seeds are placed for two weeks in water agar before they are infected with the fungus. The seeds are surface sterilized to kill off any microorganisms that may be living on the surface of the seed and it is accomplished by using 50% bleach and 70% ethanol. By growing the plants in an axenic condition, it allows the conclusion that any fungus that is observed in the roots should be *U. maydis* since nothing else should have been able to get in.

Initially, a chlorazol black stain is used to label the fungus in the roots after the roots were initially cleared using a KOH procedure. As seen in figure 1, this procedure provided good results because it was able to successfully label the fungus. Next, a fluorescent labeling method was developed in order to visualize the fungus in the roots. Through trial and error, it was determined that the best approach to this was to clear the roots using the same KOH clearing protocol as before and staining it with calcofluor and wheat germ agglutinin (WGA) with .1 M tris buffer washes in between (Figure 2). Being able to identify the best protocol for detecting *U. maydis* can aid in further research into the pathogenicity of this model organism.

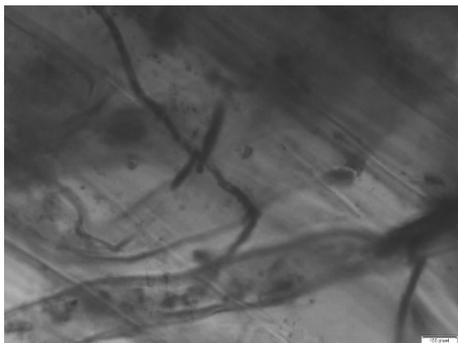


Figure 1 (Left): A micrograph of roots that were inoculated with compatible haploid *U. maydis* strains that are stained with chlorazol black.

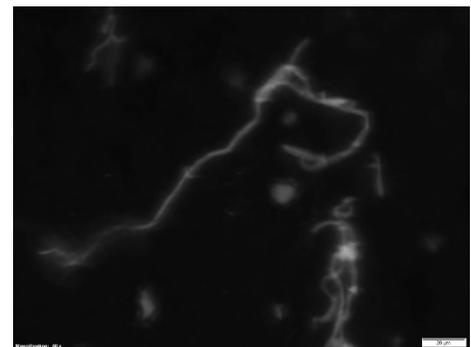


Figure 2 (Right): A micrograph of *Z. mays* roots that were inoculated with compatible haploid *U. maydis* strains that are stained with WGA and calcofluor.

The Infection Process of *Ustilago maydis* in Teosinte in Comparison to Infection Process in Maize

Sydney Taggart, '20



Faculty Mentor: Karen M. Snetselaar
Department of Biology

Supported by the SJU Summer Scholars Program

Ustilago maydis is a type of fungus, specifically a basidiomycete related to mushrooms. Unlike most basidiomycetes, the fungus exists as a saprophyte for part of its life cycle, meaning that we can easily grow it in liquid medium or on agar plates in the lab and, thus, control the timing of infection. For the other part of the *U. maydis* life cycle, the fungus exists as an obligate parasite within a host, specifically maize or teosinte. This means that the fungus must exist within the host plant in order to continue its life cycle and later produce more infectious spores. When the fungus infects a host, it induces a smut infection in that host. These smut infections typically produce dark, teliospore containing galls or tumors in the infected area in maize. Maize and teosinte, the wild ancestor of maize, are the primary hosts for the *U. maydis* fungus. Teosinte shares a common ancestor with maize and recently it is believed that the subspecies *parvilgumis* is the wild ancestor of maize. Teosinte and maize differ in their physical structures. Teosinte has smaller ears and consist of mostly lateral branching, while maize consists of one main stalk with fewer, but larger, ears.

Unlike teosinte, maize is a domesticated crop plant, meaning that the plant is completely dependent upon human beings for survival and reproduction. It is a common idea amongst researchers that domestication can select against certain defense mechanisms within the crop plant. This has been seen in beans, carrots, etc. The same could potentially be true for maize and the *U. maydis* fungus. Infection of teosinte by *U. maydis* has been reported, but not in detail. I aimed to first document the infection processes of *U. maydis* on teosinte (*Z. ssp parvilgumis*) seedlings leaves. Then, I compared this infection process to what is typically seen in maize to see if maize got more or less infected by the fungus. I did this by inoculating around a hundred teosinte and maize seedlings with the fungus. I also inoculated a hundred teosinte and maize control seedlings with sterile water to ensure that the symptoms observed were caused by the fungus and not the needle and syringe used to infect the seedlings.

The maize seedlings appeared to be more susceptible to the *U. maydis* fungus than the teosinte seedlings. The maize seedlings had a 49% infection rate, while the teosinte seedlings had a 17.5% infection rate. The teosinte seedlings, when infected, also did not develop teliospore-containing galls or tumors in contrast to the maize seedlings, which would often develop galls or tumors that ranged in size from 2 mm to the entirety of the infected leaf. This could potentially mean that the domestication of maize from teosinte could have caused the plant to become more susceptible to the *U. maydis* fungus. This means that there could have been some direct or indirect defense mechanism, selected against during the domestication process of maize, that allows the teosinte to be more immune than maize.



Jenny Spinner
Department of English
Saint Joseph's University

Ph.D. University of Connecticut

Research Interests: Women's Essays, Creative Nonfiction Pedagogy, Journalism, Writing Center Theory, Autism Spectrum Disorder and Writing

A couple of years ago, after mounting evidence that instructor course evaluations completed by students were influenced by gender and race bias, I began to question my own participation in a system that was stacked against women professors, and even more so, professors of color and those for whom English is not their first or home language. At Saint Joseph's University, as at many other institutions, the results of those evaluations are connected to tenure and promotion, and for adjunct and visiting faculty, overall employment status. They are not optional.

Two years ago, our Writing Center staff created a diversity training program that we implemented in our own Center as well as discussed with other writing center staffs and administrators at a national writing center conference. One of the main aims of our training was to underscore the value of writing center staffs examining bias in their centers from all angles and perspectives (often times, such trainings focus primarily on how tutors should handle bias in the student papers they review rather than ask staff members to examine their own personal biases or those systematic biases embedded in the structure of the writing center itself.) As part of that more global approach to inclusion and diversity in writing centers, and in light of the evidence regarding course evaluations, I began to wonder if the bias found in course evaluations would also be found in the anonymous peer tutor evaluations that writers complete at the end of each tutoring session in the Writing Center.

There are certainly many differences between a writing center versus a classroom: In a peer-based writing center such as the SJU Writing Center, students receive assistance from peers, not from instructors giving them grades. Tutors also assist not so much as experts, from a place of authority, but as fellow writers. We are a voluntary resource, not a requirement. Furthermore, the SJU Writing Center, like many writing centers, is already predominantly female. Finally, in line with the larger demographic of the St. Joe's student body, only a small percentage of our tutors are students of color. And yet, in Christina's analysis based on a sampling of nearly 2,000 peer tutor evaluations completed over the course of three years, there is evidence that gender and race bias do affect tutor evaluations. While the stakes are not as high--a tutor's employment status is not affected by these evaluations--it does now provide us with further opportunity for discussion about bias in the writing center and what we, as a writing center staff, can do to challenge bias on our campus. At our first staff meeting this fall, we looked at the results of this project, discussed actionable steps, and will be presenting our findings at a national writing center conference next spring as well.

Evaluating Gender and Race Bias in Peer-to-Peer Writing Center Feedback

Christina Photiades, '20



Faculty Mentor: Jenny Spinner
Department of English

Supported by the SJU Summer Scholars Program

A number of recent studies have shown that gender and race bias is common in student course evaluations of college professors. Specifically, these studies have shown that student evaluations of female professors differ notably from that of their male counterparts. Often times, female professors receive significantly lower ratings than their male peers, and the language used by students is focused on adjectives that describe the female teachers' personalities, rather than relating to their job performance (Schmidt, 2015).

Similarly, according to a study conducted at the University of Texas at Austin, researchers found that students with English as their first language give slightly lower ratings to non-native English speaking instructors (Hamermesh & Parker, 2005). A correlation between gender and language is also evident. Male non-native English speaking instructors receive slightly lower ratings than female non-native English speaking instructors (Huston, 2006).

My project set out to discover whether or not the same patterns that exist in teacher evaluations also exist in peer-to-peer evaluations of writing center tutors. I analyzed 1,990 student responses for 107 tutors from the SJU Writing Center. Over the three years of data I examined, I found a difference in the frequency and type of language used to describe female versus male tutors and white versus nonwhite tutors. For example, the ratio of comments about personality to ability for female tutors is far larger than the ratio of that for male tutors. Female tutors are more likely to be described by their peers as being "helpful" and "nice" whereas male tutors are more frequently described as "knowledgeable" and "professional." More than half of the comments about nonwhite tutors were based on their personality. Like female tutors, they were most frequently described as being "helpful" or a "great person."

These findings will be the basis of a presentation at a national writing center conference where tutors and administrators will be asked to consider the ways in which gender and race bias are present in their centers. The goal is to determine what can be done to counter bias, to educate staff members and writers about these biases, and ultimately to make the writing center a more inclusive space for staff members and writers alike.



Clint J. Springer
Department of Biology
Saint Joseph's University

Ph.D. West Virginia University

Research Interests: Biological Effects of Global Climate Change on Plants; Urban Agriculture; Science Education

Atmospheric carbon dioxide concentrations ($[CO_2]$) are rising at an alarming rate due to fossil fuel combustion and changes in land-use such as deforestation. Most of the attention surrounding changes in $[CO_2]$ focuses on the indirect effects that this greenhouse gas has on global temperature, however atmospheric CO_2 is also a primary substrate of photosynthesis. Therefore, changes in $[CO_2]$ have profound effects on plant physiological functioning. Research in my lab examines plant responses to changes in $[CO_2]$ and other global change phenomenon such as global temperature and water availability and the mechanisms through which these responses occur. I am especially interested in the response of plant traits that are relevant to plant evolution such as flowering time and reproduction.

Recently, I reviewed the effects of elevated $[CO_2]$ on plant flowering time and found that like changing global temperatures, rising atmospheric CO_2 will likely dramatically change the flowering time of both native and crop species in the future. Therefore, a major area of my research is aimed at elucidating the molecular mechanisms that account for these elevated $[CO_2]$ -induced changes in flowering time. To accomplish this goal I make use of the powerful model plant species *Arabidopsis thaliana*. These experiments use techniques based in traditional plant physiology, molecular genetics, and functional genomics.

An Evaluation of Sustainability on Campus at Saint Joseph's University From a Jesuit Perspective

Alyssa Matanin, '20



Faculty Mentor: Clint J. Springer
Department of Biology

Supported by the Nicholas & Susan Nicolaides Research Fellowship and the SJU Summer Scholars Program

In 2015, Pope Francis released his encyclical *Laudato Si' On Care For Our Common Home* which focused on the major impacts that global climate change will have on humanity, and serves as a call for climate action to all who follow Catholic teachings.

Multiple Jesuit universities, based on previous insight or in response to the Pope's encyclical, have implemented measures to do their part institutionally to lessen their impact on the planet and those most immediately affected by climate change. Universities are moving towards a more sustainable future by making changes both large and small, like using renewables, building sustainably, or teaching about the importance of sustainability in a way that reaches the whole student body.

Thus far, Saint Joseph's University has made some strides in promoting and creating a more sustainable campus. The focus of this research was to highlight what Saint Joseph's University is currently doing to promote sustainability and provide options for how SJU can move forward and improve. This analysis was done by splitting campus sustainability, a broad term, into five sections- Energy Use and Efficiency, Water Use and Efficiency, Sourcing and Recycling, Campus Design and Facilities, and Education. Within these parameters, Catholic social teachings and the jesuit mission are aligned with a call for increased sustainability and awareness, highlighting the impact that individual actions can have on valuing human life and dignity, standing with others in solidarity, caring for the poor and vulnerable, and respecting God's creations. Based on what the institution promotes and how climate change can affect those who we are called to serve, there is a clear connection between how the university presents itself and how it should respond in regard to this very important call.

A comparative analysis is also used to help benchmark where SJU stands compared to other universities. Several jesuit universities are assessed, including Georgetown, Fairfield, and Villanova, along with the four jesuit universities with endowments just above or just below SJU's. These evaluations were done based on the five sections listed earlier and can be used to show what could be done, how it could be done, and to serve as a reminder that many other schools are taking great steps to improve campus-wide and global sustainability.

The results of this project suggest that while Saint Joseph's University has some initiatives moving in the right direction to improve sustainability, like the community garden, green roofs, solar panels, or energy efficient lighting, heating and cooling systems, there are still improvements that can and should be made based not only on what other universities are doing, but more so on the basic identity and mission that the university promotes, which is a life built of serving others. In building a more sustainable campus, the university is fulfilling its own mission by "*Thinking critically, making ethical decisions, pursuing social justice, and finding God in all things*" in the pursuit of climate action.



A. J. Stagliano
Department of Accounting
Saint Joseph's University

Ph.D. University of Illinois

Research Interests: Social Accounting and Accountability, Sustainability Accounting, Disclosures of Environmental Costs and Liabilities

Climate change, mainly created by human activities, is much more than the “inconvenience” noted by former U.S. Vice-President Al Gore. The phenomenon may have as large a financial impact on the *next* generation as the huge run-up in energy and healthcare costs has had for the current one. This, along with other corporate social responsibility and environmental disclosure issues, has been the focus for much of my empirical research effort during the past 35 years.

While most work by professional accountants and auditors appears to be rather mundane, adjusting to the changing needs of financial and economic data users is a vibrant and dynamic activity. Owners of scarce financial resources want to be informed as decision makers with respect to the actual and expected outcomes of their investment choices. Whether it is in a private company, like GE, a non-profit entity, like the United Way, or a government unit, like the State of New Jersey, financial statement users want full, fair, transparent disclosure regarding all the effects of operations. The future of financial reckoning may well be *accountability*, not mere accounting, not just counting! Members of society at all levels want to know the social and environmental impacts of delivering goods and services. Consumers want to know more about products than availability and price; they want to know the lasting impact of choosing to buy and consume. Investors demand more than just profit measurements; they want and need to understand the societal effects of the production activities sponsored by their commitment of capital to the business firm. Contributors to non-profits and taxpayers supporting government units likewise require more than just numbers; they want information about impact.

Accounting for the risk of climate change, the cost of alternative energy generation, the impact on society of pollution and environmental despoliation is the wave of the future. Research we do today on measuring and reporting in these areas will help us design better decision-making models and assist us in making future financial decisions that take into account people and the planet along with profit. What will it cost if the sea's level increases by a foot or two? Measuring that might help us decide what to pay to prevent such an occurrence.



Retail Cybercrime Disclosures by U.S. SEC Registrants, Healthcare Sustainability, and Commercial Bank Reporting by North American Industry Classification System (NAICS) Registered Enterprises

Natalie Kautz, '21

William Legg, '20

Lisa McKeon, '21



Faculty Mentor: A. J. Stagliano
Department of Accounting

Supported by the SJU Summer Scholars Program

Although technology has made information on various businesses more accessible, a new problem is presented- the lack of transparency and correct information being set forth by businesses about themselves. This lack of transparency and purposefully skewed information is harmful to investors, the general public, and the environment of U.S. business ethics. This sort of misrepresentation of information is harmful to U.S. business ethics laws and regulations, and is negatively shaping what is and is not considered the reporting of “real” information. We worked together as a group to further examine and report our findings of corporate misrepresentation by various enterprises.

Our first project focused on cybercrime disclosures, both in retail and healthcare realms. We examined if and how cyber-attacks were disclosed. We found that a majority of the firms did not mention any cyber-attacks or cybersecurity breaches, except for a blanket disclosure statement that relinquishes responsibility for these incidents due to IT systems’ inherent vulnerability to electronic break-ins. In addition to cybercrime, we also sought to find disclosures on greenhouse gas and carbon emissions, as their effects link to climate change. We found, disturbingly so, that sustainability reporting is not required by the SEC, and therefore a very small percentage of companies make any mention of such. As with the security of their IT systems infrastructure, it is of ethical questioning that sustainability reporting is not mandatory for businesses. Our findings gave us insight into U.S. business ethics and how specific information can simply be omitted from deliverance to the public, yet still be classified as “correct” reporting. This raises questions as to what is and is not ethical reporting.

The second project looked to the commercial banking field, and we examined what information they were willing to disclose and how much of it was made public. We continued our analysis of the disclosures of cybercrime and sustainability reporting and brought them to light within commercial banks.

After having conducted these projects, we continued to research companies’ willingness to disclose and the effects it has on the U.S. business ethics environment. Correct, accurate, and enough information is crucial to not only investors and the general public, but also to preserving the ethics of business in the U.S. Upholding the standards of U.S. business ethics laws and regulations is crucial to maintaining an environment that is fair.



Eileen Sullivan

Department of Interdisciplinary Health Services
Saint Joseph's University

Pharm.D. Shenandoah University School of Pharmacy

Research Interest: Studying the Use of Non-Pharmacologic Activities to Enhance the Quality of Life in Patients with Alzheimer's Disease and Dementia

Dr. Sullivan is a registered pharmacist in the states of NJ and PA and has worked continuously in Retail Pharmacy, Hospital Pharmacy, Pharmaceutical Industry and Long-Term Care. Her Pharm.D. Clinical rotations included Drug Information (Janssen Pharmaceutia), Acute Care (St. Mary's Medical Center), and Ambulatory Care (St. Mary's Medical Center). Dr. Sullivan worked for the UMDNJ system (University of Medicine and Dentistry) before transitioning into the role as a Principal Research Pharmacist for The R.W. Johnson Pharmaceutical Research Institute from 1998-2001 a division of Johnson & Johnson. The R.W. Johnson Pharmaceutical Research Institute conducts research and development in a variety of therapeutic areas for the Johnson & Johnson family of companies.

Dr. Sullivan continued her career within the Pharmaceutical Industry within Drug Information and possesses extensive professional experience within Scientific Affairs, Medical Communications and Medical Affairs from various subsidiaries of Johnson & Johnson. She has held various positions within Johnson & Johnson including but not limited to Associate Director, Medical Education Manager, and Scientific Affairs Associate. Dr. Sullivan's primary area of concentration was Neurology and Mental Illness.

Together for West Philadelphia Community Narrative

Sydney Bennett, '21

Edna Bonsu, '21



Faculty Mentor: Eileen Sullivan
Department of Interdisciplinary Health Services

Supported by the SJU Summer Scholars Program

Students from various universities within the surrounding West Philadelphia region were involved in community service while also generating an extensive literature review on the history and socioeconomic development of West Philadelphia. The West Philadelphia Community Description describes the geographic, physical space, and community assets of the five zip codes (19131, 19104, 19139, 19151, 19143) in the West Philadelphia area. Each student involved in the research program was assigned a specific community immersion site in one of the five zip codes. Through the community immersion and research done, a narrative of West Philadelphia was written. The narrative captures the historical context, cultural characteristics, values, perspectives, and social behaviors of the residents of the West Philadelphia neighborhoods. The objective of this narrative is to be a resource for future health care providers, services, and research projects in West Philadelphia. The two community immersion sites where our study was conducted were the Anti-Drug and Alcohol Crusaders Program by Sydney Bennett and Bartram Gardens-Sankofa Farms by Edna Bonsu.

Anti-Drug & Alcohol Crusaders is an educational/recreation program that focuses on alcohol, tobacco, and drug awareness, career readiness, social-emotional support, and community resources. Through writing, theatre, and art workshops ADAC provides a safe space and alternatives for children who experience everyday traumas and emotional and behavioral issues. The mission is to support the youth and their families physically, emotionally, and socially by supporting growth and resilience through team building and leadership focused activities. During the six-week summer camp, I worked alongside three youth workers, two senior workers, and a Drexel alumna who I partnered with to create two curriculums for students ages 5-15. After hosting a community discussion with the parents of the ADAC campers, I was able to generate an unbiased write-up from the perspective of the residents in the 19139-area using both the qualitative data from the ADAC camp and the locals.

Bartram's Gardens is a 45-acre area historical landmark owned by the John Bartram's association which seeks to connect those in the community by their love for gardening and agriculture. Bartram Gardens has a community garden where residents in the area own personalized garden beds which they can use to plant their own flowers, fruits and vegetables. The Bartram Gardens estate is also home to Sankofa farms, my specific community immersion site for the summer. The Sankofa community farm is a 4-acre farm that produces thousands of pounds of fruits and vegetables a year. Alongside staff and the farm director, I worked as a supervisor and helped in the building and running of the farm with 20 paid students. These high school students worked on the farm over the course of the summer, where they were immersed into the rich African farming culture and taught about plants, fruits and vegetables through a series of activities.

After 6 weeks of immersion in these community programs and researching the history of the specific zip codes that make up West Philadelphia, our work was published in the Together for West Philadelphia Community Narrative.



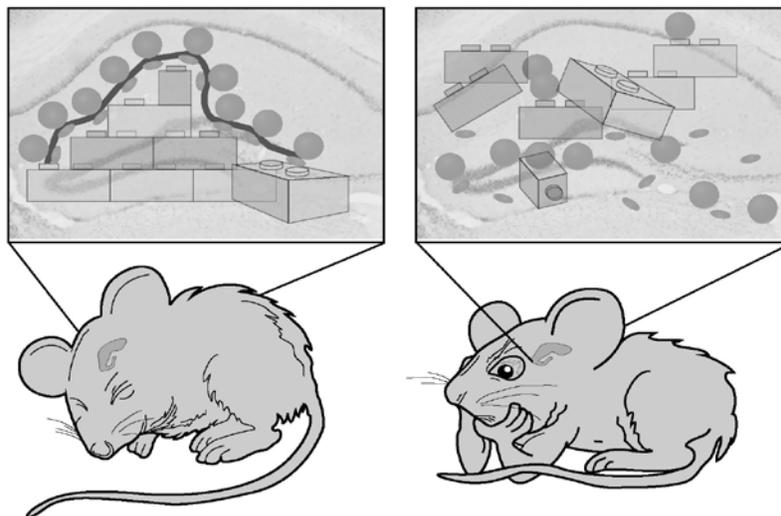
Jennifer C. Tudor
Department of Biology
Saint Joseph's University

Ph.D. New York University

Research Interests: Molecular Mechanisms of Memory, Neurodevelopmental and Neurodegenerative Disorders, and Sleep

Sleep deprivation is a public health crisis with more than a third of American adults not receiving enough sleep. Even short periods of sleep deprivation are detrimental to cognition. More specifically, lack of adequate sleep can affect attention, mood, judgement, and memory. I have previously described that sleep deprivation impairs memory by attenuating the production of proteins in the brain required for memory formation. This is due to reduced activity in the insulin signaling pathway in a region of the brain called the hippocampus, which is particularly important for memory. My students and I are investigating how this signaling pathway affects memory formation and the role of sleep in memory.

The insulin signaling pathway has also been implicated in several neurodevelopmental and neurodegenerative disorders, such as autism and Alzheimer's disease. My lab is focused on understanding how changes in the insulin signaling pathway in the brain cause the behavioral deficits associated with these disorders. Interestingly, problems with sleep have also been associated with many neurodegenerative diseases. Therefore, we are interested in examining the interrelationship between the behavioral and cognitive deficits associated with these disorders and sleep dysfunction.



Sleep deprivation impairs the production of proteins required for memory formation.

Phosphorylation of 4EBP2 Affects Memory Formation

Natalie Burkert, '21

Faculty Mentor: Jennifer C. Tudor
Department of Biology



Supported by the Nicholas & Susan Nicolaides Research Fellowship and the SJU Summer Scholars Program

Sleep is important for memory formation. Neural connections are strengthened during sleep which contributes to the production of new memories. As sleep deprivation becomes more common in society, it is important to identify how sleep facilitates memory formation and how to prevent these memory deficits caused by sleep deprivation. Research done previously by Dr. Tudor and colleagues has shown that sleep deprivation impacts the insulin signaling pathway, or AMPK-mTOR-4EBP2 pathway, in the hippocampus of mice. The AMPK-mTOR-4EBP2 signal transduction pathway regulates protein synthesis required for memory formation. In the hippocampus, sleep deprivation causes a decrease in phosphorylation of 4EBP2 leading to impaired protein synthesis. Thus, sleep deprivation causes less protein synthesis to occur and inhibits memory formation in the hippocampus. Previous research has shown that viral expression of 4EBP2 in the mouse hippocampus can prevent these deficits.

My project examined whether phosphorylation of 4EBP2 is required to prevent these deficits using mutant versions of 4EBP2 virally expressed in the hippocampus of mice. Two versions of adeno-associated viruses, phospho-defective 4EBP2 (PD4EBP2) and phospho-mimetic 4EBP2 (M4EBP2), that led to the expression of mutant 4EBP2 were previously developed. We hypothesized that PD4EBP2 should impair protein synthesis and memory, while M4EBP2 should enhance protein synthesis and memory. The eGFP virus was used as a control in this experiment, so that all mice went through the experience of stereotactic surgery. Viral expression of these mutant versions of 4EBP2 may be able to show the importance of the phosphorylation of 4EBP2 in the memory formation pathway and potentially prevent the effects of sleep deprivation on memory formation.

I injected the designated virus, eGFP, PD4EBP2, or M4EBP2, directly into the mouse hippocampus via stereotactic surgery. This surgery allowed the virus to reach their targeted excitatory neurons in the hippocampus. After injection, the mouse was allowed to recover from surgery. The virus took three weeks to express the protein of interest. After waiting those three weeks, the recovered mouse went through the zero maze. The zero maze was used to measure anxiety and to ensure that viral injection was not a confounding variable in our experiment. We examined the percentage of time spent in closed quadrants of the maze compared to the percentage of time spent in open quadrants of the maze. More time spent in the closed quadrants would show a higher level of anxiety for the mouse. We found no significant difference between control and experimental mice time spent in open quadrants, and thus no difference in anxiety between groups. The next day, the mice were sleep deprived for five hours and then sacrificed. We collected the mice prefrontal cortex, hippocampus, and cerebellum. This summer has allowed us to create an n of 7 for each group. The tissue is now being analyzed to determine whether phosphorylation of 4EBP2 is critical to memory deficits caused by sleep deprivation. This fall, I will continue to work on this project.

The Effect of Sleep Deprivation on Stress Granules in *Caenorhabditis elegans*

Lynly Carman, '21



Faculty Mentor: Jennifer C. Tudor

Department of Biology

Supported by the SJU Summer Scholars Program

In many organisms, sleep is a crucial function that plays a key role in numerous physiological functions. In mice, sleep deprivation has been shown to decrease protein synthesis and cause poor performance in memory tasks. One mediator of protein synthesis often looked at in research is the mammalian target of rapamycin (mTOR) and its non-mammalian orthologue target of rapamycin (TOR). The mTOR pathway has been found to be suppressed in mice after sleep deprivation.

Stress granules are aggregations in the cytosol made up of messenger ribonucleoprotein. Stress granules are aptly named for the fact that their formation is typically related to the cell experiencing stresses, such as heat and cold shocks. In previous studies, cells *in vitro* have been used to show that suppression of the TOR/mTOR pathway has an association with increased formation of stress granules. This coupled with the relationship between the TOR/mTOR pathway and sleep deprivation suggests that there may be a connection between sleep deprivation and stress granule formation.

The purpose of this project is to analyze the impact of sleep deprivation on stress granule formation using the transparent and genetically tractable *C. elegans* nematode. It is believed that depriving *C. elegans* of their developmentally-timed sleep, also known as lethargus, will show a significant increase in stress granule formation. This is tested by measuring the amounts of stress granules formed in a genetically sleep-deprived strain, a genetically sleep-enhanced strain, and a non-sleep-deprived wildtype strain. Through confocal microscopy, they are imaged before, during, and after lethargus. The processed images are used to compare the amounts of stress granules in the genetically sleep-deprived and genetically sleep-enhanced strains with those in the wildtype strain.

The Effects of Sleep Deprivation on TOR and AMPK Activity in *Caenorhabditis elegans*

AnnaMarie Glaser, '20



Faculty Mentor: Jennifer C. Tudor
Department of Biology

Supported by the John P. McNulty Scholars Program and the SJU Summer Scholars Program

Sleep is a necessary function that has been conserved across a wide variety of organisms. Sleep deprivation has been linked to impaired memory across species, but the function of sleep remains mysterious to researchers today. *Caenorhabditis elegans* are useful model animals of sleep. We are able to control and track their genes, and observe developmental changes due to their transparent bodies. They also have predictable sleeping patterns, which makes sleep studies easy to conduct.

C. elegans undergo two different types of sleep. The first type is developmentally timed sleep, also called lethargus. The other type is called stress-induced sleep, which occurs after an environmental stressor, such as heat shock. It is thought that the purpose of this type of sleep is to promote the maintenance of balance in a cell to keep it healthy and fully functioning. Cellular pathways involving cell reproduction, metabolic activity, and protein synthesis are also affected during sleep. Stress-induced sleep is controlled by the ALA neuron in *C. elegans*. Upon environmental stress, epidermal growth factors are released from tissues, bind to receptors on the ALA neuron, and release neuropeptides which lead to sleeping behavior. Utilizing *C. elegans* allow us to explore the hypothesis that sleep is critical for cellular signaling. This cellular signaling contributes to the restoration of cellular function during sleep.

The target of rapamycin (TOR) pathway is critical to translation, the production of proteins from RNA. TOR is also essential for growth and reproduction. It acts as a nutrient sensor and responds to the availability of amino acids as well as growth factors, mediating metabolic response. AMPK can affect TOR activity; when activated, it will inhibit the activity of TOR. It has been found that AMPK levels are increased and mammalian TOR levels are decreased following sleep deprivation in mice, and it is hypothesized that the same would be found in *C. elegans*.

The purpose of this project is to find how AMPK and TOR levels are influenced by stress-induced sleep following heat shock. Two different strains of worms were compared: a wild-type control that underwent normal sleep, and a genetically sleep-deprived strain. The genetically sleep-deprived strain have a non-functional ALA neuron and so are unable to undergo stress-induced sleep specifically. Worms were first grown to first day adults to ensure all were the same age. Next, they underwent a 30-minute heat-shock at 37°C as an environmental stressor. The worms were then collected for biochemical analysis to determine AMPK and TOR levels. I will be continuing these studies in the upcoming academic year.

Dorsomorphin May Rescue the Effects of Sleep Deprivation on Memory

Maria Johnson, '21



Faculty Mentor: Jennifer C. Tudor
Department of Biology

Supported by the John P. McNulty Scholars Program and the SJU Summer Scholars Program

Sleep deprivation causes many detrimental health effects and contributes to memory impairment. Memory formation is reliant on protein synthesis, and sleep deprivation impairs this process. Adenosine monophosphate-activated protein kinase (AMPK) is a protein which increases in activity during sleep deprivation. This increase results in the biological changes and cause memory impairment.

The objective of this project is to determine if the drug dorsomorphin can prevent impaired memory caused by sleep deprivation levels in a mouse model. Dorsomorphin is a selective AMPK inhibitor and should prevent the rise of AMPK activity that occurs during sleep deprivation. It is hypothesized that dorsomorphin would then prevent impaired protein synthesis and memory would be intact, even after sleep deprivation. To test this, mice will be treated with dorsomorphin or saline control. Mice will be trained in an object place recognition memory task. For the task, the mice undergo three training periods in which they are placed into a box with three objects and are allowed explore their placement. After training, they will be either sleep deprived or allowed to sleep during the period that protein synthesis is required for memory formation. The next day, the long-term memory of mice will be tested in the object place recognition memory task. For the test, one object is moved into a different position and the mice are allowed to explore the box again (Figure 1). If the mice learned and remember the original placement of the objects, it is expected that they will explore the moved object more than the others. To determine this, the mice are filmed, and the percentage of time spent exploring the moved object versus the total time spent exploring all objects is calculated. If dorsomorphin works as predicted, the mice that received dorsomorphin but were sleep deprived should have a percentage of time spent exploring the moved object similar to mice which have not been sleep deprived. I will continue working on this project during the coming academic year.



Figure 1. Mouse explores the box of three objects during training and testing, after 24 hours. Yellow square represents moved object.

Sleep Enhancement May Not Increase Protein Synthesis in Mouse Brain

Gianna Penezic, '21



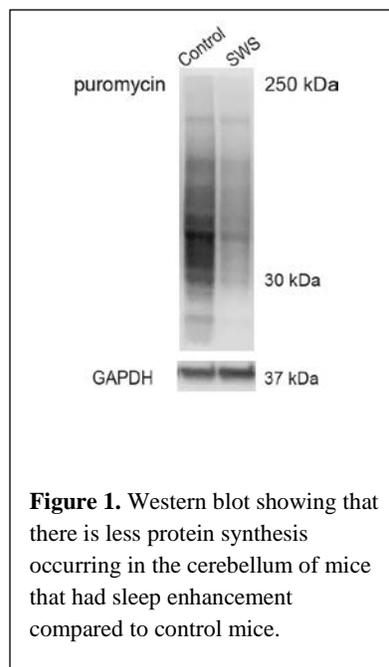
Faculty Mentor: Jennifer C. Tudor
Department of Biology

Supported by the John P. McNulty Scholars Program and the SJU Summer Scholars Program

Sleep is essential for an individual to be healthy and to survive. Lack of sleep impairs cognition and memory in an individual. Memory formation requires protein synthesis in the brain. My project this summer focused on examining if mice that had more sleep showed more protein synthesis in the brain.

Sleep enhancement in mice must be done pharmacogenetically, which is inducing sleep through the injection of a virus. The mice in this experiment underwent three injections. The first was an adeno-associated virus (AAV) injection in the brain stem that expressed a receptor in a particular neuron. The second was an intraperitoneal clozapine n-oxide ligand (CNO) injection that recognized these AAV injection receptors and bound to them. This binding activates GABAergic neurons in the parafacial zone of the brain, which induces slow wave sleep (SWS). This sleep is thought to be important for memory formation. We then used a technique called ribopuromylation, which uses an injection of puromycin to label newly made proteins during protein synthesis. Three different brain regions were collected from the mice: the cerebellum, frontal cortex, and the hippocampus, a brain region highly important in regard to memory. These injections and dissections were performed by Dr. Christelle Anacleit's laboratory at the University of Massachusetts Medical School, who then sent me the collected tissues to analyze them through Western Blot analysis.

In each brain region I examined, the enhanced SWS mice exhibited less protein synthesis than the control mice, as shown (**Figure 1**). Although this is not what was hypothesized, more trials must be conducted before conclusions are drawn, due to the limited sample set available.



Sleep is Enhanced in Old Mice That Express Calcium/Calmodulin Protein Kinase IV

Erin Threlfall, '20



Faculty Mentor: Jennifer C. Tudor
Department of Biology

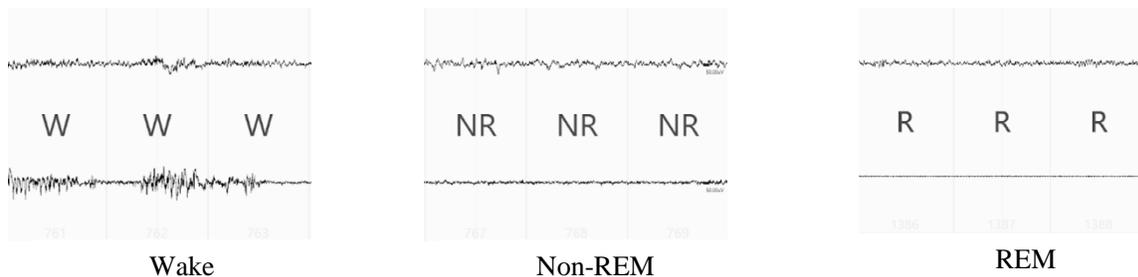
Supported by the SJU Summer Scholars Program

Sleep is a vital part of behavior that is important for many biological processes. Aging is commonly associated with the disruption of sleep, specifically the circadian rhythm, which is responsible for allowing wakefulness during the day and sleepiness at night. Sleep is also critical for memory, so the disruption of sleep can lead to memory deficits. The following sleep/wake states were studied: non-rapid eye movement (non-REM), rapid eye movement (REM), and wake.

The calcium/calmodulin protein kinase IV (CaMKIV) signaling cascade plays a key role in the formation of memories. In aging individuals, this protein is downregulated, thus causing memory deficits. Cyclic-AMP response element binding protein (CREB) is a downstream target of CaMKIV and has been attributed to memory formation and circadian rhythms. A previous study demonstrated that the upregulation of CaMKIV was able to rescue memory and restore CaMKIV levels in the brain. The hypothesis of this experiment is that the upregulation of CaMKIV may also help to normalize disrupted sleep/wake cycles of aging mice.

This experiment examined electroencephalogram (EEG) recordings, which measures brain waves and electromyography (EMG) recordings, which measures muscle activity. Recordings were taken over a 24-hour period in old mice. Transgenic overexpressed CaMKIV mice and wildtype control mice were studied. The recordings were scored using a program called SleepSign and were scored on the basis of sleep/wake states (see below). After scoring, the percentages of total time spent in each state were totaled, compared, and then interpreted. We found that CaMKIV mice were awake for a significantly less time compared to the controls. In turn, it was found that the CaMKIV mice had a significantly more non-REM sleep compared to the controls. There was no significant difference in REM sleep between the groups of mice.

Future work will be focused on analyzing additional recordings. It will be interesting to investigate whether CaMKIV mice respond differently to sleep deprivation compared to the control mice, as well as how they are able to recover differently.





Jill Amitrani Welsh
Faith-Justice Institute
Saint Joseph's University

M.S.W. Temple University

Research Interests: Poverty; Education Inequality; Racial Justice

It was my pleasure to work with Refatun Momo on her research exploring education inequality. Refatun chose to structure her Summer Scholars work in a way that explored the macro level root causes of education inequality while assessing how community partner agencies can provide an equitable alternatives for students from under-resourced areas. Her reseach was motivated by her own educational expeirence in the Philadelphia public school ystem as well as the mission-driven education she has received at Saint Joseph's University.

My own Jesuit education lead to a personal and professional commitment to social justice with a particular interest in issues related to poverty, education and diversity and inclusion. During my year of service with the Jesuit Volunteer Corps, I worked with first generation college students, many of whom were children of immigrants and/or lived at or below the poverty line. Here at Saint Joseph's University, I have had the privilege of working in the Faith-Justice Institute for the past 16 years. I have also had the opportunity to teach the *Poverty, Ethics and Social Policy* course as an adjunct faculty member and *Social Justice, Ethics and Society* course through the Ignatian College Connection Summer Enrichment Program. While I was a graduate student at Temple University, I worked on two community-based research projects that used photovoice as the primary methodolgy to explore how African American youth in Philadelphia viewed gun violence in their community. All of these experiences affirmed the same lesson: the voice of those experiencing the injustice is vital in how we shape our response.

When Refatun first met with me to discuss the possiblity of Summer Scholar research, two things were very evident: 1. she was passionate about education equality; 2. she wanted her work to be of benefit to high school students in Philadelphia. Refatun took this passion and knowledge from her reseach to assist with a city-wide data base of community partner organizations through a partnership with After School Activities Partnerships and the City of Philadelphia. It was my honor to work with such a thoughtful and driven student.

Is Education a Right or a Privilege: A Micro and Macro Level Analysis of Education Inequality in Philadelphia and the Role of Community Partner Organizations

Refatun Momo, '20



Faculty Mentor: Jill Amitrani Welsh
Faith Justice Institute

Supported by the SJU Summer Scholars Program

My summer's scholar research focused on education inequality, the role community partner organizations can have in providing supplemental experiences and education for students, and an exploration of signature programs. My project also included work on a directory of resources for students in Philadelphia. I volunteered with a partnership between the City of Philadelphia and the After Schools Activities Partnership to help update and maintain a city-wide resource guide. Much of my research focused on the impact redlining has had throughout history on poverty and the quality of education in those particular neighborhoods.

As a former student from a neighborhood school in Philadelphia, I experienced a lack of resources such as funding, experienced teachers, a shortage of staff, college programs and resources in the community. When I visited a couple other magnet schools in Philadelphia I saw the difference. Then, I began to wonder. What makes the schools so different? Why is there education inequality and what factors play roles into it?

Most of the extracurricular activities offered at my high school were focused on the high achieving students. The guidance counselors were the ones to share these opportunities with the high achieving students, but the opportunities were not shared with the students in general. In addition, the school staff tended to be more focused on the students that are high achieving, leaving the students that need help behind. Having a lack of staff and inexperienced teachers did not help the students who were struggling. Many students would slowly lose interest in school and exhibit problematic behavior in class.

Extracurricular activities can help students to explore different careers paths and discover themselves in new ways. Opportunities can be offered to students through a community partner organization that their school or neighborhood cannot provide. Personally, I think opportunities where students from the nearby neighborhoods come together and join in activities at community partner organizations could benefit the overall student and help respond to education inequality. My goals for my Summer Scholar work are to provide an awareness around education inequality and to support local Philadelphia students with a resource of community partner organizations. Community partner organizations can provide students with educational, personal and social opportunities that can support their growth and long-term well-being.

