



**Twenty-Fifth Annual Symposium  
of the  
Dr. Charles S. Weiss  
Summer Research Program**

September 7, 2018  
Hogan Ballroom

*Dear Members of the Holy Cross Community,*

*Welcome to the 2018 Dr. Charles S. Weiss Summer Research Symposium. Now in its 25<sup>th</sup> year, the symposium is a college-wide event that brings together faculty and students from all disciplines at Holy Cross and provides an opportunity to celebrate their accomplishments over the summer of 2018. It also affords an occasion for students to witness the breadth of research possibilities both on and off campus, and to open a dialogue with members of the faculty about conducting research during the upcoming academic year and summer. We hope you enjoy the impressive collection of scholarship on display today.*

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- 115.** Revising the Preoperative Protocol in Arthroplasty Patients to Better Benefit Postoperative Recovery. E. Keleher, J. M. Drew, and A. Abdeen. Beth Israel Deaconess Medical Center
- 116.** Examining Female Selfhood and the Struggle for Independence Through Fiction in the Eighteenth and Nineteenth Century. S. Underhill and S. Maurer. Department of English College of the Holy Cross
- S1.** Characterizing the *Enkurin* Gene's Role in Male Fertility in *Drosophila melanogaster*. F. Busser, R. Snow, H. Florman, and G. D. Findlay. Department of Biology, College of the Holy Cross and Department of Cell and Developmental Biology, University of Massachusetts Medical School
- S2.** "You Knew Him Well": Gendered Epistolary Patterns in Conrad's Letters and Their Effect on *Heart of Darkness*. A. Grey and P. Reynolds. Department of English, College of the Holy Cross
- S3.** What Do Graffiti Tell Us About the Middle East: Case Studies of the West Bank and Egypt. M. Chen and V. Langohr. Department of Political Science, College of the Holy Cross

## Poster 1

### Toxic Effects of Lead Disposal in Water: An Analysis of TRI Facility Releases

P. Koval and R. Baumann

Department of Economics and Accounting, College of the Holy Cross

With the introduction of the EPA's Emergency Planning and Community Right-to-Know Act in 1986, particular manufacturers above a certain size are now mandated to give detailed reports as to the chemicals they release in a given year. Researchers have used this data to identify priority chemicals through theoretical models and have analyzed the emissions with respect to all-cause mortality as well as infant mortality. This paper serves to add to that literature in the analysis of the effects of lead released into water with respect to birth weights. I find that a 1% increase in lead emissions per square mile leads to a 0.326% increase in the percentage of births considered low birth weight (< 2500 grams), robust to several demographic controls and county fixed effects. This result, along with the short- and long-term effects, relating to both health and economic outcomes, associated with low birth weight should be considered in the appraisal of additional legislation to reduce emissions of lead into water.

I thank the Weiss Summer Research Program in the Social Sciences and Humanities for financial support.

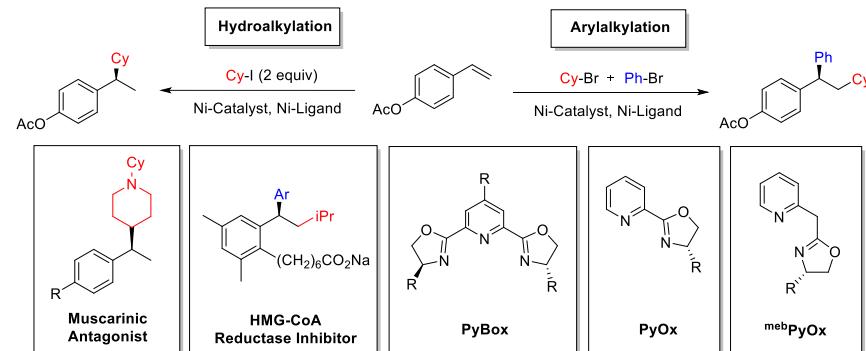
## Poster 2

### Stereoselective Carbo-functionalization of Alkenes Using Nickel Catalysts

J. Kim, X. Qi, and T. Diao

Department of Chemistry, New York University

Synthesis of pharmaceutically-relevant drugs require the construction of carbon-carbon bonds with the appropriate stereocenters, since only single enantiomers of most potential drug candidates have the desired effect on the body. The largely under-explored asymmetric carbo-functionalization of simple alkenes via hydroalkylation (adding a hydrogen and an alkyl group on the double bond) or arylalkylation (adding an alkyl group and an aromatic group) is an attractive method to build complex molecules with high enantioselectivity. The Diao Lab capitalizes on the selective control of Nickel ligands to build relevant, chiral molecules; selective in the sense that different ligands that chelate to the Nickel center dictate the *chemoselectivity* (what groups add to the double bond), *regioselectivity* (where on the double bond each group will add), and the *enantioselectivity* (which enantiomer product is favored). I successfully synthesized a variety of nitrogen-based bidentate and tridentate ligands, such as pyridine-bisoxazolines (PyBox), pyridine-oxazolines (PyOx), and methylene-bridged pyridine-oxazolines (<sup>m<sup>eb</sup></sup>PyOx), to control the selectivity of the reaction with promising preliminary results. I will continue to synthesize and examine these ligands on alkene functionalization to prepare relevant drug target molecules.



We thank the National Science Foundation (NSF) for funding, as part of the Research Experience for Undergraduates (REU) program.

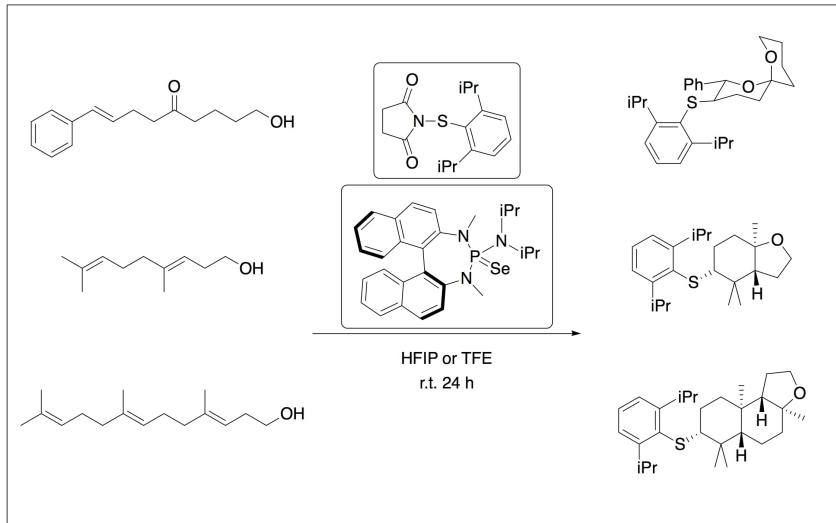
### Poster 3

#### Lewis Base Catalyzed Sulfenocyclizations of Olefinic Compounds

K. Kelly, K. Robb, K. Hilby, and S. Denmark

Department of Chemistry, University of Illinois at Urbana-Champaign

The ability of Lewis base catalysts to enhance the electrophilicity of Lewis acids via the formation of a cationic donor-acceptor adduct is well-established. In the presence of a sulphenylating reagent, the catalyst promotes enantioselective cyclizations of unactivated, olefinic compounds via the formation of a sulfonium-ion intermediate. We have studied the ability of this system to act upon two classes of substrates: polyenes and  $\gamma,\delta$ - unsaturated ketones, both possessing a terminal alcohol to act as a ring-closing nucleophile. Sulfenocyclization of these substrates in fluorinated solvents proceeds in typically good yield and high enantioselectivity. Further functionalization of the thioether handle demonstrates the utility of this method, and could be used to access various natural products.



We thank the Harold R. Snyder Scholar fund for financial support.

### Poster 4

#### Synthesis of New Imidazolium Imine Bioorganometallic Compounds

A. S. Kui and R. S. Herrick

Department of Chemistry, College of the Holy Cross

Rhenium compounds can be utilized to further study the applications of technetium-99m, a gamma emitter which is commonly used in nuclear medicine as a radioactive tracer. Due to technetium lacking any stable isotopes, rhenium can instead be used as a cold, stable analog of  $^{99m}\text{Tc}$  to study the chemical properties of technetium and the potential bioorganometallic complexes that could be made. In addition to rhenium being a stable analog to technetium, both  $^{186}\text{Re}$  and  $^{188}\text{Re}$  are  $\beta$ -emitters, and therefore the synthesis of novel complexes of rhenium can not only be applied to  $^{99m}\text{Tc}$ , but also to the radioactive isotopes of rhenium itself. This summer, the Herrick lab focused on synthesizing rhenium tricarbonyl chloride compounds with diimine ligands. These ligands were synthesized using various amines and imidazole carbonyl-based derivatives. The synthesized products were then characterized using  $^1\text{H}$  and  $^{13}\text{C}$  NMR, IR spectroscopy, and X-Ray crystallography.

We gratefully acknowledge the National Institutes of Health for the financial support of this research. The Herrick Lab also thanks Professor C. J. Ziegler and his students at the University of Akron for performing the crystallography.

## Poster 5

### Synthesis of New Rhenium Carbonyl Iodide Compounds

S. Touchan and R. S. Herrick

Department of Chemistry, College of the Holy Cross

Technetium-99m is a  $\beta$ -emitter, which makes it useful for medical imaging for the purpose of disease diagnosis. However, technetium has no stable isotopes making it difficult to study its chemistry in the lab. Using rhenium, an element with similar reactivity without being radioactive, we synthesize new compounds that could likely be formed by technetium. This summer, we synthesized the new compound rhenium tricarbonyl triqua iodide,  $[Re(CO)_3(H_2O)_3]I$ , by both a thermal route and a microwave route. The microwave method was developed to generate an aqueous solution for immediate reaction. The thermal route was designed so that the compound could be made in larger amounts and stored for future use. We obtained crystals of the compound by slow evaporation of an aqueous solution. The molecular structure of the compound, obtained by X-ray crystallography, is more complicated than its empirical formula and resembles that of the bromide compound we reported previously. We tested the utility of the new compound as a reagent by reacting it with various bidentate ligands, such as 2,2'-dipyridyl, 1,10-phenanthroline, dimethylglyoxime to form the new compounds,  $Re(CO)_3(N-N)L$ . The synthesized products were characterized using  $^1H$  NMR, IR spectroscopy and X-Ray crystallography.

We would like to thank the Alumni / Parent scholarship fund for their generous financial support. We also thank Professor C. J. Ziegler at the University of Akron and his students for performing the crystallography.

## Poster 6

### Concupiscentia, Continuity, and Creativity:

A Phenomenological Study of Addiction

R. Welsh IV and J. P. Manoussakis

Department of Philosophy, College of the Holy Cross

Addiction has always existed historically, and expresses itself with both obvious and subtle varieties in our modern context. Medicine and psychology recognize this phenomenon as an *exception* to the rules of normal behavior, but because it is so widespread and historically established this may not be the case. Our project localizes addiction in the soul, or as a part of human nature, which can only be understood by use of philosophy. The history of philosophy rarely discusses addiction as such, and thus a related phenomenon, namely sin, is analyzed to discuss our habitual nature in its benign and problematic forms. Sin and addiction are connected phenomenologically through the categories of desire, repetition, and temporality, all of which are addressed in works like Sigmund Freud's *Beyond the Pleasure Principle*, Kierkegaard's *Repetition*, and J.P. Manoussakis' *The Ethics of Time*. With the parallel drawn between sin and addiction, we made use of what has been said of original sin by Kierkegaard's *Concept of Anxiety* and St. Augustine's *Confessions* to affirm that we are, and have always been addicted as a species. The elitism between the addict and non-addict is truly nonexistent, as all addictions are for the past, and all people crave the same irretrievable moment. We concluded that, like sin, addiction is only possible through time, but time is also the means by which both are destroyed. This idea underlies the twelve step program typically prescribed to addicts. Additionally, we believe creative works are a productive way to suspend desire and, by implication, addiction. On the basis of this point, we proposed an expansion to the twelve steps to include artistic and intellectual pursuits.

We thank the Weiss Summer Research Program in the Humanities, Social Sciences, and Arts for their financial support.

## Poster 7

### Salt Dependence of a Self-splicing Enzyme from an Extreme Halophile

*A. Cawood, A. Gomez and K. V. Mills*

*Department of Chemistry, College of the Holy Cross*

Protein splicing is a post-translational process facilitated by an intervening polypeptide called an internal protein, or intein. The intein is located between two flanking polypeptides, called exteins. The intein catalyzes its excision from the extein concomitantly with the ligation of the exteins. The extremophile *Haloferax volcanii* exists in a high salt environment. We are interested in the halophile because we want to learn how efficiently the intein that has invaded its PolB gene splices as a function of salt concentration. We have shown that we can induce splicing of the intein *in vitro* as a function of salt concentration and time. Others have demonstrated that the intein has an active homing endonuclease domain *in vivo*, and that the presence of the intein has a high fitness cost for the organism. We are interested in studying the endonuclease activity of the intein *in vitro*, given that a salt-dependent conditionally-active nuclease may have utility in biotechnology applications.

This work was supported by the National Science Foundation (grant MCB-1517138) and by the Camille & Henry Dreyfus Foundation.

## Poster 8

### Behavioral Synchrony and Functional EEG Networks

*S. McGuire, D. Damiano, and R. Schmidt*

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*Department of Psychology, College of the Holy Cross, and  
Child and Adolescent NeuroDevelopment Initiative (CANDI), UMass  
Medical School*

People engaged in social interactions exhibit natural, unintentional coordination of their body movements. Although intense efforts have been made to localize behaviors in human brain activity, little is known about the functional networks that underlie human social interaction. We are interested in how social behavioral synchronization corresponds to functional networks in the brain. To this end, we analyzed electroencephalograph (EEG) activity from an experiment involving participant pairs swinging pendulums in different interpersonal coordination conditions (in-phase, anti-phase, unintentional, and intentional). EEG activity was recorded at 64 electrode locations on the scalp. Our initial analysis considered power values in selected frequency bands across the collection of trials of ten participants. Further analysis focused on the weighted phase lag index (WPLI) of the Fourier transformed time series data in selected frequency bands. Using methods of computational topology and network theory, we are able to identify functional networks and cliques based on pair-wise coherence of the WPLI between electrodes. Initial results indicate the existence of dynamic network features across different interpersonal coordination conditions and frequency bands. In future work, we will apply these novel network analysis techniques to evaluate the social brain networks in adolescents with Autism Spectrum Disorder (ASD), as one of the suggested tendencies of people with ASD is social disconnection.

We thank Wendy R. and Kenneth J. Edwards, M.D. '80 P12 for financing this research and the Holy Cross Weiss Summer Research Program for their support.

## Poster 9

### Under Pressure: Pressure and Temperature Dependent Intein Homing Endonuclease Activity

A. Wibben, H. Comeau, and K. V. Mills

Department of Chemistry, College of the Holy Cross

An intein is an interrupting protein segment that is typically self-excised to allow for mature protein function. Inteins are rare but have notably been found in extremophiles. We are interested in studying specific inteins that contain a homing endonuclease (HE), an enzyme that cleaves double stranded DNA in order to initiate the insertion of an intein gene by homologous recombination, allowing the intein to persist in later generations. We are focused on the homing endonuclease activity of inteins from two hyperthermophilic archaea: *Thermococcus barophilus* (*Tba*), isolated from a deep sea hydrothermal vent, and *Thermococcus kodakarensis* (*Tko*), isolated from a volcanic shoreline of a Japanese island. Because these intein-containing extremophiles have been isolated from very high temperatures but from different depths, we are interested in the differential homing endonuclease activity of these extremophiles at varied temperatures and pressures. Previous lab members have shown that *Tba* HE is active at pressures up to 1000 atm. Given that *Tko* is a surface-dwelling organism, we suspect that *Tko* HE will be pressure sensitive while *Tba*, which lives naturally at a pressure near 400 atm, is not. Additionally, since both organisms reside in extreme temperatures, we hypothesize that both *Tba* HE and *Tko* HE will be more active at higher temperatures. Should our temperature and pressure assays demonstrate the hypothesized results, we might be able to differentiate between the different adaptations that organisms might have to survive at both high pressures and temperatures as opposed to high temperatures and ambient pressure.

This work was supported by the National Science Foundation (grant MCB-1517138) and by the Camille & Henry Dreyfus Foundation.

## Poster 10

### Enantioselective Phosphorylation of Diols

A. Bucknam, E. Lynch, and B. R. Sculimbrene

Department of Chemistry, College of the Holy Cross

Activation of certain pharmaceutical drugs requires a phosphorylation reaction to take place, where an alcohol group is converted to a phosphate. One such example is FTY720, a drug used to treat multiple sclerosis. Structurally, FTY720 is a diol, a molecule with two alcohols. When ingested, FTY720 is phosphorylated selectively by an enzyme, where only one of the two alcohols is converted to a phosphate. FTY720-phosphate is the active drug in modulating the immune system. The Sculimbrene lab has previously published on the Lewis acid catalyzed phosphorylation of diols. We are currently attempting to apply our method to the selective phosphorylation of FTY720. Our lab has investigated two areas of study this summer to obtain more information on factors that influence the selectivity of our phosphorylation reaction. One approach involved phosphorylating different model compounds in order to investigate what structural features on the diol are necessary for selectivity. The other approach changed the amount of catalyst used in the reaction to determine whether this factor affected selectivity. Additionally, we have conducted experiments to determine which of the two alcohols the phosphate is reacting with. We hope to continue improving the selectivity of our reaction and use this knowledge to complete a selective laboratory phosphorylation of FTY720.

We would like to thank Kathleen and Stephen R. Winslow P16,14; and Daniel J. Polacek, M.D. '73 P14,12 for their financial support.

## **Poster 11**

### **Peptide Isostere Synthesis Via Olefin Cross Metathesis**

*H. S. Miksenas and B. R. Sculimbrene*

*Department of Chemistry, College of the Holy Cross*

Peptides are short chains of amino acids that are the basis of many biomolecular functions. Peptides often make up antibiotics and drug candidates yet the amide bonds in the peptides can be unstable when taken orally. Peptide isosteres mimic a peptide by replacing the amide bond with a different functional group, such as an alkene. Alkenes do not readily break down in the stomach like the amide bond in peptides. The Sculimbrene lab seeks to develop a general method to synthesize alkene peptide isosteres. Previously we published a synthetic strategy that used two key steps: 1) diastereoselective alkylation and 2) cross metathesis. Currently, we propose that conducting the cross metathesis step first, between an N-termini and simple C-termini, followed by the diastereoselective alkylation will lead to a more advantageous cross. This new retrosynthetic mechanism should allow for a more effective way to synthesize peptide isosteres. We plan to test our new strategy with a synthesis of the peptide isostere of Gramicidin S. Gramicidin S is an antibiotic that is effective against some gram positive and negative bacteria. The dipeptide sequence Leu-D-Phe present in Gramicidin S has been found to be effective in mitochondrial targeting as a therapeutic strategy. Studies this summer included the synthesis of the N-terminal fragment and the diastereoselective alkylation.

We thank the Alumni/Parent Summer Research Scholarship Fund for financial support.

## **Poster 12**

### **Logical Fallacies in Political Discourse**

*C. Zhou and P. Bizzell*

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I examined the use of logical fallacies in political discourse. Logical fallacies are fraudulent tricks people use in their argument to make it sound more credible while what they really do is to fool the audience. Out of more than 300 kinds of fallacies, I focused on 18 common ones by analyzing their use in debates about political issues. For example, Benjamin Shapiro gave a speech for pro-life and said that he donated money to charities. An audience member asked him, "So, have you donated to Planned Parenthood?" Shapiro said, "No, because they kill babies; they kill 300,000 unborn children a year! I don't donate to a baby genocidal organization like Planned Parenthood." In his answer, he used the hasty generalization fallacy. It is true that Planned Parenthood provides abortion service, but it also provides other services such as birth control, long-acting reversible contraception, cervical cancer screening, etc. Shapiro used the hasty generalization fallacy to evoke the audience's empathy to the unborn and anger to Planned Parenthood. Moreover, I have learned more this summer than what the definition of the logical fallacies are and how to discern them in an argument. During conducting my research, I noted that being aware of my mental state is very important if I want to accurately detect the fallacies. Furthermore, while watching two sides debating, being impartial is as significant as staying calm. I also need to put aside both personal political opinions and my strong feeling toward the ethos of the speakers. It could be pretty easy to find logical fallacies from the argument of someone I dislike and thus, overlook the fallacies used by the other speaker -- a good arbiter should not make such mistake. I came to the conclusion that the political debates nowadays are simply misleading. They use personal attack, inflammatory language, and emotional demagoguery, which do not belong to a democratic country. And most importantly, citizens are not aware of this, and they need to be informed with these fallacies because a rational, respectful, and democratic environment needs to be reintroduced into the political world.

We thank the Weiss Summer Research program in the Humanities, Social Sciences and Arts for funding this project.

## Poster 13

### Exploring the Boundaries of the Mannich Condensation for Preparing Ligands to Bind Transition Metals

*J. Farrell, W. Crowley, A. LaMothe, and L. Masnyk  
Department of Chemistry, College of the Holy Cross*

The Mannich condensation is a multicomponent organic reaction, which uses an amine, formaldehyde, and an enolizable carbonyl to form a new carbon-nitrogen and a carbon-carbon bond. The novel compounds resulting from the Mannich condensation are then used to chelate transition metals and control their reactivity. Over the summer, we used a variety of amines and substituted phenols in order to produce a library of ligands to be used in several different projects. The focus this summer has been on expanding this chemistry to new functional groups, incorporating redox-active groups, and exploring the role of steric bulk on reaction outcomes. A series of new ligands have been prepared that have applications as nanoparticle precursors, liquid batteries, modeling of bioinorganic complexes, and MRI contrast reagents. Synthetic schemes, compound characterization, and how our understanding of the Mannich condensation has expanded will be described. Future work focuses on continuing to expand our library of ligands and testing their coordination to metals.

We would like to thank the Alumni/Parent Summer Science Research Scholarship fund for financial support.

## Poster 14

### Equi-areal Clairaut Parametrizations of Surfaces in Real 3-Space

*X. Wang and A. Hwang  
Department of Mathematics and Computer Science,  
College of the Holy Cross*

Gaussian curvature is a numerical invariant for surfaces introduced by C. F. Gauss in 1827. The Gaussian curvature quantifies the shape of a surface and is unchanged when the surface is bent without stretching. A surface with positive Gaussian curvature is convex; a surface with negative curvature is saddle-shaped and a surface with zero curvature is intrinsically flat. A general surface has the form

$$E(u,v)du^2 + F(u,v)(dudv + dvdu) + G(u,v)dv^2.$$

An equi-areal Clairaut parametrization has the form

$$G(u)^{-1}du^2 + G(u)dv^2$$

and the Gaussian curvature is minus one-half the second derivative of  $G$ . The goal of the project was to classify geometrically accurate representations (isometric immersions) of equi-areal Clairaut parametrizations in real 3-space. This class of parametrizations is equipped with a natural orthonormal frame. The Cartan structure equation for this frame becomes a system of first-order partial differential equations, whose solutions correspond to isometric immersions.

We thank Dr. Dan Kennedy '68 for financing this research and the Weiss Summer Science Research Program for their support.

## Poster 15

### Occupational Licensing: A Barrier to Employment After Serving Time

*J. Metzger and J. Congdon-Hohman*

*Department of Economics and Accounting, College of the Holy Cross*

Occupational licensing is legal permission to work in certain industries, granted at either local, state, or national levels. Usually, applicants are required to have a certain level of job experience or training, to pay a fee, to successfully pass exams, have a certain minimum general education level and be of a certain age. Licensing boards consist of people who already hold an occupational license in the particular field for which one seeks a license. Whether an occupation is licensed or not, and the requirements to obtain a license, vary from state to state. Examples of commonly licensed jobs are: barber, bus driver, cosmetologist, and emergency medical technician. Sometimes, laws surrounding licensing prohibit people with criminal records for obtaining a license because they either have vague guidelines regarding the board's ability to deny solely based on criminal history or the use of a "character clause" to automatically bar people with criminal records from getting licenses. The purpose of this study is to determine whether occupational licensing laws and their burdensomeness to people with criminal record impact employment outcomes. Data from the Current Population Survey from 2010, 2012, 2014 and 2016 is used to identify people with former convictions by using their ineligibility to vote from the November voting samples. Data from the Institute of Justice reports in 2012 and 2017 is used to gauge the severity of licensing requirements for the general population. Data from the National Employment Law Project's 2016 report is used to score state on their rules regarding criminal history and how much the laws block people with criminal records. The empirical method used is a difference in difference model that measures labor force outcomes against the extent of the licensing laws. We do not find evidence that occupational licensing laws regarding criminal history have an impact on labor market outcomes for those with a criminal record.

We would like to acknowledge the Weiss Summer Research Program in Economics for financial support.

## Poster 16

### Influence of an Archaeal-Specific Subdomain on Intein Structure and Activity

*A. Chavez, C. J. Minteer, M. Jaramillo, and K. V. Mills*

*Department of Chemistry, College of the Holy Cross*

Protein splicing is a self-catalyzed process where an intervening intein is excised with the concomitant ligation of the two flanking exteins to form a mature protein. The inteins we studied interrupt the DNA Pol II of *Pyrococcus abyssi* and *Pyrococcus horikoshii*. These extremophile inteins conditionally splice at high temperatures. The Hyperthermophilic and Thermophilic Hairpin (HTH) is only found in the structures of archaeal inteins. We hypothesize that the HTH increases stability by elongated the central beta-sheet, and thus that mutations that disrupt this hairpin would affect the stability toward unfolding and the reactivity at the active site. To further understand the protein splicing of the *P. abyssi* intein, an intein with an Arg40Gly mutation in the HTH was expressed, and we studied its activity. We also purified 15-N labeled intein for NMR (HSQC) analysis of residue-level changes induced by the mutation. We have also purified a variant of the *P. horikoshii* PolII intein in order to attempt to solve the structure of an unspliced precursor intein.

This work was supported by the National Science Foundation (grant MCB-1517138) and by the Camille & Henry Dreyfus Foundation

## Poster 17

### Modeling Symptom Severity Based on Metabolic Risk Genes in Patients with Schizophrenia: An Exploratory Use of Machine Learning Algorithms

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and Department of Psychology, College of the Holy Cross*

Schizophrenia is a psychiatric illness characterized by psychotic symptoms, social dysfunction, and cognitive impairment. Both treated and untreated patients with schizophrenia have an increased risk of poor metabolic outcomes, which largely contributes to a shorter life span among these patients. Recent work suggests that metabolic risk genes established in the healthy population might also be associated with metabolic co-morbidity in patients with schizophrenia, which raises the possibility of a shared genetic vulnerability pathway. We explored this possibility using machine learning algorithms, including tree-based and regularized linear regression. These modeling approaches reduce the dimensionality of the covariate space, and provide results that are easily interpretable for physicians. Our preliminary results indicate that different patterns of metabolic risk genes are associated with disease severity among patients in different age categories.

We thank an anonymous donor's contribution to the Alumni / Parent Summer Science Research Scholarship fund for financial support.

## Poster 18

### Internal Audit within U.S. Colleges and Universities

V. Karalolos and S. DeSimone

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Internal auditors in the public sector provide service to their institutions that influence their financial reporting processes. Despite this little research has focused on the role that the Internal Audit Function (IAF) plays in the financial reporting of public sector organizations. Additionally, little research has examined the effectiveness of external reviews of IAFs as prescribed by the Institute of Internal Auditors (The IIA) and the Governmental Accounting Standards Board (GASB). Using a unique set of hand-collected data, this study will investigate the association of (1) the presence of an IAF and (2) the quality of the IAF with financial reporting quality and grant outcomes in four year U.S. colleges and universities. Specifically, we will examine if the presence of IAFs and the quality therein is associated with the presence of financial statement audit reportable conditions and grant awards in these institutions. We gathered information from contacting the leaders of the audit departments of the schools, along with analyzing the IAF charters for additional information to facilitate our analysis of test variables. We will be using variables such as 1) IAF size 2) IAF Financial Work 3) IAF Grant Work 4) University or College 5) CAE Experience 6) CAE Certification 7) IAF reporting line... To our knowledge, it will be the first study to examine the financial reporting quality of U.S. public colleges and universities and the IAF's contribution therein. Results should be of interest to standard setters, regulators, and public-sector leadership as they attempt to improve public sector financial reporting quality and transparency.

We thank PWC Inquiries Program, Weiss Summer Research Program, and the Batchelor Ford Summer Fellowship Program for financial support.

## Poster 19

### A Novel Approach Using Hot-Melt Spacers to Tackle Prostate Cancer

P. Sindurakar, B. Singh, and S. Sridhar

Northeastern University Egan Research Center

Prostate cancer remains the most common cancer among men, following skin cancer. Despite the early detection from precautionary standardized routines, patients still suffer from the aggressive and metastatic behaviors of cancer cells. Brachytherapy is an effective treatment for cancer, involving the insertion of chemotherapy implants directly into the tissue. Anti-cancer drugs such as *Docetaxel* and *Talazoparib*, have been extensively studied and known to be successful in the treatments of different cancers. Our lab has previously designed biocompatible and biodegradable spacers, with the ability to alter their release of docetaxel depending on the varying growth of prostate cancer cells. These spacer implants resulted in significant tumor inhibition and improved survival rates. Since these spacers were solvent-based, the polymer and drug were dissolved in chloroform, preventing clinical translation of the implants. To develop spacers for effective clinical use, we performed a similar study developing hot-melt docetaxel spacers and tested the effects of these spacers on drug administration, cell toxicity, and tumor growth. Through in-vitro and in-vivo experiments within mice, we determined the efficacy of HME, solvent-free, spacers. This development can lead to higher survival rates of patients, improved drug delivery, and avoid systemic toxicity.

We thank the National Institute of Health (STTR) for financial support.

## Poster 20

### Understanding the Effects of a High-Glucose Diet on Fertility in *C. elegans*

E. Flynn, K. Guilbo, K. Larkin, and M. A. Mondoux

Department of Biology, College of the Holy Cross

Over the past several decades, sugar consumption has increased worldwide, resulting in the rise of obesity and diabetes. Both diseases are correlated with a variety of health problems, including a decrease in fertility. In order to understand the cellular mechanisms responsible for a decrease in fertility on a high-glucose diet, we use *Caenorhabditis elegans* as a model system. *C. elegans* have many genes and pathways conserved in humans, and, like humans, have decreased fertility on a high-glucose diet. Glucose affects many cellular functions that could contribute to fertility. First, we hypothesized that hermaphrodite *C. elegans* have decreased fertility on a high-glucose diet because of an increase in glycogen, the main glucose storage polymer in both *C. elegans* and humans. Glycogen has been shown to have negative effects on lifespan in *C. elegans*. However, we found that decreasing glycogen using a mutant in the glycogen synthase enzyme (*gsy-1*) led to a decrease in fertility in hermaphrodites, leading us to believe that glycogen is actually necessary for fertility. Second, we hypothesized that glucose could be an environmental stressor, increasing the rate of apoptosis in the hermaphrodite oocytes. We found that decreased hermaphrodite fertility on a high-glucose diet is dependent on the core apoptosis protein CED-4, consistent with a role for apoptosis. In contrast, a high-glucose diet decreases male fertility independently of apoptosis, suggesting a unique mechanism for reducing male fertility. We hypothesize that glucose acts to reduce sperm competitiveness, because when hermaphrodites are mated with males on a high-glucose diet, they produce fewer male progeny than expected. Since male progeny originate from male sperm, this suggests the hermaphrodites may be self-fertilizing due to less competitive male sperm. Through our work we hope to better understand the cellular mechanisms which decrease fertility on a high-glucose diet.

We thank our donors, Dr. Anthony Marlon '63 and Mrs. Renee Marlon, Mrs. Patricia McGovern Hill '82 P'12 and Mr. Peter J. Hill '82 P'12, for their generous financial support.

## Poster 21

### A Ketenimine Approach to 4-alkylidene- $\beta$ -lactams

*B. Carvalho and A. K. Isaacs*

*Department of Chemistry, College of the Holy Cross*

A core challenge of the 21st century is addressing the issue of microbial resistance. Beta-lactams make up the core structure of various antibiotics. We have been interested in developing and optimizing the synthesis of a subset of beta-lactams known as 4-alkylidene- $\beta$ -lactams. These molecules consist of the same four-membered ring core structure, but contain a double bond on the 4-position of the ring that increases the molecule's reactivity with bacteria, potentially making it more effective as an antibiotic. There are a few known methods to date to synthesize 4-alkylidene- $\beta$ -lactams. However, each process has limitations, including the requirement of complex  $\beta$ -lactam precursors. Herein, we propose a novel and efficient synthesis of these 4-alkylidene- $\beta$ -lactam precursors in a one-pot process. This process makes use of 'click chemistry' that utilizes copper as a catalyst to generate desired ketenimines from the reaction of an alkyne with a sulfonyl azide. In this process, the acyclic substrate is transformed into a 1,4-disubstituted 1,2,3-triazole that spontaneously fragments to the ketenimine intermediate, which can then be engaged by a nucleophile at the electrophilic carbon. In the process of forming the 4-alkylidene- $\beta$ -lactam we have introduced a new nucleophile in the form of an activated alkyne thereby expanding the known nucleophile scope. The activated alkyne attacks the electrophilic carbon in an intramolecular fashion and subsequent steps leads to the beta-lactam precursor. We have optimized the conditions of this copper catalyzed reaction to produce higher yields of the precursor. We hope to cleave the protecting group to create the fully functionalized 4-alkylidene- $\beta$ -lactam.

We thank Richard Fisher '47 P79 for financial support.

## Poster 22

### The Development and Evaluation of Dodecyne Functionalization on Metal Surfaces

*M. Silas and E. C. Landis*

*Department of Chemistry, College of the Holy Cross*

Self-assembled monolayers (SAMs) are made up of molecules that spontaneously attach to a surface when in the liquid or vapor phase. The attachment of thiol based SAMs to a variety of metal and nonmetal surfaces have been extensively studied. Despite this, there has been very little investigation into the alkyne equivalents of these molecules. We examined the functionalization of dodecyne on platinum (Pt), gold (Au) and nonporous gold (NPG), to gain a better understanding of the potential role that alkyne based SAMs could play in the future. Past research has shown that these reactions are oxygen sensitive, but little was known about the severity of this sensitivity. In order to gain a more firm grasp of the impact that oxygen plays in the functionalization, we examined the reaction under multiple atmospheric conditions. Through the use of fourier-transform infrared spectroscopy (FTIR) and X-ray photoelectron spectroscopy (XPS), we were able to characterize the molecules attached to our metal surfaces. From these results we were able to determine that the functionalization was most efficient through the use of a nitrogen glovebox, as it lead to the most consistent results and lower oxygen contamination. Additionally, Cyclic Voltammetry (CV) was used to probe the density and ordering of the monolayer. We used this technique to examine the impact that both time and concentration had on the functionalization of dodecyne on Pt. Based on this data, we saw that concentration does not play a key role in the attachment of dodecyne to Pt. Furthermore, while increased functionalization time did result in increased surface blocking, this did not appear to be a linear relationship. Continuing to increase functionalization time appeared to yield diminishing results. From these results we concluded that despite rapidly functionalizing into a crystalline structure, dodecyne does not block Pt electron transfer very efficiently.

We thank the American Chemical Society Petroleum Research Fund for financial support

**Poster 23**

**Attachment and Ordering of Alkyne Self-Assembled Monolayers on Nanoporous Gold Surfaces**

A. Sevigny, M. Silas, Z. Li, and E. C. Landis

*Department of Chemistry, College of the Holy Cross*

Self-assembled monolayers (SAMs) use adsorption to form a spontaneous single layer of molecules on a surface, and have many applications in fields such as molecular electronics. Most prior research on SAMs has studied alkanethiol attachments to gold. Using nanoporous gold instead of flat gold can increase the available surface area for binding, allowing for the attachment of more molecules to the metal surface than flat gold. While the gold-sulfur bond has been studied more, the gold-carbon bond is expected to be more stable. We have attached 1-ethynyl-4-nitrobenzene to nanoporous gold under various temperature and atmosphere conditions, as well as differing lengths of time. We then analyzed the results using infrared reflection absorption spectroscopy, cyclic voltammetry, and x-ray photoelectron spectroscopy to identify binding success. Cyclic voltammetry was used to determine the density of the molecular layer using ferricyanide as a solution redox couple. X-ray photoelectron spectroscopy was used to quantify the amount of the molecule attached to the nanoporous gold surface. Temperature and atmosphere were found to have significant effects on coverage, with the best results being at higher temperature and in Ar. Future research will investigate the effects of temperature and time on the reaction and measure attachment stability.

We thank the American Chemical Society Petroleum Research Fund for financial support.

**Poster 24**

**Binding of Alkyne Monolayers on Gold Surfaces**

Z. Li and E. C. Landis

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Self-assembled monolayers (SAMs) are the result of organic chemicals spontaneously binding to surfaces. SAMs are potentially useful in the field of sensing. Although there have been studies on SAMs, few have tried binding alkynes onto gold and nanoporous gold. In this project, we investigated the binding of 4-Ethylybenzoic acid on gold with and without the protection of a silane group. We collected the kinetics information of functionalizing gold surface with this alkyne. We used IR spectroscopy and X-ray photoelectron spectroscopy (XPS) to analyze the bonds and elements on the gold surface, we also used cyclic voltammetry to test the density of the SAMs.

We thank American Chemical Society Petroleum Research Fund and Marion and Samuel E. Krug, Ph.D. '65 for financial support.

## Poster 25

### LGBTQ+ History at Holy Cross and in Worcester

N. Grimes, E. Powell, and S. Yuhl

Department of History, College of the Holy Cross

Our student research team split their time this summer gathering materials relating to LGBTQ+ histories from local communities for two different sites: the Worcester Historical Museum (WHM) and the College of the Holy Cross (HC). Materials collected (including documents, ephemera, and artifacts) and created (oral histories) became the basis for two distinct digital archives that are sustained by each community partner (WHM & HC). In turn, these archived materials provided support for the creation of two 2019 public exhibits on LGBTQ+ history, one at the WHM (co-curated by Professor Yuhl), and another focusing especially on HC LGBTQ graduates at Holy Cross (for which the student team was largely responsible). Summer research on these related projects, that serve both Holy Cross and a community partner in the City of Worcester, enhanced students' practical and intellectual development. On a practical level, over the nine weeks, students gained valuable, transferable skills, such as research, interviewing, problem-solving, working in teams, public speaking, and design experience with digital humanities tools.

We thank the Weiss Summer Research Program for financial support.

## Poster 26

### Investigation of the Role of a *de novo* Evolved Gene in Male

*Drosophila melanogaster* Reproduction

A. Zou, K. Kelleher, P. Patel and G. D. Findlay

Department of Biology, College of the Holy Cross

*De novo* genes are new genes that arise as a result of mutations in non-coding DNA sequences. In many organisms, *de novo* genes are expressed in the male reproductive tract. *Katherine johnson* is a *de novo* gene expressed in the testes of *Drosophila melanogaster*. Our previous experimental results suggested the expression of the gene plays a critical role in male fertility. We attempted to replicate these results using RNA interference, and confirmed successful knockdown of *katherine johnson*. However, we observed no significant difference in fertility in the knockdown males. To resolve this ambiguity, we have been developing a knockout line of flies using CRISPR/Cas9, which completely deletes the gene, rather than only suppressing the gene's expression. This line of flies should be ready to use in the fall. We will repeat the fertility assays with this line of flies to more definitively determine the role of *katherine johnson* in *Drosophila* male fertility.

We thank the Alumni / Parent Summer Research Scholarship fund for financial support.

## Poster 27

### ***Redstone*, a *de novo* Evolved Gene, Is Required for Full Fertility in Male *Drosophila***

G. C. Mascha, B. J. Kelly, P. H. Patel, and G. D. Findlay

Department of Biology, College of the Holy Cross

*De novo* evolved genes arise from previously non-coding genomic material and have potential to develop integral functions within a relatively short evolutionary time-frame. Many *de novo* genes are expressed predominantly in male reproductive organs, suggesting roles in improving male fertility. Utilizing bioinformatics analyses, we have identified 96 putative *de novo* genes with testis-biased expression in *Drosophila melanogaster* and have begun screening each for roles in fertility. Among the genes assessed in this screen, one gene, which we have called *redstone*, appears to have a small effect on male fertility. Testis-specific, RNAi-mediated knockdown (KD) of *redstone* caused a modest, but statistically significant and reproducible, reduction in male fertility of about 20-24 percent compared to control males. To determine how *redstone* KD reduces fertility, we used a fluorescent sperm marker to measure sperm production in KD males and sperm storage in wild-type females mated to KD males. While *redstone* KD does not appear to affect sperm production, there is some evidence suggesting KD of *redstone* leads to improper sperm storage. For example, four days after mating to KD males, females had an abnormal amount of sperm in the uterus and the ducts leading to the spermathecae. To confirm the results obtained by RNAi, we are currently constructing a null allele of the *redstone* gene using CRISPR/Cas9. We are also developing an antibody that will allow us to determine the cellular localization of the *redstone* protein. Our results suggest that *de novo* genes can have a significant impact on fertility and have prompted us to construct RNAi lines to investigate 50 additional putative *de novo* genes for roles in fertility.

We thank the National Science Foundation for funding this research.

## Poster 28

### **Adaptive Evolution of Increased Vibrissae Length in Forest-dwelling *Peromyscus***

E. Rivard, J. Gable, and H. Hoekstra

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Deer mice (*Peromyscus*) serve as ideal model organisms for studying adaptive evolution due to their wide geographic distribution and phenotypic diversity observed among mice from disparate local environments. Current research suggests that extant *Peromyscus maniculatus* are derived from prairie-dwelling ancestors that later expanded into forested habitats following the last glaciation (10kya). Investigating the morphological differences between forest and prairie mice therefore facilitates understanding of how forest mice adapted to an arboreal lifestyle. Here, we specifically examined vibrissal morphology both across the genus *Peromyscus* and within populations of *P. maniculatus* from diverse habitats. Whiskers are tactile hairs virtually universal to mammalian species and especially significant for rodent sensation. Arboreal rodents are hypothesized to have longer whiskers than their terrestrial counterparts because they engage in active whisking while climbing. We observed results consistent with repeated evolution of longer whiskers in arboreal mice, since forest-dwelling *Peromyscus* from across the continent generally had significantly longer whiskers than prairie-dwelling subspecies. In addition, we are in the process of investigating whether variation in the timing of whisker development onset may account for differential whisker length by conducting whole mount RNA in situ hybridizations in *P. maniculatus* embryos from both forest and prairie habitats. Finally, we are searching primary literature for information on whiskers in a diverse array of mammalian species in order to identify patterns in vibrissal evolution relevant for our interest in how whiskers change in response to different lifestyles. This study's findings suggest that *Peromyscus* whisker morphology is a useful system for analyzing mechanisms of adaptive evolution in the wild.

We thank the Harvard-Amgen Program, the Amgen Foundation, the Howard Hughes Medical Institute, and the Department of Organismic and Evolutionary Biology at Harvard University for financial support.

## Poster 29

### Functional Analysis of *de novo* Evolved Genes in Male *Drosophila* Reproduction

B. J. Kelly, P. H. Rumde, G. C. Mascha, P. H. Patel, and G. D. Findlay  
Department of Biology, College of the Holy Cross

The reproduction of *Drosophila* fruit flies is controlled by many genes. Some of these genes appear to have evolved *de novo*, arising from previously noncoding DNA. Our lab has identified five *de novo* genes that, despite their recent origins, have become essential to male fertility. One such gene, *Saturn*, originated early in the evolutionary history of the *Drosophila* genus and has since been duplicated and lost in various species. In *Drosophila melanogaster*, *Saturn* knockdown males produce fewer sperm overall, and the sperm they do produce travel inefficiently in the female reproductive tract. Based on these observations, we created a null allele of *Saturn* using CRISPR/Cas9 and generated an antibody to the *Saturn* protein. Fertility assays confirmed that *Saturn* is required for male fertility. We are conducting experiments with GFP-labeled sperm to quantify sperm present in various reproductive organs. Western blots confirmed that *Saturn* encodes a protein, and preliminary immunofluorescence experiments suggest that the protein may be enriched in the post-meiotic testis. Based on these results, we have also initiated a comprehensive screen of other testis-expressed, *de novo* evolved genes. We are constructing RNAi lines for over 50 such genes and will use them to screen for additional *de novo* genes essential to male fertility. Our results highlight the importance of *de novo* genes for male reproductive success and implicate *de novo* gene evolution as a mechanism by which males respond to sexual selection pressure.

We thank the National Science Foundation for financial support of our research.

## Poster 30

### The Investigation of the Sequential Adsorption of 2-Naphthalenethiol and Octanethiol on Au(111)

C. Roy, M. Cummings, and L. G. Avila-Bront  
Department of Chemistry, College of the Holy Cross

This study was conducted to characterize the ordering and packing tendencies of multi-component self-assembled monolayers (SAMs) in ambient conditions. The multi-component SAMs consisted of octanethiol (OT) and 2-naphthalenethiol (2NT). Both the sequence of deposition and the concentration of the 2NT were varied. The primary techniques used to analyze the resulting SAMs were Scanning Tunneling Microscopy and X-Ray Photoelectron Spectroscopy. It was observed that when the 2NT was used at a higher concentration, it overrode the presence of the OT, independent of the order of deposition. Coexisting domains of the compounds were collected when a lower concentration of 2NT was deposited on the surface first, followed by the OT.

We thank the American Chemical Society Petroleum Research Fund and the Robert J. Stransky Foundation Research Fellowships in the Sciences for financial support.

## **Poster 31**

### **Resilience and Protective Factors Among Burmese Refugee Adolescents in Worcester, Massachusetts**

*M. Nguyen and S. Rodgers*

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Resilience refers to the process of overcoming adversity and avoiding negative trajectories that correspond to risk exposure. Researchers working within the resilience framework find that despite risk exposure, many adolescents are able to attain positive outcomes through promotive factors. However, resilience and related protective factors among forced migrant youth in the United States are one of the research areas that have not been much explored in psychological research. The purpose of this study (drawing on sociology, anthropology, and psychology) is to build knowledge to fill the gap in this domain of refugee studies and resilience research, particularly focusing on the Karen and Karenni forced migrants in Worcester, Massachusetts. This project aims to discover some of the social structural factors encouraging resilience among Worcester's refugee youth by examining literature on various protective factors fostering resilience and conducting in depth interviews with Karen and Karenni youth in the city. Using a qualitative approach, the primary data was collected through ethnographic methods of participant life history interviews and participant observation in a weekly youth group with the Worcester Refugee Assistance Project. The protective factors that emerged from the study included the role of supportive services such as WRAP, the importance of community, certain personal qualities, certain familial support systems, sports participation, and close adult mentorship by teachers or WRAP volunteers. The findings of this project suggest that social workers, schools, and nonprofit organizations should aim to minimize challenges that refugee youth face upon resettlement by enhancing and supporting these resilience promoting factors.

We thank the Holy Cross Weiss Summer Research Program for financial support.

## **Poster 32**

### **Fostering Effective Mentoring Relationships with Burmese Refugees in Worcester, Massachusetts**

*S. Fields and S. Rodgers*

*Department of Sociology and Anthropology, College of the Holy Cross*

The non-profit Worcester Refugee Assistance Project (WRAP) has a youth group that enables refugee youth to gather, form social networks, and explore issues of identity, health, leadership, and goal-setting through peer leadership and work with mentors. Many of the volunteers who interact with the refugees have backgrounds in medical fields, including nurses, nursing students, medical students at UMASS, and physicians. This research investigates the effect (on the refugee youth) of connections made with mentors who have successful educational backgrounds in health fields. Furthermore, the research aimed to determine if processes such as the widespread medicalization of American culture (including the volunteers' perception of "refugee needs") hindered the formation of strong and beneficial relationships between refugee youth and medical professional volunteers in WRAP. For this project I used in depth ethnographic fieldwork interviews with refugee youth and medical school students; I also did weekly volunteer work with WRAP and review of scholarship on mentoring relationships and the social history of American medicine. I found no evidence indicating medicalization was affecting the formation of beneficial relationships; however, through the use of these methods, I found factors that seem to foster effective mentoring relationships, such as consistency, shared interests, and lengthy amounts of time devoted to the mentoring relationship and the refugee youth.

We thank the Holy Cross Weiss Summer Research Program for their financial support.

## Poster 33

### Presenting Craft: The Perception and Preservation of “Refugee Art” in Worcester, Massachusetts

*H. Moore and S. Rodgers*

*Department of Sociology and Anthropology, College of the Holy Cross*

This summer I worked with Refugee Artisans of Worcester, or RAW, a local non-profit project that assists artisans from refugee communities by selling their works and providing them with supplies. The refugee communities these artisans come from is diverse, including individuals from Bhutan, Burma, Central African Republic, Democratic Republic of Congo, Rwanda, and Iraq. RAW’s goal is to empower these artisans, who are often elders within their community, by enabling them to gain some economic independence. However, the artisans’ work is presented to the public by RAW as craft, a term that previous research revealed these artisans tend not to use. What are the implications of presenting non-Western cultural objects through Western classifications? What are the power dynamics at play here? My research also focused on the preservation of refugee artisans’ works. The number of refugees coming to Worcester has significantly decreased and the younger members of the community are not learning the skills used to create these works. I wanted to learn what was being done to document and promote refugee art as well discover what rhetorics were being used to achieve these goals. My methodology included analyzing museum websites, meetings with the co-founders of RAW, a large-scale interview with a family of Bhutanese refugees that works with RAW, interviewing Dr. Maggie Holtzberg the Massachusetts Cultural Council’s Program Manager for Folk Arts and Heritage, studying United States preservation law, and researching available scholarship discussing refugees and craft.

I would like to thank the Weiss Summer Research Program for their financial support as well as Ellen Ferrante, Joan Kariko, and my interviewees for participating in this project.

## Poster 34

### Characterization of Single Component Self-Assembled Monolayers on Au (111) Formed from Octanethiol and 2-Naphthalenethiol

*L. G. Avila-Bront, J. Gould, and C. Mangiacotti*

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Self-assembled monolayers (SAMs) consisting of a single molecule have become some of the most thoroughly studied phenomena in the field of surface science. As the field continues to advance, the library of studied SAMs has become increasingly larger. Our study seeks to characterize SAMs composed of octanethiol (OT) and 2-naphthalenethiol (2NT) independently with the goal of eventually forming mixed monolayers. Monolayers of 2NT were formed by exposing the Au (111) surface to two different concentrations. Scanning tunneling microscopy (STM) and X-Ray photoelectron spectroscopy (XPS) were the primary techniques used to image and characterize the composition of the resulting SAMs. The data collected show that Au (111) samples exposed to OT vapor produce well-ordered domains with significant surface coverage, while samples exposed to 2NT solutions showed unordered localized clumping.

This work was funded by the American Chemical Society Petroleum Research Fund, Grant PRF #56993-UNI5, and the Robert J. Stransky Foundation Research Fellowships in the Sciences.

## Poster 35

### **Analysis of Biodiesel-Diesel Blended Fuels Using Gas Chromatography and Chemometric Methods**

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Greenhouse gas emissions refers to the quantities of carbon dioxide released into the atmosphere as a result of the burning of fossil fuels, such as diesel, that commonly provide energy to support industrial sectors. Climate change scientists have strongly correlated levels of carbon emissions with the rise of average temperature of Earth's surface. Biodiesel offers a renewable source of energy from various plant and animal-based feedstocks. The chemical composition of biodiesel fuels is identified through the presence of fatty acid methyl esters (FAMEs) that vary in composition based on feedstock. In this research, samples of pure biodiesel and blends of biodiesel and diesel were separated using Gas Chromatography-Mass Spectrometry (GC-MS) on a RTX-50 mid-polar column. Various concentrations of biodiesel-diesel blends (B100, B20, B10, B5, B2, and B1) were analyzed using Principal Component Analysis (PCA) to determine variables contributing to differences in sample composition.

We thank Dr. and Mrs. Timothy J. Babineau '82; and Kim and Wendell P. Weeks P15 for their generous contribution to the Alumni / Parent Summer Research Scholarship Fund.

## Poster 36

### **Birth Matters: Representations, Perceptions, and Experiences of Childbirth in America**

*M. Collins and R. L. Beard*

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For most of history, women have given birth with the assistance and support of midwives. In most of the world today, midwives remain the primary practitioners for birth. In the US, however, midwives attend about 10% of births, most of which are in hospitals rather than at personal homes. The US also has a cesarean section rate of 31.8% - far in excess of the 20% recommended by the World Health Organization. The advent of modern medical training, which largely precluded women, challenged the legitimacy of midwives. Since the 1900s, we have been socialized to believe that the "safest", "most efficient" way to give birth is in a hospital with obstetricians. In this explorative, qualitative study, representations of birth in various contexts were analyzed using grounded theory methods. Through participant observation and extensive field notes at one birth center and two hospital maternity wards, four themes arose regarding differences in how birth was portrayed, discussed, and evidently understood by various stakeholders: 1) the setting, 2) institutional logics, 3) practitioner interactions, and 4) potential client experiences. The settings, the organizational priorities, and the interactions between nurses, midwives and families all shape the experiences of women considering their birth options. Given the hegemony of medicalized birth practices, few women in America are actually making a choice. Instead they are automatically giving birth in a hospital, the only time otherwise "healthy" people are hospitalized. Three major goals of this study were to understand how this medicalized view of birth has persisted, to discover why some still choose to be and utilize midwives, and to provide additional information on alternative forms of maternity care so women can make increasingly informed decisions. Given the high rates of medical care it would behoove us to offer the lower cost alternative that midwives and birth centers provide to the women giving birth who are low-risk and do not require the medical expertise of trained surgeons.

We thank the Richard J. Greisch '72 P99 Summer Research Fellowship in Sociology for its generous financial support.

## Poster 37

### In Office Urolift Procedure Performed Under Local Anesthesia in an Outpatient Institution: Early Outcomes

*L. Hildreth, A. L. Le Sueur, A. Martin, A. E. Katz, J. T. Schiff*  
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Benign Prostatic Hyperplasia (BPH) with Lower Urinary Track Symptoms (LUTS) is most often treated with medical therapies or transurethral resection of the prostate (TURP), yet these treatment options have adverse quality of life (QoL) outcomes and side effects for the patient. The prostatic urethral lift, or Urolift, provides both adequate relief of symptoms and preservation of sexual function. Existing research has yet to investigate a population on whom the procedure was performed exclusively under local anesthesia. This retrospective, single surgeon study evaluates the effectiveness of the Urolift performed under local anesthesia in an outpatient setting. Demographic and clinical information for 102 consecutive patients were analyzed. Primary outcome measures included the International Prostate Symptom Score (IPSS), Quality of Life (QoL), post residual void (PVR) volumes and adverse events. Patients were not excluded based on prior procedures, IPSS or PVR values. Primary outcome measures, IPSS, QoL and PVR were analyzed using a two sample paired t-test and a Wilcoxon signed-rank test in order to account for deviation from normality. A one-way Analysis of Variance was used to determine differences between samples within the population. All Urolift procedures in this study were performed under local anesthesia in an outpatient setting. This study reported a 30% reduction in symptoms according to IPSS surveys and a 37% improvement in QoL scores ( $p<0.001$  and  $p<0.001$ ). Data showed a 28% improvement in PVR volumes ( $p<0.01$ ). Fifty-two men were able to stop oral therapies post-procedure. Adverse events were reported for 14 patients, with most resolving within two weeks of procedure. In addition, 15 men with prior BPH procedures exhibited similar improvements as the entire cohort. The Urolift performed in an out-patient setting under local anesthesia yielded similar results to that performed in an in-patient setting under general anesthesia. In addition, our facility showed a greater reduction in PVR volumes.

We thank the Crusader Internship Fund for the financial support.

## Poster 38

### Cryptography in a Post-Quantum World

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In modern electronic transactions such as online purchases or banking, cryptographic systems are in place to protect a user's private information. The security of these *cryptosystems* is based on the hardness of certain mathematical problems, whose computational infeasibility creates resistance to attack, protecting private information. Once fully developed, the power of quantum computers threatens to solve those hard problems, risking the security of electronic data protected by current systems. Recognizing this approaching threat, the National Institute of Standards and Technology (NIST) began a public process of searching for quantum-resistant cryptosystems. In early 2017, NIST invited experts to submit quantum-resistant algorithms, and received sixty-nine viable submissions. In the first round of this search, these algorithms are currently available for public comment, testing, and evaluation. In our research we studied the mathematical foundations of two of these algorithms, examining the fundamental structures, specifications, and implementations of each. We looked at the NTRUPrime submission, a public key cryptosystem using polynomial convolution rings. This is a variant of the classic NTRU system which has been in use since the 1990s (with an update to this system, called NTRUEncrypt, being another submission). Further, we examined the Supersingular Isogeny Key Encapsulation (SIKE) protocol, an algorithm that uses compositions of isogenies between Montgomery elliptic curves to securely communicate information in a key exchange system.

This research was funded by the generous contribution made by Richard A. Marfuggi, M.D. '72 to the Alumni / Parents Summer 2018 Research Scholarship Fund.

## Poster 39

### Effects of Family Functioning, Patient Temperament, and Patient Age on Post Traumatic Growth in Pediatric Cancer Patients:

#### A Literature Review

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The stress of cancer treatment can have particularly significant impacts on the lives of children, as they are simultaneously experiencing critical stages of physical, social and emotional development. Post traumatic growth is sometimes observed as a response to this stressor. My review of the literature revealed that environmental factors such as family functioning interact with individual factors such as patient temperament and age and affect the prevalence of post traumatic growth experiences in pediatric cancer patients. Post traumatic growth (PTG), or benefit finding, is a positive psychological change experienced as a result of adversity or a traumatic event. Although the general belief is that serious illnesses lead to psychological difficulties, these challenges can also serve as catalysts for personal growth and empowerment. Family functioning relates to the type of relationship between the ill child and his/her parents, and also includes the amount of cohesion, expression of emotions and the degree of organization within a family unit. A parent's positive disposition and open communication can serve as a protective factor for a child and can foster better emotional adjustment. In particular, my literature review revealed a significant link between patient temperament and PTG. Research reveals that PTG is more prevalent among children who have high levels of self-esteem, effortful control and ego resilience. However, PTG is most common during adolescence, as youth have developed greater thinking and reasoning capabilities and are better able to self-report positive outcomes from their treatment experiences.

We thank the Weiss Summer Research Program for financial support.

## Poster 40

### Optical Pumping of Rubidium Atoms

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Atoms in gas typically travel randomly at various directions and speeds and have a random orientation. In our lab, rubidium atoms are slowed down by using laser light and magnetic field, then used to study quantum wave reflection. Each atom is a tiny dipole magnet, and in our experiments it is advantageous for the atoms' dipole moments to be all pointing in the same direction. In order to align these, we can apply a uniform, circularly polarized beam of laser light in a uniform magnetic field. Absorption and scattering of the light changes the atoms' angular momentum, thus changing its dipole direction, a process known as optical pumping (OP). Atoms with dipole moments pointing opposite to the local magnetic field will be repelled from a surface having a large field. Controlling the atomic orientation will allow us to investigate its effect on the reflection of rubidium atoms. To produce a uniform OP laser beam we built a spatial filter, giving a smooth intensity profile, highest at the center and decreasing farther away from the center. The filter also allows us to create a larger diameter beam. Because the cloud of rubidium atoms when trapped is only a couple of millimeters wide, we want a beam wider than this so that every atom is optically pumped. In a typical experiment, we first slow down and collect a cloud of atoms, then turn on a uniform magnetic field and OP light beam for 5 milliseconds, and finally measure the reflection of atoms from a magnetized surface. By varying the polarizer used for the OP light, we are able to observe a change in the reflected atom signal. We see a sinusoidal pattern where the peak happens when the atoms' dipole moments are aligned antiparallel with the magnetic field, and we see a trough at polarizer angle 90 degrees after, when the dipole moments are aligned parallel to the field, as expected from quantum theory.

We thank Catherine and Domenic J. Dinardo '75 P21,17,06 for their financial support.

**Poster 41**

**Copper-Catalyzed Reactivity of Ketenimines**

A. T. Palaia, and A. K. Isaacs

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Ketenimines are reactive synthetic intermediates that can engage with nucleophiles, electrophiles and radicals. We applied ‘click chemistry’ that utilizes copper as a catalyst to generate desired ketenimines from the reaction of an alkyne with tosyl azide. In a one-pot copper-catalyzed process, the acyclic substrate is transformed into a 1,4-disubstituted 1,2,3-triazole, which will decompose into a ketenimine. Nucleophilic addition of an external nucleophile to the ketenimine generates an enamine which can participate in an Aza-Michael addition to a well-designed  $\alpha$ ,  $\beta$ -unsaturated portion of the parent substrate creating a 1,2-dihydroisoquinoline, with the nucleophile attached on the 3-position of the 1,2-dihydroisoquinoline in a one-step reaction. The 4-substituted-1,2-dihydroisoquinoline can be accessed by first forming the triazole by using copper(I)-thiophene-2-carboxylate, followed by exposure to a rhodium catalyst. This results in the formation of a rhodium carbenoid which allows for nucleophilic addition at the 4-position and subsequent aza-michael addition to form the product. This allows for rapid access to both regioisomers of the 1,2-dihydroisoquinoline, which can then be converted into an isoquinoline, with substitution on either the 3-position or 4-position. Isoquinolines are important structural motifs present in a wide range of naturally occurring compounds with important biological profiles. By utilizing multiple known nucleophiles (amines, alcohols and pyrroles) and varying the alpha,beta-unsaturated portion of the substrate (ketone, ester) we hope to synthesize a wide variety of isoquinolines and their derivatives.

We thank Mr. Richard B. Fisher '47 P79 for financial support.

**Poster 42**

**Copper-Catalyzed Reactivity of Ketenimines**

G. R. U. Gildersleeve and A. K. Isaacs

*Department of Chemistry at the College of the Holy Cross*

Pegaharmine F is a naturally occurring compound that has not been previously synthesized. Pegaharmine F is a  $\beta$ -carboline alkaloid found in the seeds of a peganum harmala flower that was traditionally used in northwestern China for cancer and malaria treatment. Although Pegaharmine F has not been tested for biological applications, a synthesis could be very useful for confirming the structure. We hope to utilize ketenimine chemistry in a one pot total synthesis of Pegaharmine F, which would also represent the first application of ketenimine chemistry in a total synthesis of a naturally occurring compound. Pegaharmine F is an indole alkaloid consisting of three rings. The third ring includes a nitrogen on a double bond that could be created by taking advantage of the electrophilic central carbon in a ketenimine. We envision accessing Pegaharmine F via coupling of the appropriate indole derivative with a ketenimine accessed from methyl propiolate. This would give us an intermediate that would provide Pegaharmine F after SN<sub>2</sub> displacement with the activated indole derivative. We are currently optimizing the coupling of indole and indole derivatives with a ketenimine to test the viability of this synthetic route.

I would like to thank Mr. Richard Fisher '47 P79 for financial support

## Poster 43

### Developing a Rubric to Examine Children's Conceptions of the Day-Night Cycle Before and After Instruction

V. Jackson, A. McCarthy, G. Anzilotti, M. Ciolkowski, F. Anggoro, and B. Jee<sup>1</sup>

Department of Psychology, College of the Holy Cross

<sup>1</sup>Department of Psychology, Worcester State University

Research has documented children's difficulty reconciling their observations of the sky (an Earth-based perspective) with scientific models of the solar system (space-based perspective). Understanding the day-night cycle requires such an integration, where Earth's eastward rotation causes the apparent motion of the Sun. In this project, we examined video data from structured interviews with 108 3<sup>rd</sup>-grade children about the day/night cycle. The goal was to develop and apply a comprehensive rubric to capture children's representations before and after instruction that emphasized *relational learning*—mapping the spatial, causal, and temporal relations inherent in the day-night cycle. We focused on several key dimensions for the rubric, such as the *perspective* of the child (e.g., Earth-based, whole system), the child's *causal attributions* (e.g., goal/process-oriented), and the *mental model* used to explain the phenomenon (e.g., Sun goes up and down). Children's mental models were further classified into *Earth-based*, *Space-based/Sun motion*, and *Space-based/Earth motion*. Reliability was established among 4 research assistants, who subsequently coded the pre- and post-test videos using the coding rubric. Preliminary results showed that (a) consistent with our prior findings, children who received the instruction demonstrated fewer misconceptions about Sun motion at posttest compared to those who didn't, and (b) misconceptions were more persistent on topics where it is particularly challenging to integrate Earth- and space-based perspectives (e.g., Earth rotates eastward but sunset appears in the west).

This project was supported by the Institute of Education Sciences Grant #R305A150228 to F. Anggoro and B. Jee.

## Poster 44

### Wikimap Project

A. Noenickx and J. Svec

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Static maps often fail to contextualize history and clearly illustrate change over time. They depict a limited number of variables, finite rectangular regions, and often confusing colors and notation. Using HTML, CSS, and JavaScript, we have coded a prototype for a comprehensive world map that rectifies the shortcomings of traditional paper and digital static maps. Our wikimap is editable—allowing trusted users to add their own toggleable layers to the map. The map is zoomable up to street level and can display satellite images. Wikimap also features a draggable slider that changes the year and layers accordingly and a play button that allows one to watch layers change automatically as history unfolds before them. Our finished wikimap will be a collaborative tool that allows experts in their own fields to add their respective layers to the map. Teachers, history enthusiasts, and the public will then be able to view the map and customize it by selecting from our repository of layers. One can pick and choose which layers and variables they see, allowing users total customization of their mapping experience.

We would like to acknowledge the Weiss Summer Research Program in Economics for financial support.

## **Poster 45**

### **Constitutional Law in Higher Education**

*W. McGee and S. Sandstrom*

*Hon. Joseph F. Greene Moot Court Program, College of the Holy Cross*

Constitutional law plays a vital role in determining the modus operandi of educational institutions in the United States. Examining the role of constitutional law in higher education, we highlighted two issues: gender-conscious affirmative action and an employee's right to free expression. While American colleges and universities frequently employ gender-conscious admissions policies, courts have tested their permissibility only under Title VI of the Civil Rights Act of 1964 and Title IX of the Education Amendments of 1972 — never under the Equal Protection Clause of the Fourteenth Amendment. We attempted to bridge the gap between existing jurisprudence on affirmative action and gender-based classifications to develop cogent arguments for and against the implementation of a gender-conscious policy in university admissions. Another persistent challenge for educational institutions, regulating the speech of employees, has puzzled courts because of the "special niche" that colleges and universities occupy in our constitutional tradition. We examined the right of an employee to speak on matters of public concern and still maintain a balance with the interests of the institution they represent. Focusing on several instances of retaliation by individuals and institutions alike, we developed an understanding of both parties' positions and worked to discover the legal bounds of 'academic freedom.'

We thank the members of the Hon. Joseph F. Greene Moot Court Program, especially our coaches and captains, past and present, for their invaluable leadership. We further thank the Weiss Summer Research Program in the Humanities, Social Sciences, and Fine Arts for financial support.

## **Poster 46**

### **Effect of Immediate Postpartum Implant Use on Breastfeeding Status at Six Weeks**

*C. MacMillan, S. Higgins<sup>1</sup>, and A. Nelson<sup>2</sup>*

*<sup>1</sup>The University of Connecticut School of Medicine*

*<sup>2</sup>Hartford Hospital, Department of Obstetrics and Gynecology*

Long acting reversible contraception (LARC) is important in modern family planning and in maternal and fetal health. Providing LARC devices in the hospital immediately postpartum has practical and medicinal benefits, but also raises concerns about hormonal interference with postpartum processes like lactation. This retrospective, cross-sectional chart review looks at the percentage of women with an immediate postpartum etonogestrel-containing implant who are breastfeeding at six weeks postpartum. The percentage of patients with the etonogestrel-containing implant exclusively breastfeeding at six weeks postpartum was about 50% less than the percentage exclusively breastfeeding immediately after delivery. This study was not powered to analyze the many confounding factors influencing breastfeeding status.

We thank Hartford Hospital for financial support.

## Poster 47

### The Influence of Age on Canine Lung Mesenchymal Stromal Cells

L. Dominguez, A. Hentschel, B. McDonough, and Julia Paxson

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We are interested in identifying how age affects the function of cells used in tissue repair. This is important, since many chronic diseases are associated with reduced tissue repair and are known to increase with age. We are investigating the effect of aging in mesenchymal stromal cells (MSCs), which are known to be important in tissue repair. Our study examines the regenerative and proliferative abilities of canine lung mesenchymal stromal cells (LMSCs). These cells are harvested post-mortem from seven companion dogs of varying ages (<1 week to 15 years) that died of natural causes. Companion dogs are a useful model organism, for they age similarly to humans and are exposed to our same environmental stressors. The cells are isolated by explant outgrowth, a technique that requires the LMSCs to migrate out from small tissue sections in culture dishes. LMSC function was assessed using the Colony-Forming Units (CFUs) assay and Population Doubling Time (PDTs) at three different passages (P3, P5, P7). In addition, the capacity of the cells to recover after oxidative stress was assayed at P5 before and after exposure to hydrogen peroxide using incorporation of EdU to measure cell proliferation. Younger dogs tended to exhibit more proliferative abilities, with higher clonogenicity (CFUs) and shorter population doubling times. Younger LMSCs also showed greater proliferation (75-90% EdU-positive cells), compared to older LMSCs (~60%). However, oxidative stress affected young LMSCs more than old LMSCs, with 40-60% less EdU-positive cells on young LMSC damage plates than their respective controls.

This research was made possible by generous contributions made to the Alumni / Parent Summer Research Scholarship fund by Dr. William C. Goggins and Mrs. Laurie D. Goggins '88; Janice and William F. McCall, Jr. '55 P90,90,89; and Jacqueline H. and George A. Paletta, Jr., M.D. '84 P15.

## Poster 48

### Examining the Effect of Inflammation on Limb Regeneration in the Axolotl

C. Davis, J. Farkas, A. Lovely, and J. Monaghan

Department of Biology, Northeastern University

Axolotl salamanders have the ability to completely regenerate their limbs after amputation. Previous studies have shown that limb regeneration is dependent upon an intact nerve supply and suggest that peripheral nerve axotomy may inhibit regeneration by releasing factors that cause inflammation. We investigated whether inflammation via immune cells in the amputated limb does, in fact, inhibit limb regeneration. We hypothesized that an increase in immune cells present in the blastema would correlate to a decrease in proliferating cells. We compared the percentage of proliferating cells present to the percentage of immune cells present in three types of limb tissues: a control group, a denervated group, and a group injected with Poly IC, which induces an immune response. Our results show that inflammation does inhibit limb regeneration but also suggest that, contrary to our expectations, denervation may not cause this inflammation. Interestingly, previous work has shown that inflammatory cells are required for limb regeneration. Our results showing that an overabundance of inflammatory cells is also detrimental to regeneration suggests that tight regulation of the inflammatory cells is critical for mounting a robust regenerative response.

We thank NSF grant #1656429 for financial support.

## Poster 49

### Investigating the Potential Macroalgae Diets of *Arbacia punctulata* Larvae

S. Grosskopf and J. McAlister

Department of Biology, College of the Holy Cross

Sea urchin adults have relatively diverse diets of benthic macroalgae (seaweeds); whereas, larvae feed primarily on unicellular microalgae (phytoplankton). It is not completely known what role macroalgae play in the diets of sea urchin larvae. Recent research demonstrates that kelp detritus can serve as a high-quality food source for sea urchin larvae. This summer, my goal was to determine if other benthic seaweeds found in adult urchin habitats provide for similar larval growth as does kelp. I performed a pilot study and determined that urchin larvae can consume lab-made detritus of the common intertidal seaweeds *Ulva intestinalis* and *U. lactuca* (sea lettuce), *Laminaria agardhii* (kelp), *Fucus* sp. (bladder wrack), and *Chondrus crispus* (Irish moss) and prefer kelp and Fucus. Next, I reared larvae of the sea urchin *Arbacia punctulata* under four food treatments: high and low concentrations of the unicellular microalga *Isochrysis galbana*, and separate food slurries made from kelp and Fucus. I found that *A. punctulata* larvae can grow while consuming kelp and Fucus detritus. However, the larvae reared under the Fucus and kelp diets did not grow as much within 10 days as larvae provided with a satiation diet of Isochrysis. Larvae consuming Isochrysis grew to the 8 arm stage within 10 days whereas the majority of the Fucus and kelp larvae were still at the 4 arm stage. This project provides an avenue for further research into the diets of sea urchin larvae. Future related studies may examine the effects on larval growth of mixed macro- and microalgae food treatments.

I would like to thank the George I. Alden Trust for financial support.

## Poster 50

### Investigating Coated Laser Diodes in an ECDL System

C. Umohoza, S. Saiti, and T. Roach

Department of Physics, College of the Holy Cross

We have been studying the effect of low-reflectivity coatings designed to improve the frequency control of an Extended Cavity Diode Laser (ECDL) system. The system includes a semiconductor laser diode chip that has two reflective facets. These partially confine light produced inside the chip so that it can undergo amplification. The ECDL uses an external diffraction grating that reflects light back into the laser chip, allowing finely controlled tuning of the light frequency. The competition between reflected light from the external grating and the chip's front facet to the back facet of the laser diode leads to an unstable light frequency. The laser light has specific allowed frequency modes that it can operate on. One set of modes is due to the chip reflections, with the allowed mode frequencies separated by typically tens of GHz. A second set of modes comes from the external grating reflection and has allowed frequencies separated by a few GHz. When changing the laser frequency by adjusting the grating, we sometimes observe "mode hopping" whereby the light frequency does not stay on one mode but jumps discontinuously to a different frequency mode. Competition between the two mode sets is unstable leading to more frequent and less predictable mode hops. We have coated the front facet of the laser chip with a thin anti-reflection layer of SiO to minimize its reflectivity, increase the laser's threshold current, and observe fewer more predictable frequency mode hops. My goal was to analyze the optical behavior of the coated lasers and look for changes and improvement relative to the uncoated lasers. Using a precision spectrometer and a power output sensor, I measured the frequency of light and how it depends on the length of the extended cavity, and I also studied the effect of the tilt and rotation alignment of the grating. I analyzed experimental data from five coated lasers, and I will show results showing a successful reduction in chip mode hopping and improved stability of the laser.

We thank Mr. and Mrs. Edward J. Burke, Jr. '86 for their financial support.

## Poster 51

### Reflectivity of SiO Coatings on Semiconductor Lasers and Silicon

S. Saitia, C. Umuhoza, and T. Roach

Department of Physics, College of the Holy Cross

Reflectivity of light off any surface strongly depends on the index of refraction of the material's surface. However, it is possible to greatly reduce the overall reflectivity by applying a thin layer of a different material onto the original surface. If this "anti-reflective coating" is applied at the correct thickness, the two reflections between the front and the back of the coating itself cancel out through destructive interference and the overall reflectivity decreases, ideally to 0. Optical wave theory states that destructive interference is maximized, and reflectivity is minimized, when the layer thickness is  $\frac{1}{4}$  of the wavelength of light, or any odd integer multiple of that. We use this theory to reduce an undesired reflection in our External Cavity Diode Laser (ECDL) system. An ordinary semiconductor laser diode produces light which reflects between its front and back facets while getting amplified and emitted. In the ECDL system, a reflective diffraction grating is positioned a distance away to send some emitted light back into the laser chip. This grating is used to control the frequency; however, there is a competition between the reflection off the front facet and the reflection off the grating which causes for an unstable frequency of emitted light. By coating the front facet of the chip and eliminating the reflection, the grating would have full control over the frequency of emitted light. The anti-reflective coating itself is deposited in a vacuum system in which we supply a large current to heat up a container of silicon monoxide (SiO), which then evaporates onto any surface above it, such as a laser chip. It is difficult to directly measure the reflectivity of the laser chip facet because of its small size (about  $1\mu\text{m}$  across), so we have coated 10 wafers of silicon semi-conducting material (about 2 cm across) with varying thicknesses of SiO, and then measured the reflectivity at two different wavelengths of light, achieving a reflectivity as low as 0.1%. We will present our data from coating laser chips and silicon wafers and compare them to the expectations from optical theory.

We thank Karen Connolly Gregg '79, P10 and Gary R. Gregg, P10 for their generous financial support.

## Poster 52

### Retrospective Investigation of a 2017 Outbreak of Carbapenem-Resistant *Klebsiella pneumoniae*

L. Dentinger, K. Mitchell, E. Snavely, P. Lapierre, L. Pascal, E. Nazarian, and K. Musser

Wadsworth Center, New York State Department of Health

Carbapenems, a class of  $\beta$ -lactam antibiotics that include drugs such as imipenem, meropenem, ertapenem, and doripenem, are the treatment option of choice for serious infection caused by multi-drug resistant bacteria. Carbapenem-resistant *Enterobacteriaceae* (CRE) can cause life-threatening illness in individuals who are immunocompromised. One mechanism of resistance to carbapenems are carbapenemases, enzymes capable of hydrolyzing carbapenems; this type of resistance can be easily spread to multiple bacteria via acquired plasmids. The KPC carbapenemase (encoded by the *bla<sub>KPC</sub>* gene) is the most common enzyme identified in the United States and is often found in *Klebsiella pneumoniae*. Here, we investigated an outbreak of carbapenem-resistant *K. pneumoniae* in a health care facility in the Northeastern United States. We verified the identity of all the organisms involved in the outbreak using mass spectrometry. We then identified the resistance mechanism present using a real-time PCR assay. DNA was extracted from the organism and its genome was sequenced using the Illumina MiSeq sequencing platform. Our WGS analysis determined that all *bla<sub>KPC</sub>* positive isolates contained the *bla<sub>KPC-3</sub>* variant. In agreement with our real-time PCR analysis, 16 of the 44 isolates did not possess the *bla<sub>KPC</sub>* gene but did contain other genes that confer resistance to  $\beta$ -lactam antibiotics. Using both PFGE and SNP analysis, we determined that the KPC-positive bacteria could be grouped into two clusters, with slight variation on the isolates belonging to each cluster depending on the method used. This work allows for a better understanding of this outbreak and will impact the future of infection control in this facility.

We thank the CDC ARLN for funding through the ELC Cooperative Agreement Award (NU50CK000423-04).

## Poster 53

### Toward a Heideggeean *Ethos* for Contemporary Environmentalism

E. Oser and C. Dustin

Department of Philosophy, College of the Holy Cross

Recently several philosophers have argued that environmental reform movements cannot halt humankind's destruction of the biosphere because they still operate within the anthropocentric humanism that forms the root of the ecological crisis. According to these "radical" environmentalists, disaster can be averted only if we adopt a nonanthropocentric understanding of reality that teaches us to live harmoniously on the Earth. Martin Heidegger agrees that humanism leads human beings beyond their proper limits while forcing other beings beyond their limits as well. The doctrine of the "rights of man" justifies human exploitation of nonhuman beings. Paradoxically, however, the doctrine of rights for nonhuman beings does not escape the orbit of humanism. According to Heidegger, a nonanthropocentric conception of humanity and its relation to nature must go beyond the doctrine of rights. We can dwell harmoniously on Earth only by submitting to our primary obligation: to be open to the Being of beings. We need a new way of understanding Being, a new metaphysics, that lets beings manifest themselves not merely as objects for human ends, but as intrinsically important. Heidegger calls this *ethos* the "fourfold" of earth and sky, gods and mortals. An environmentally sound *ethos* can arise, according to Heidegger, only from a shift within the cultural heritage of the West. Richard Rorty agrees that we must become open for a new "conversation" with the West, even if this requires abandoning traditionally important fields, such as epistemology. The need to develop a new understanding of Being is so great that thinkers from the analytic and continental traditions of philosophy are finally initiating a long-overdue dialogue.

We thank the Weiss Summer Research Program for funding this work.

## Poster 54

### Electron Beam Testing using a Faraday Cup, and Assembly of an Ion Beam Profile Monitor

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Collision experiments between an ion beam and an atom beam are subject to inefficiencies and systematic errors without reliable information concerning the size, shape and intensity of the ion beam. The work described in this poster details the construction of an ion beam profile monitor (BPM) to accurately provide this data. In addition, an electron beam system was constructed and tested, which will in the future allow testing of the BPM with an electron beam. The BPM is comprised of a wire grid which has 8 horizontal and 8 vertical tungsten wires. When a beam of charged particles strikes the wire grid small electrical currents are induced in the wires. These currents can be measured by a set of sensitive current amplifiers, allowing the determination of the size, shape, and intensity of the charged particle beam. Much work this summer was spent assembling the BPM and integrating it into a custom vacuum system which will allow it to be tested using an electron beam. An additional vacuum chamber was constructed to house the electron beam system for its initial testing prior to use with the BPM. The electron beam system consists of a heated filament to provide a source of electrons, an acceleration electrode to accelerate the electrons towards a Faraday cup which is used to measure the intensity of the electron beam. Electric and magnetic fields are also applied to steer the electrons accurately into the six millimeter entrance of the Faraday cup. We present data showing electron beam currents of several hundred nano-amps. However, the current varies significantly with time, which we attribute to changes of the filament surface composition as the filament is heated. Data showing the enhancement of the electron current with increased acceleration are also shown, in addition to a study of the secondary electrons emitted from the Faraday cup surface when it is struck by the primary electron beam. Eliminating these secondary electrons is required for an accurate determination of the primary electron beam current.

We thank the Alumni/Parent Summer Research Scholarship Fund for financial support and Dick Miller for machining expertise.

## **Poster 55**

### **A Comparison Study of Social Reintegration: Veterans and Contact Sport Athletes**

*R. Barsic, N. Chouairi, and G. Senecal*

*Department of Psychology, College of the Holy Cross*

Veterans returning from combat, having survived war and social reintegration, suffer from physical and mental disorders at far higher rates than the American population as a whole. These include depression, bipolar disorder, substance abuse, personality disorder, pain disorder, anxiety disorder, and death by suicide, along with “invisible wounds of war,” such as the anxiety disorder Post-Traumatic Stress Disorder (PTSD). More than 40% of returning veterans exhibit these illnesses. Likewise, increasing rates of former contact sport athletes are being diagnosed with a similar range of symptoms. The discovery of CTE (chronic traumatic encephalopathy) in the brains of former contact sport athletes has raised awareness around the prevalence of these struggles. Recent tragedies and deaths in the lives of some professional contact sport athletes has spurred greater intrigue into researching the biological, psychological, and social factors that might be contributing to these difficulties. A more thorough examination of this transitional phenomenon is required to understand it and to assist both veterans and athletes during their reintegration process. Our study addresses quantitative and qualitative methods that dive into the social, phenomenological, moral, emotional, and intersubjective aspects of the transition. By adding detail and nuance to the lived experience, the study hopes to advance research beyond the current classification and treatment of the general categories of diagnosis as they currently stand.

We thank the Weiss Summer Research Program and the Holy Cross Psychology Department for financial support.

## **Poster 56**

### **Catalytic Esterification of Amides**

*J. L. Hendsey, S. Wright, and J. Bandar*

*Department of Chemistry, Colorado State University*

Amides and esters are both important functional groups found in proteins, natural products, and pharmaceuticals, making them useful functional groups to study. Amides are poor electrophiles, and not very reactive because they are resonance stabilized. This makes it difficult to convert amides into esters, as the reaction is energetically uphill. This reaction would be useful as it would allow us to use amides as protecting groups and incorporate esters at the end of a synthesis pathway. There is currently no general method for this transformation. In the presence of a strong base and an alcohol, an amide will form some ester product in very low yields. We have discovered a way to push this equilibrium forward using a Michael acceptor. The free amine adds to the Michael acceptor, creating the hydroamination product, and preventing the amide from adding back to the newly formed ester product, pushing the reaction forward based on Le Chatelier’s Principle. We have found that this addition of a Michael acceptor has increased our yields significantly. Our methods work on a wide variety of aryl amides and alcohols, and we hope to expand our scope to aliphatic amides as well.

I would like to thank the National Science Foundation for funding.

## Poster 57

### Dovetail Internet Technologies: Development Documentation Internship

K. Keohane and M. Villa

Dovetail Internet Technologies

As an intern for Dovetail Internet Technologies, I worked on the product development team and helped create documentation explaining technological features of Dovetail's software. I analyzed existing content and helped build their documentation while maintaining the established information architecture. I worked with team members to obtain an in-depth understanding of Dovetail's products and services, primarily CyberStore. Working collaboratively with developers, computer programmers, quality engineers, and product managers, I built documentation on a number of CyberStore features. I wrote internal documentation for Dovetail employees along with external documentation for clients to directly access on Dovetail's Documentation Center. I used clear and understandable language for clients with minimal technological background, ultimately helping create a bridge between the Dovetail product development team and clients.

I would like to thank the J.D. Power Center for Liberal Arts in the World for financial support.

## Poster 58

### Ferric Iron Reduction Supports Growth of *Campylobacter fetus*

D. Cojocaru, H. Matthews, and M. Vargas

Department of Biology, College of the Holy Cross

*Campylobacter fetus* is a gram negative, curved bacterium that may cause intestinal illness, and abortions in humans and domestic animals. *C. fetus* is an asaccharolytic organism that respires amino acids primarily with low concentrations of oxygen (5-10% O<sub>2</sub>) at temperatures ranging from 30-42°C. In addition, several reports indicate that *C. fetus* can utilize anaerobic electron acceptors such as fumarate, nitrate, thiosulfate, and sulfite with hydrogen, formate, or several amino acids as a source of energy. However, it is not known whether pathogenic species, including *Campylobacter*, can respire with iron. Therefore, we conducted anaerobic cell suspension assays in test tubes containing 5mM soluble iron (III) in bicarbonate buffer and 80% hydrogen and 20% carbon dioxide in the headspace to assess whether *C. fetus* can biologically reduce iron. Our results showed that within four hours, *C. fetus* reduced 82% of the ferric iron provided only in the presence of hydrogen. Furthermore, we determined that *C. fetus* grows in a strictly anaerobic environment using ferric iron as the terminal electron acceptor in a standard complex medium, reducing 90% of the iron provided. The growth rate increased when supplemented with hydrogen. *C. fetus* also grew anaerobically in a defined medium with ferric iron in the presence of hydrogen. This phenomenon was also displayed in solid media as a clearing around microbial growth incubated in an anaerobic chamber. This is the first report of a pathogen capable of growth supported by iron reduction. Thus, this ability may be important in *C. fetus* colonization of humans and animals and/or survival under free-living conditions in the environment.

We thank Mr. and Mrs. John Kirby Bray '79 P10; and Deirdre O'Brien Soltesz '94 and Edward G. Soltesz, M.D. '94 for supporting this research.

**Poster 59****Technology Spillovers Within China's System of Research Institutes**

*A. Yang and D. Tortorice*

*Department of Economics and Accounting, College of the Holy Cross*

Many factors influence the productivity and patenting activity of research institutes in China: total expenditure, total personnel, total revenue, etc. Technology spillovers, which are the beneficial effects of new knowledge produced by an institute on the productivity of other institutes, also contribute to the output of research institutes. We have attempted to study their effects on China's research institute system. We collected data on inputs, expenditure, personnel and patents from the Ministry of Science and Technology for institutes from 1995 to 2013. We found relationships between such variables and output. For example, research institutes tend to patent more if total expenditure increases. We have also found GPS locations for the institutes. These coordinates allow us to calculate the distance between every institute and find the average distance of a research institute from other related institutes. We proposed an estimation equation, and we expect that a research institute with greater average distance to related institutes will have less technological spillovers and therefore produce fewer patents.

We would like to acknowledge the Weiss Summer Research Program in Economics for financial support.

**Poster 60****Mega-Events and Tourism: The Case of the 2014 World Cup in Brazil and the 2016 Rio Summer Olympic Games**

*S. Vrountas, V. Matheson, and R. Baumann*

*Department of Economics and Accounting, College of the Holy Cross*

Brazil's hosting of both the 2014 FIFA World Cup and the 2016 Rio Olympics provides a unique opportunity for comparison of these two events. We compare the tourism effects of the 2014 FIFA World Cup and the 2016 Rio Olympics with respect to the change in net foreign arrivals in Brazil. Given the relatively equal costs of both events, the aim of this work is to determine which of these events had a greater payoff. We found that the increase in net foreign arrivals as a result of the World Cup was ten times greater than the increase due to the Olympics.

We thank the Weiss Summer Research program in Economics for financial support.

## Poster 61

### Spay and Neuter Mandates: Are they Effective?

*E. Sullivan and M. Boyle*

*Department of Economics and Accounting, College of the Holy Cross*

Shelters in the United States are grossly overpopulated: an estimated 11 million dogs and 9 million cats enter our shelters annually. This has damaging effects on animal welfare, since the most common outcome for sheltered pets is euthanasia. To combat this, some have proposed spay and neuter mandates, or laws requiring that pets undergo a medical procedure to make them unable to breed. The effects of such a policy are unknown, since they could either decrease pet populations or simply discourage pet owners from registering their pets in fear of being fined or having their animal impounded. We performed an empirical analysis of spay and neuter mandates in California between 1995 and 2016 to see if there is any measurable impact on animal intakes or outcomes. We employed a difference-in-difference strategy to compare counties with mandates and counties without mandates before and after the mandate was in effect. Our results showed that the mandates did have a statistically significant effect on several important measures. In mandate counties, the number of dogs and cats surrendered by their owners decreased by 18.8% and 24.5% respectively after the mandates. For dogs, adoptions increased by 18.7% while euthanasia decreased by 10.4%. For cats, adoptions increased by 7.9% and euthanasia decreased by 10.4%. An additional specification using a matching algorithm based on propensity scores was used to compare mandate counties to similar non-mandate counties, and found similar results.

We thank the Weiss Summer Research Program in Economics for financial support to complete this project.

## Poster 62

### The Effect of Rotten Tomatoes Ratings on Movie Profitability

*W. LaFiandra and D. Schwab*

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Classical economics assumes that consumers have full information when making consumption choices, but this assumption does not hold in many sectors of the economy. One case in which this assumption fails is in the presence of experience goods — goods whose quality are not known until after consumption. In these cases, consumers have to rely on external sources of information such as reviews or branding in order to make well-informed buying decisions. This study explores how movie consumers react to the review aggregation website Rotten Tomatoes. A simple regression of profitability on movie reviews will not identify the causal effect of RT because movies of higher quality are likely to receive better reviews and be more profitable than those of lower quality. However, one of Rotten Tomatoes' institutional features is its rotten/fresh distinction; movies that receive a rating above 60% are labeled fresh, while those that score under 60% are declared rotten. Using a regression discontinuity design, we exploit this threshold in order to better determine a causal relationship between ratings and profitability. We find no evidence to suggest that consumers are influenced by Rotten Tomatoes' rotten/fresh distinction. This may indicate that consumers instead rely on other sources of information when making movie consumption choices.

We thank the Weiss Summer Research Program in Economics for financial support.

## **Poster 63**

### **Economics of the Concert Industry**

*C. Hendershott and V. Matheson*

*Department of Economics and Accounting, College of the Holy Cross*

Our research aims to inform policy decisions regarding future subsidization of stadium and arena renovation and construction. Venue subsidies are often awarded under the notion that the sports infrastructure will also attract non-sporting events and performers. To assess the validity of this belief, we first explore growth and concentration within the concert industry. Using data from Pollstar's Top 200 North American Tours from 2002 to 2018, we found that the industry as a whole is becoming more lucrative. At the same time, the industry is not particularly concentrated and has not become any more concentrated in recent years. Understanding the economic nature of the concert industry will help us identify the effects of updating sports infrastructure on income from non-sporting events.

We would like to acknowledge the Weiss Summer Research Program in Economics for financial support.

## **Poster 64**

### **Poetry at the Margins: Identity and Ideology in Contemporary**

**“Pop” Poetry**

*R. Fay and M. Schoenberger*

*Department of English, College of the Holy Cross*

Poetry has a long and extremely varied history, but—although much poetry has survived by virtue of its poetic substance and cultural significance—the contemporary cultural conceptualization and consumption of poetry opts for poems of a less substantial and more ephemeral sort. Indeed, this “pop” poetry of simple, readily consumable meaning and brief, quick composition has become increasingly prevalent in recent years due to a variety of factors. The predominant cultural conceptualization of poetry, for instance, frames poetry as “high,” unattainable art, and yet this unattainability also renders poetry fraught with cultural capital to be cashed in; pop poetry, then, is appealing inasmuch as it offers readily attainable “poetry” with the same degree of cultural capital that consuming poetry entails. This factor has perhaps been prevalent for quite a while, whereas factors such as social media and identity politics complicate poetry. Social media effectively allows for immediate mass *distribution* of poetry, thereby accommodating its mass production. Given that the phenomenon of online pop poetry reduces the substance of poetry to a mere commodity, the identity of the poet, by extension, becomes reduced to a mere commodity as well; specifically, *marginality* is no longer viewed in a socioeconomic or historical context, but it rather seen as some merely *aesthetic* quality, and so substantial marginality becomes culturally conflated with some apparent “aesthetic marginality.”

We thank the Weiss Summer Research Program for financial support.

## Poster 65

### Monitoring Changes in CRH Neuron Activity in Mice Using a Model of Bladder Outlet Obstruction: A Pilot Study

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Beth Israel Deaconess Medical Center

Studying changes in neural activity in regions of the brain that control micturition in mice has significant relevance to lower urinary tract symptoms (LUTS). With recent advancements, groups of neurons have been identified in the pontine micturition center (PMC) that become excited with micturition events. The purpose of this project is to study changes in neural activity of CRH neurons in male mice which are induced with bladder outlet obstruction (BOO), a condition that can be present in ageing men who have an enlarged prostate that obstructs the flow of urine exiting the bladder. We hypothesize that CRH neuron activity increases due to hypertrophied prostate and bladder. Transgenic CRH-ires-Cre mice had two pellets implanted containing testosterone and 17 $\beta$ -estradiol to induce symptoms of BOO. After pellet implantation, behavior was recorded using a non-invasive technique called Micturition Video Thermography (MVT). Four weeks after pellet implantation, the mice underwent stereotactic surgery to receive a microinjection of an adeno-associated virus with a calcium indicator linked to a fluorescent probe; GCaMP6s. An optical fiber was implanted above the PMC region to record from CRH neuron cell bodies. Seven weeks into the project, mice underwent surgery for a bladder catheter implantation, after which bladder pressure could be monitored while neuron activity from CRH neurons was recorded. Once all behavior trials are completed, mice will be cardiac perfused, brains then cut on a freezing microtome, and immunohistochemistry performed on the brain slices. At this time, conclusions can only be drawn from our MVT behavior analysis. Seven weeks after the pellet implantation, some mice showed incontinent voiding behaviors when compared to behavior trials before surgery. More experiments need to be conducted to draw conclusions about CRH neuron activity and micturition control.

We acknowledge the financial support from the National Institutes of Health.

## Poster 66

### Parsing Pliny the Elder's Natural History

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We are morphologically parsing a digital edition of a 9th century Latin manuscript of the *Natural History*. Since Latin is an inflected language, word forms vary by their use in a sentence's syntax. "Morphological parsing" is essentially automating the recognition of those word forms. With a new system called "tabulae," we can build a Latin parser using nothing more than simple, tabular text files. The process begins with creating rule-tables. Word endings are recorded in these tables with identifying grammatical information. For example, in a table of rules for 1st conjugation verbs, "o" is matched with the appropriate person, number, tense, mood, and voice. Lexical stems have a separate table and match with their appropriate rule set. So "am-" (the stem for "amo") would automatically be matched with rules for 1st conjugation verbs. While building a parser for Pliny, we are also creating a demonstration parser for *Allen and Greenough's New Latin Grammar*. In treating the vocabulary found in *A&G*'s paradigms as a corpus, we can build rules for every possible form in the grammar. Since the rules found in the *A&G* cover the vast majority of forms seen in classical Latin, we are importing these rules into our Pliny parser. Then, only the lexical stems for Plinian vocabulary need to be added. The implications of fully parsing a text in this way are substantial. We will, for example, be able to analyze Pliny's use of the first person, or examine what individuals in the *Natural History* are often treated as subjects or objects. This level of linguistic analysis, especially on such a broad and efficient scale, has not previously been possible.

We thank the Weiss Summer Research Program in the Humanities, Social Sciences, and Fine Arts for funding our research this summer.

## **Poster 67**

### **The Quiet Resistance Against Federal Immigration Policy**

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This research investigated how cities and towns create opportunities for undocumented immigrants. It questioned the policy of declaring sanctuary status, arguing that there is an array of instruments that cities can use to support undocumented immigrants without having to confront the federal administration openly. As such, the research compared Worcester, not a sanctuary city, and Somerville, which has been a sanctuary for 30 years. Data showed that both towns use similar strategies to support their undocumented immigrant population. One way was the prevention of municipality's funds to the enforcement of federal immigration policy. Another was ensuring that housing codes could not disproportionately affect undocumented migrants. However, at the same time, there was a definite difference, Worcester library had more extensive programs designed to help undocumented immigrant compared to Somerville. Worcester as well faces more risks from declaring itself a sanctuary city compared to Somerville.

We thank the Weiss Summer Research Program for financial support.

## **Poster 68**

### **A Rhetorical Analysis of Donald Trump and the Christian Right**

*A. Fimognari Jr. and D. Klinghard*

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The Christian Right, a voting bloc consisting of mainly Evangelical Protestant Americans, is now one of the most influential voting blocs in the United States of America as it made up 26 percent of the electorate in the past three presidential elections. As influential as the Christian Right is today, it has also proven to be one of the most unpredictable voting blocs as its support does not always align with the policies of candidates. The most shocking moment in the history of the Christian Right is undoubtedly its record support for Republican Candidate Donald Trump in the 2016 presidential election. In an attempt to predict the voting tendencies of the Christian Right in future elections more accurately, this paper shows a rhetorical analysis of speeches from candidates who received great support from the Christian Right, candidates who did not receive great support from the Christian Right, prominent Methodist pastor Norman Vincent Peale, as well as a multitude of Evangelical Protestant leaders within the Christian Right Movement. Through this rhetorical analysis, this paper explains that candidates who did not receive a significant amount of support from the Christian Right utilized the rhetorical appeals of logos, pathos, and ethos in order to create a rhetoric that tells a story of overcoming problems as an entire country or international community. Alternatively, candidates who used the rhetorical appeals of logos, pathos, and ethos in order to create a rhetoric that tells the story of good vs. evil received the most support from the Christian Right. This paper finally explains that the same rhetorical tactic is also present in the speeches of Norman Vincent Peale, the childhood pastor of Donald Trump, and the Evangelical Protestant leaders thus uncovering that the voting patterns of the Christian Right tend to rely on the rhetorical techniques of candidates; not only their policy stances.

We thank the J.D. Power Center for Liberal Arts in the World for financial support.

## Poster 69

### Egg Size and Protein Composition in Hybrid *Asterias* Seastars

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Egg size and composition vary both within and across marine invertebrate taxa. Generally, smaller eggs offer little energy and materials for developing larvae, requiring larvae to collect food from the surrounding environment. Larger eggs often reflect increased maternal investment, i.e. biochemical constituents, which are used to fuel metabolism and for building the initial pre-feeding morphology of the larva. Of these constituents, protein is used primarily for morphogenesis, but can also serve as an energy source during periods of starvation. Larger eggs do not always correlate with increased protein amount. In fact, how egg size and individual biochemical constituent composition co-vary is generally poorly understood. In some cases, larger eggs may have similar protein amounts as smaller eggs, but a greater volume of seawater. Hybridized individuals of the sea star *Asterias* have been observed to produce two size classes of eggs. Hybrids may show more variation in egg size across reproductive females than within populations of pure-bred females, but whether this variation is due to differing amounts of biochemical constituents or seawater is unknown. We assayed the eggs of 13 females collected from within a hybrid zone for protein composition. While none of the females we spawned produced two different size classes of eggs simultaneously, we did find that across females, the eggs we obtained fell into two different classes: smaller eggs (egg volume  $<1.0 \text{ nL}$ ) and larger eggs (egg volume  $>1.0 \text{ nL}$ ). We found that the protein amount amongst smaller eggs was not significantly less than protein amount in larger eggs and that protein density decreased as egg size increased. These results suggest that the variability in egg size in hybridized individuals may be due to differing amounts of seawater. We are conducting additional assays for lipid and carbohydrate composition, which will provide a more complete understanding of maternal investment in the eggs of hybridized individuals of *Asterias rubens* and *Asterias forbesi*.

We thank the George I. Alden Trust for financial support.

## Poster 70

### Triassic Paleontological Fieldwork and Fossil Preparation in Arizona, Wyoming, and Utah

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Many major vertebrate groups first originated in the Triassic Period, at the start of the Mesozoic Era. In June and July of 2018, we excavated and prepared fossils to help increase the understanding of reptilian evolution and vertebrate biodiversity in the Upper Triassic. Our fieldwork took place in the Petrified Forest National Park, Arizona, and near Lander, Wyoming. In the Chinle Formation of the Petrified Forest, we excavated fossils belonging to early archosaurs, such as phytosaurs and aetosaurs, extinct relatives of modern crocodiles and birds. In the Popo Agie Formation of Wyoming, we worked to excavate and airlift a fully articulated Triassic phytosaur skull, which will be removed from its sediment encasing over the next few years. Based on a preliminary field examination, this phytosaur likely belongs to a new species. In the fossil preparation laboratory at the Natural History Museum of Utah, we prepared several specimens, including phytosaur ribs, a humerus, osteoderm, metacarpal, and an unidentified long bone. In the museum's paleontology collections, we examined Eocene fossils that had been illegally collected from the Green River Formation in Wyoming during the 1980s and had recently been given to the museum. We helped catalogue these fossils, belonging to early mammals like the *Uintatherium* and *Palaeosyops*, and then stored them in the museum's vast collections. In the Bell Springs Member of the Nugget Sandstone in Rawlins, Wyoming, we surveyed geological rock layers to evaluate stratigraphic connections. At this locality we also helped excavate a reptilian trackway preserved in sandstone. Studying the fossil record from these Upper Triassic geological formations will help increase our insight into reptilian speciation and biodiversity across the Triassic landscape.

We thank our donors, Mr. Michael C. Trimboli '72 and Mrs. Rosemary Trimboli Burgio, for graciously sponsoring our summer research experience and enabling us to gain practical experience in paleontological fieldwork and fossil preparation. We thank the Yale Peabody Museum of Natural History, the Natural History Museum of Utah, and the field crew from Virginia Tech for guiding us during our first fieldwork experience.

## Poster 71

### **<sup>1</sup>O<sub>2</sub>-Responsive Dialkoxy and Thiophene Containing Acenes**

*D. Che, V. Brega, and S. W. Thomas III*

*Department of Chemistry, Tufts University*

Here, we report the synthesis and the reactivity of various acene derivatives towards singlet oxygen (<sup>1</sup>O<sub>2</sub>). <sup>1</sup>O<sub>2</sub> is the lowest energy excited state of molecular oxygen. It is prepared by a process known as photosensitization, where a photosensitizer is irradiated into its singlet state, and then converted into its triplet stage. From there, the triplet photosensitizer reacts with oxygen, taking the oxygen into its singlet state. Due to the fact that many acenes are readily oxidized by <sup>1</sup>O<sub>2</sub> into endoperoxides, acenes can play a significant role in <sup>1</sup>O<sub>2</sub>-responsive materials. We have synthesized and characterized a library of acenes and we report their kinetic properties in accordance with pseudo first order kinetics. We observed the oxidation of the acene in a solution of methylene blue, a soluble and red shifted photosensitizer. We followed the disappearance of the acene absorbance bands using a UV-Vis Spectrophotometer and determined the rate constant of each acene in comparison to 9,10-diphenylanthracene, a standard that was used as its rate constant is known. By understanding the reactivity and kinetics of a wide range of different acene derivatives, the ability to use these acenes in <sup>1</sup>O<sub>2</sub>-responsive materials widens even further, with possible uses in OLEDs, sensing probes, drug delivery systems and much more.

We thank the National Science Foundation for financial support.

## Poster 72

### **Notes from the Underground Palaces: The Moscow Metro System**

*and Its Hidden Figures*

*P. Corey and A. Adams*

*Department of Russian, College of the Holy Cross*

With 200 stations, 207 miles of track, and trains arriving every 90 seconds, the Moscow Metropolitan is one of the most impressive public transportation systems in the world. The Soviet era “Metro” stations are museum quality spaces that display Socialist Realist art, statues, mosaics, and stained glass windows. In 1935, Joseph Stalin broke ground on the Metro. From the outset, the system was not just a means of transportation. It was also a powerful a propaganda tool that functioned as a semiotic hub that instructed the masses in Soviet ideology. These underground “palaces” feature historical, political, economic, and cultural “icons” from Revolutionary soldiers, technological innovations, and quotations from great literary works, all designed to model the heroism of the past and create “splendid images” of a promised Soviet socialist future. Today, the Metro is undergoing the kind of expansion seen during the Stalin era. President Vladimir Putin plans to expand the Metro system by 40 percent by the year 2020, creating at least another 79 stations, which calls for serious examination of Putin’s construction of these stations. My research found that Putin also seems to use the underground transit system as a semiotic space by using artwork to memorialize past historical and cultural figures in a similar way that Stalin does. But Putin’s message is new: while the Soviet era system distinguishes the USSR from the West, these newer stations seem to try to create parallels between Russia and the West. With support from the Ignite Fund, I was able to travel to Moscow to view and photograph 13 newly opened stations. I have chosen three – Sretensky Bulvar, Lomonosovksy Prospekt, and CSKA (цска) -- to demonstrate how Putin now celebrates past figures such as Pushkin, Russia’s national poet, Lomonosovsky (Russia’s Fibonacci), as well as representations of Soviet sportsman. In my view, Putin’s expansion construction of these stations displaying Russia’s world figures in comparison to other worldly figures aims to appeal to the Western world just in time for the World Cup in 2018.

We thank the Weiss Summer Research Program and Ignite Fund for financial support.

## Poster 73

### Hyperinsulinemic-Euglycemic Clamp to Assess Insulin Sensitivity In Vivo

*T. Luong and J. Kim*

*Department of Molecular Medicine, University of Massachusetts Medical School*

Insulin resistance is a major characteristic of type 2 diabetes. It is the impaired ability of insulin to stimulate glucose utilization. Insulin sensitivity can be measured using many different techniques that are commonly employed in diabetes research and care such as glucose tolerance test (GTT), and insulin tolerance test (ITT). However, hyperinsulinemic-euglycemic clamp is the gold-standard method to assess insulin sensitivity *in vivo* by addressing the limitations of GTT and ITT. The hyperinsulinemic-euglycemic clamp raises and maintains circulating insulin levels by intravenously infusing insulin at a constant rate. However, insulin infusion rate may be adjusted for various reasons. During the clamp, glucose is intravenously infused at variable rates to maintain euglycemia. Incorporation of radioactive-labeled glucose during the euglycemic clamps makes it possible to assess the rate of glucose metabolism in individual organs. Blood samples are taken at different time-points throughout the experiment to measure basal concentrations of glucose and insulin, as well as plasma glucose concentration and finally, blood sample is taken at the end to measure plasma insulin concentration. At the end of the experiment, mice are anesthetized and tissues are rapidly taken for biochemical and molecular analysis. In recent years, this gold-standard method has been actively performed in transgenic animal models of obesity, diabetes, and its complications. This technique has significantly advanced our understanding on the etiology and pathogenesis of type 2 diabetes.

I would like to thank co-chairs Mr. Troy Dixon and Mr. Tom Jessop of New York Leadership Council for funding my internship.

## Poster 74

### Retrospective Review of the Effect of Neuromuscular Blockade on Pain after Pediatric Hip Arthroscopy

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Boston Children's Hospital, Harvard Medical School*

So as to maximize the successful outcomes of surgical procedures, it is necessary to minimize pain. Hip arthroscopy is an operation used to treat a range of hip disorders. Although this procedure has an excellent safety profile, postoperative pain remains a persistent problem. While the efficacy of various anesthetic techniques used for hip arthroscopy have been reported, the effect of a neuromuscular blockade on pain has not been specifically evaluated. Muscle relaxants are important as their use is thought to decrease traction-related injuries in pediatric patients. The aim of this review was to determine the effect of muscle relaxation during hip arthroscopy on pain outcomes. We hypothesized that there would be a decrease in postoperative pain reported in patients who received muscle relaxants during hip arthroscopy compared to those who did not. We utilized an integrated perioperative outcomes database at Boston Children's Hospital to gather data on preoperative demographics, intraoperative care, and postoperative outcomes for patients undergoing hip arthroscopy between June 2015 to June 2018. Data on 400 total hip arthroscopy patients were evaluated. Of the patients that qualified for analysis, 204 received muscle relaxation while 196 did not. An analysis of our primary and secondary outcomes showed no significant difference in postoperative pain where 31% of patients with muscle relaxation experienced high postoperative pain compared to 33% of patients without muscle relaxation;  $p = 0.78$ . Similarly, opioid consumption in the postoperative period was not significantly different, with a median of 1.61 (1.3-2.09) mg/kg used for patients with muscle relaxation compared to a median of 1.66 (1.41-1.96) mg/kg reported for those without muscle relaxation;  $p = 0.56$ . Further analysis of prospective, randomized, blinded cohorts of patients will be necessary to confirm our findings.

I thank Boston Children's Hospital and the Department of Anesthesiology, Perioperative and Pain Medicine for their support, and Mr. John Kirby Bray and Mr. Joseph Fallon for funding my internship.

## **Poster 75**

### **Philosophical and Poetic Truths: Reconnecting the Head and the Heart**

*L. Luu and C. Dustin*

*Department of Philosophy, College of the Holy Cross*

Much has been written about the nature of poetry and the nature of philosophy, about the way they relate to one another, and about the relation of poetry to any nugget of truth. This goes back to Plato who discloses, in the Republic, the “ancient quarrel between [poetry] and philosophy.” (Book X, 607c-d). Most writers have concluded that the nature of philosophy has nothing to do with poetry while poets do not aspire to be philosophers. But, what truly comes alive and breathes into the words of great poetry are shades of assonance and dissonances that reveal a belonging together of poetry and philosophy. It is a matrimony made in heaven: philosophy speaks in words and not just in concepts. The word weds itself to the poetic nature that gives birth to philosophy. It is poetry that breathes the life into philosophy. Using poetic words to communicate philosophical ideas, we are able to not only move our heads, but also our hearts. Poetry is more interesting when it asks serious questions about life, while philosophy has to be in harmony with human beings and life itself. Philosophy needs to speak to the soul in order to shed light on existence.

We thank the Weiss Summer Research Program in the Humanities, Social Sciences and Fine Arts for financial support.

## **Poster 76**

### **Re-Staging the Life Course: The Family Therapy Paradigm and Memoirs of Personal Transformation**

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Ideals of healthy family relationships permeate today's practice of psychotherapy and animate a billion-dollar industry of self-help. These frameworks are historically relatively recent, however, and derive from the emergence of the family therapy movement in the 1950s and 1960s, a popular cultural paradigm that has challenged ‘dysfunctional’ and ‘toxic’ childhood effects. This project analyzed the effects of the family therapy movement on the life course of individuals through a content analysis of best-selling memoirs and self-help books. These data were coded using qualitative software, MaxQDA. By identifying the types of dysfunction, critical life-changing events, key actors, and engagement with popular cultural resources defining dysfunctional and healthy relationship strategies, we traced the social forces that shaped how each individual reshaped their life course following dysfunctional childhoods. Our empirical analysis helps us to theorize how an individual’s life course is shaped by macro social forces and micro social interactions, then the different factors that keep the individual in the dysfunctional environment and/or lead the individual out toward a life course transformation resulting in processes we explain as ‘restaging’, exposing the private relational dynamics of family in a public sphere ‘transformation’, adopting a new framework for understanding what is normal and what is deviant and ultimately ‘avowal’, resistance against the old paradigm and affirmation of a new one all serving the process of creating a new, ideal life course for the individual.

We thank the Weiss Summer Research Program, the Ignite Fund, and the Greisch Scholarship Fund for financial support.

## Poster 77

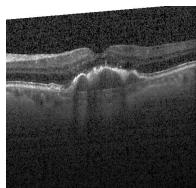
### Macular Degeneration Classification Through Topology and Convolutional Neural Networks

*M. Marlett, D. Damiano, R. Righi\*, and E. Gasparovic\**

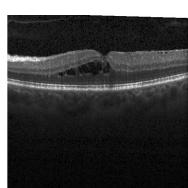
*Department of Mathematics, College of the Holy Cross*

*\*Department of Mathematics, Union College*

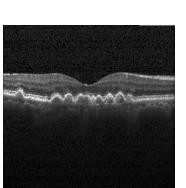
Macular degeneration is a disease of the retina that affects the macula, the region in the center of the retina responsible for high-resolution, color vision that is possible in good light. The loss of central vision makes it difficult to recognize faces, drive, read, or perform other activities of daily life. The classification of macular degeneration in the retina involves the ability to differentiate between three different types of macular degeneration, drusen, choroidal neovascularization, and diabetic macular edema as well as healthy retina. In this project, we combine methods from computational topology and deep learning to analyze a data set consisting of 83,711 optical coherence tomography (OCT) images of healthy and diseased retinas. In the first stage of this project we have applied convolutional neural networks to this data set. Our goal is to improve on non-topological based analyses of OCT images.



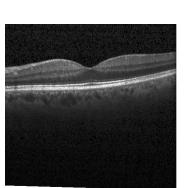
CNV



DME



Drusen



Normal

We thank Wendy R. and Kenneth J. Edwards, M.D. '80 P12 for their support of the Alumni/Parent Summer Research Fellowship.

## Poster 78

### Young Adult Smokers' Reactions to Smoking Cessation Campaigns: A Qualitative Study Background

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*Division of Intramural Research, National Institute on Minority Health  
and Health Disparities*

Media campaigns have been used to encourage smoking cessation. However, few studies have examined how this population react to smoking cessation campaigns. In this study, we examined young adult smokers' reaction to two recent smoking cessation campaigns. Twelve focus groups ( $n=75$ ) were conducted among young adult smokers (ages 18–29) stratified by race/ethnicity (i.e., non-Hispanic white, non-Hispanic black, vs. Hispanic) and education (i.e., some college, vs. high school education or less). Advertisements from two ongoing smoking cessation campaigns (*Tips from Former Smokers* and *Every Try Counts*) were shown to the participants. Reactions were solicited using a discussion guide. Discussions were audio recorded, transcribed verbatim, and analyzed using a thematic analysis through an online qualitative analysis tool, Dedoose. Many young adult smokers said they were unaware of these campaigns. Participants expressed that fear appeals used in the *Tips from Former Smokers* had no immediate relevance to them. They also stated that messages from the *Every Try Counts* seemed to be dull or condescending. Both campaigns were deemed ineffective. Participants also identified messages in the *Every Try Counts* campaign as smoking cues. In contrast, elements identified to be efficacious were: relatable health consequences (e.g., tooth loss) and encouraging messages that recognized the difficulty in quitting smoking. Importantly, participants wished to see more facts about the process of quitting smoking. Participants expressed a preference towards relatable and encouraging smoking cessation messages. Incorporating these suggestions may increase the acceptance and effectiveness of smoking cessation campaigns targeting young adult smokers.

This research was funded by the National Institutes of Health

## Poster 79

### The Effects of the Fall of Socialism on Gender Equality in Volgograd, Russia

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The collapse of the USSR had a significant effect on the economic, cultural and ideological frameworks in Russia. Gender equality, though never fully achieved from a social standpoint, was encouraged by the socialist state. In contrast, gender inequality appears to have been exacerbated when Russia shifted into a more market-driven economy. In order to further understand the intricacies of this process, I collected 32 detailed, personal accounts from women of three different generations, who were residing predominantly in Volgograd, Russia – a historically prominent city that suffered significant negative economic repercussions after the perestroika. Comparing perspectives from three different generations allowed a better understanding of the impact historical events had on these women's lives. It also illuminated the ways in which the collapse of the USSR created a shift in values and ideological framework. Though individual accounts varied, these women revealed that structural conditions have worsened for a large majority. The younger generations, in particular, appear to be struggling after having been deprived of both material and educational opportunities. Economic collapse was a tragedy for the older generation, which depended on state pension plans for retirement. It did, however, open some doors for creative and spiritual direction for middle-aged women previously discontent with the Soviet Order. These interviews were conducted in Russian and translated in order to be accessible to an English speaking public.

We thank the J.D. Power Center for Liberal Arts in the World for financial support.

## Poster 80

### An Investigation into Golgi Biogenesis in *T. brucei*

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Trypanosoma species are kinetoplastid parasites located primarily in Africa and Southeastern Asia and are the causative agents of trypanosomiasis. Due to this, many aspects of their cellular biology have been subjects of investigation including the mechanism of Golgi duplication during cell division. So far, two models of Golgi biogenesis have been proposed: the templated vs the *de novo* models. Upon preliminary examination of the *T. brucei* cell cycle using data found in the TrypanoDB database, the *de novo* model seemed to be most probable. A series of bioinformatic graphs using this data then revealed two potential groups of proteins which seemed to incorporate into the daughter Golgi at different times, "early" and "late". To examine this phenomenon, these proteins were tagged with a fluorescent gene marker and visualized using fluorescent microscopy in order to observe their movement into the new Golgi with respect to one another. The data amassed by this microscopy in fact supported our preliminary bioinformatic data. At the same time, aberrations in cell cycle progression in a couple cells led to questions involving the role of the closely-associated bilobe in Golgi division; a subject never fully investigated. While cells were nutrient starved to try to recreate these aberrations, none were found. Further analysis was halted by bacterial contamination.

This research was funded by the Wellcome Trust.

## Poster 81

### Validation and Reliability of Mobile Technology for Speech Sample Acquisition in Healthy Controls

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University of Melbourne

Measuring speech pathologies in patients with neurological diseases such as multiple sclerosis (MS) requires expensive equipment with a complicated setup, which limits the number of people that can be included in studies. There is a strong incentive to find a speech diagnostic biomarker for MS, but first the recording protocol must be simplified by using cheaper and more convenient devices. In this study, we compared three cheap microphone configurations of the iPod touch to the professional microphone to determine whether they can be used as more affordable and convenient alternatives. Many aspects of speech timing and frequency of three different microphone configurations of the iPod touch were statistically comparable to that of the professional microphone, the benchmark device for speech sample acquisition. This suggests that these cheaper microphones might serve as reliable substitutes for the professional microphone in order to measure speech pathology in patients to guide diagnoses.

We thank the National Health and Medical Research Council for financial support.

## Poster 82

### Investigating Maternal Effects in the Sea Anemone, *Nematostella vectensis*, from Chronic Exposure to 17 $\beta$ -Estradiol

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Department of Biology, College of the Holy Cross

An organism's phenotype is the product of its genotype, the environment that the organism experiences as well as the environment experienced by its mother. This effect of the maternal environment on phenotype expression is termed the maternal effect and it has a crucial impact on the offspring's phenotype and performance. Maternal exposure to stress and toxins can result in physiological, behavioral, and developmental changes in offspring. Most importantly, the effects of chronic exposure to endocrine-disrupting chemicals in most marine invertebrates are unknown. Therefore, the aim of this study is to determine whether a chronic maternal exposure to an environmentally disruptive agent such as 17 $\beta$ -estradiol in relevant concentrations has effects on the growth, behavior, feeding, and potentially the development *N. vectensis* and its offspring. In this study, anemones (15-35 in each group) were exposed for 21 days to one of 7 treatments: seawater control, DMSO control, and 0.1, 1, 10, 100, 1000 ng/L of 17 $\beta$ -estradiol in constant darkness. The anemones were weighed and photographed before and during treatment exposure in order to record their growth, behavior, and feeding. We found no effect of 17 $\beta$ -estradiol on survivorship or feeding abilities. However, anemones in the highest doses of 17 $\beta$ -estradiol (100 and 1000 ng/L) displayed deflated morphology and retraction of the tentacles, behaviors that were dissimilar to anemones exposed to low concentrations of estradiol or the two control treatments. Other analyses are ongoing. The results from this study provide information on how various concentrations of chemical exposure can lead to disadvantageous behavioral, and developmental outcomes.

We thank the George I. Alden Trust Excellence in Career Related Undergraduate Education for financial support.

## **Poster 83**

### **Choice between Pattern and Random Sequences**

*P. F. Segura Tobarra and C. Locurto*

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Humans are capable of implicitly learning sequences, meaning that they learn a sequence without the knowledge that they are doing so. In previous experiments in our lab, we developed an animal model of implicit learning. Using random reinforcements we demonstrated that nonhumans are capable of this type of learning. Our most recent experiments examined whether pigeons show a preference for either patterned or random image sequences, each of which was learned implicitly. Across multiple experiments, each pigeon, received baseline training of trials consisting of only pattern sequences and trials consisting of only random sequences. The pigeons were then given the choice between pattern and random sequences. This choice allowed us to test whether pigeons have a preference for patterns. We hypothesized that pigeons would prefer pattern sequences over random sequences even with reinforcement equated between the two types of sequences, across different types of training, and despite changes in stimuli. Our results show that pigeons have a significant preference for pattern sequences. Additional analysis during conditioning days shows that the pigeons completed both random and pattern sequences equally fast. However during choice trials the pigeons tapped the cue for pattern sequences faster than the cue for random sequences when they were given the choice.

We thank the Alumni / Parents Summer Research Scholarship Fund for making this research possible.

## **Poster 84**

### **Terrorism and the Success of Peace Treaties in Northern Ireland and Israel**

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Between 1960 and 1998 the Provisional Irish Republican Army utilized guerilla tactics against pro-United Kingdom militants and British forces in Northern Ireland. Their terrorist campaign was aimed at toppling the Northern Irish government, ousting the British from the island, and eventually unify Ireland. In 1998 the Belfast Agreement was created and recommended to the public by both Nationalist, or pro unification, and Unionist, or pro-United Kingdom, politicians alike. The Agreement ended the decades of violence and brought radical political parties into democratic institutions. Twenty years later, violence has not resumed, and the Belfast Agreement remains strong. Israel and Palestine attempted a similar process of peace negotiations in 1993 between the Israeli government and the Palestinian Liberation Organization. While multiple treaties were signed, the PLO could not contain terrorism nor the rise of groups like Hamas. The treaties, known as the Oslo Accords, fell apart. This project analyzes the success of the Belfast Agreement and the downfall of the Oslo Accords. Furthermore, with a more narrow scope upon Hamas, the potential for their involvement in lasting peace negotiations is discussed.

We thank the Weiss Summer Research Program for funding this research.

## **Poster 85**

### **Isange One Stop Center as a Multi-Sectoral, Government-Based Institution Fighting Gender Based Violence in Kigali, Rwanda**

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Gender based violence is a recurring method of inflicting harm on an individual that leads to devastating effects on said individual, such as physical injuries, undesired pregnancies, HIV, PTSD, depression and sometimes death. This paper examines Isange One Stop Center, a government-established center that provides medical, legal, and psycho-social services to victims of gender based violence in Kigali, Rwanda. The clinic aims to provide holistic medical treatment to the victim, and seeks to foster a society that is proactive against gender based violence and holds perpetrators legally accountable for their actions. This paper uses staff insight to examine the administrative strengths and weaknesses of the institution. Data was collected through anonymous surveys distributed to doctors, psychologists, and police officers from the center, as well as government officials from the Ministry of Gender and Family Promotion (MIGEPROF). It was analyzed using the Statistical Package for Social Sciences. Our results showed that Isange is perceived as successful by the majority of its staff, suggesting that it is a positive clinic model for other countries to consider implementing. A shortage of resources, however, insufficient preventative care, and laws restricting what forensic evidence is acceptable severely limit the efficacy of the organization. Additionally, the majority of the staff were unaware of MIGEPROF's policy initiatives that complement the clinic's work against gender based violence; therefore, they were not able to fully contribute to the Ministry's efforts. Steps to improve the clinic's weaknesses include implementing tactics to increase preventative care options as well as improving transparency with MIGEPROF. Further research must be conducted to understand how to best address the legal system's restrictive guidelines on forensic evidence. Lifting these parameters could potentially allow lawyers to prosecute sexual and domestic abuse cases in a way that provides justice to victims and reshapes cultural norms that enable violence.

We thank the J.D. Power Center for Liberal Arts in the World for financial support.

## **Poster 86**

### **Alterations of the Anti-HIV Protein APOBEC3G Results in Super Activity**

*L. Piz and A. M. Sheehy*

*Department of Biology, College of the Holy Cross*

Human Immunodeficiency Virus (HIV) causes an incurable disease which affects millions of people globally. Infection leads to profound immunosuppression leading to Acquired Immunodeficiency Syndrome (AIDS) and ultimately death. The human protein APOBEC3G (A3G) is an innate restriction factor that combats HIV infection by damaging the viral genome via its catalytic cytidine deaminase activity. A3G-mediated damage occurs during reverse transcription and results in the destruction of the viral DNA and thus inhibition of HIV replication. The Sheehy lab has created a library of 135 distinct A3G mutants to further investigate the catalytic activity of A3G and the contribution to its antiviral function. There are data that suggest that A3G can function independently of this well-characterized catalytic activity. We examined several A3G constructs for catalysis and, somewhat unexpectedly, identified a mutation of A3G that exhibited activity significantly greater than that of wild type A3G. Of the more than 50 A3G mutants previously assayed, this is the first alteration in A3G to demonstrate super-catalysis in the screening assay. Because A3G catalysis is linked to its antiviral activity, we are currently investigating whether this super-catalytic activity is also indicative of enhanced antiviral activity. Preliminary experimentation is focused on defining the relationship between protein expression of the super-catalytic A3G and its enzymatic activity. In addition, the stability of the altered A3G protein and its antiviral activity relative to wildtype A3G will also be examined in human cells.

Thank you to the Alumni / Parents Summer Research Scholarship Program for funding my research this summer.

## Poster 87

### **Penalty Kicks in Soccer: Exploring the Unconscious Brain**

E. Gurchiek, F. Sorcini, J. Hall, M. Rabinovich, and G. J. DiGirolamo

*Department of Psychology, College of the Holy Cross*

During a penalty kick, a goalkeeper must rapidly predict ball directionality before reacting to attempt a save. Eye-tracking studies indicate fixation on the kicking leg, non-kicking leg, and hip orientation are all cues that correspond to improved directional anticipation (Salvelsbergh et al., 2002; Causer et al., 2017; Diaz et al., 2012; Woolley et al., 2015). Goalkeepers tend to focus on these areas and surpass field player counterparts in penalty prediction tasks who, in turn, are more successful than those who lack soccer experience (Woolley et al., 2015). Poulter et al. (2005) found that if individuals were explicitly informed of these cues, their predictions significantly improved. This suggests performance can be *consciously* enhanced. We sought to examine the *unconscious* brain's ability to assess penalty kick directionality. Participants (n=4 soccer players, n=4 controls) viewed images of three stages of penalty kicks that were either masked (obscured to prevent conscious interpretation) or unmasked, then completed a motor task, responding left or right based on the location of a cue. We assessed speed of reaction time based on the congruency of the cue to either the ball's location or the ball's eventual direction. Preliminary results suggest that for conscious trials, faster responses are elicited by the ball's location but not its eventual direction ( $p=0.0754$ ). This effect was not found during masked trials. We will be testing more participants to expand on these findings; additionally, we will incorporate a goalkeeper group to more fully explore expertise and unconscious processing.

We thank the Alumni / Parents Summer Research Scholarship Fund for financial support.

## Poster 88

### **Unconscious Detection of Cancerous Stomach Nodules**

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Diagnosis in biomedical imaging (does this stomach CT have a cancer tumor?) is the outcome of a difficult visual search which, like any complex task, employs both conscious and unconscious brain processes. Detection relies ultimately on these processes triggering a conscious recognition. Radiologists spend many years of training, enhancing these conscious and unconscious processes. Here, we tested whether these unconscious processes were capable of detecting the lesion and influencing the radiologist in the absence of conscious awareness of the abnormality. On a touch screen, we briefly (50 msec; 1/200<sup>th</sup> of a second) presented a CT scan of either a healthy stomach or a stomach with a tumor, and then masked the image (covered it so the radiologist couldn't continue to visually process the image). The mask after the 50ms presentation of the CT scan ensures that the radiologist cannot consciously register the image, so any significant results are due to unconscious processes. We then presented a 4-square grid and gave an audio cue telling the radiologist to touch the location specified by the audio cue as fast and accurately as possible. Preliminary results indicate that the radiologist is significantly faster at touching the quadrant in which an abnormality was present than touching where normal tissue was. Moreover, the number of errors (touching the wrong quadrant) was halved when the radiologist was cued to touch where an abnormality had occurred than normal tissue. These data suggests that unconscious detection of the abnormality occurred, and the radiologist's brain knew the location of the abnormality in the absence of conscious awareness.

We thank the Alumni / Parents Summer Research Scholarship Fund for financial support.

## Poster 89

### Analysis of Topic Models

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A topic model consisting of  $n$  topics over  $k$  passages of a text can be considered a collection of  $k$  vectors in  $n$ -dimensional Euclidean space. The sum of components of each vector sums to 1; consequently, each vector lies on the  $n-1$ -dimensional unit simplex. Using this interpretation, we can calculate several geometric quantities of individual vectors, including their Euclidean magnitude and sup norm. Furthermore, the magnitude of difference, difference of magnitude, and angle can be calculated between different vectors. Such values may reveal information about the narrative structure of the work as a whole. A larger magnitude corresponds to passages focusing on a fewer number of topics. A large magnitude of difference between two passages suggests the passages overall focus on very different topics. Similarly, a large angle suggests the passages differ by a large amount. A rolling average of these values over the entire work may offer further insight by revealing larger trends in the narrative. Moreover, such analysis can help identify how ‘good’ a particular topic model is for a text. Although the vectors lie on an  $n-1$ -dimensional simplex, most components are usually near 0. So, these vectors are practically on a much lower dimensional simplex, such as a 5-skeleton for a 30 topic model. Thus, a ‘better’ topic model may be one whose distribution of vectors more closely resembles that of a simplex of randomly-generated vectors in a lower dimension.

We thank Dr. Dan Kennedy ‘68 for financial support.

## Poster 90

### International Post-Operative Intravesical Chemotherapy Study

*M. Daidone, K. Pinto, T. McLaughlin, T. Nzenza, and A. Meraney*

*Hartford Hospital*

Transurethral resection of bladder tumors (TURBT) is utilized to biopsy bladder tumors. Following bladder tumor resection, instillation of intravesical chemotherapy (IVT) within 24 hours of resection has been associated with lower tumor recurrence rates. Data suggests an 11.7% reduction in recurrence rates. However, despite this promising data, it’s felt that is an underutilization of post resection IVT. Thus, this study aimed to investigate the rate of use of postoperative intravesical chemotherapy for non-invasive bladder cancer in USA, Australia, New Zealand, Ireland, England, and Canada. Additionally, the study explored the different types of IVTs that are in use across a wide range of countries, as well as the timing of instillation or any barriers that exist preventing their use. While only preliminary data exists at the moment, it aligns with the initial hypothesis of under usage of IVTs, approximately one third of administer some form of IVT. While the majority of cases instill an IVT within 24 hours, the reasons for not giving them go vastly undocumented. Additionally, the types of IVTs are limited to Mitomycin and Epirubicin. Further analysis of the data is expected in the near future.

We thank Hartford Hospital for funding this research.

## Poster 91

### **WRATH: A New Play Adapted from the *Iliad***

L. Prendergast, M. Ebbott, and E. Isser

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College of the Holy Cross*

What is the essential story of the *Iliad*? How does Achilles change? What episodes from the epic are necessary to tell this story and which can be removed? I explored these questions and more as I first began my research studying the *Iliad* as literature. I then moved on to translating and adapting the story for the stage which prompted a whole new set of questions: What makes something theatrical instead of literary? How can words on a page turn into visuals that clearly communicate a story? How can sound design, lighting and other technical elements enhance the clarity of the piece and the experience of the audience? How can a translation both be true to the original poetry and be compelling as dialogue in its own right? I plan to continue to search for the answers to these questions as a part of my thesis this year, which will culminate in a performance during the Spring Academic Conference.

I would like to thank Nancy Savage Skinner '79 and Stephen P. Skinner '77 for their generous gift which made this research possible.

## Poster 92

### **Practical Minds: The Effect of Reform Politics on Worcester**

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Since the beginning of the 20<sup>th</sup> century, Worcester has had 3 forms of municipal government: a strong mayor and large council system (1848-1949), a reformed “Plan-E” government (1949-1985), and a mixed system (1985-present). The first system featured a large bi-cameral legislative body, with members elected from each ward or neighborhood, as well as a strong a popularly elected Mayor. This type of politics, which was heavily corrupted by the actions of political parties, was forced out in several cities in the US by so called “reform politics.” In 1949 Worcester voters moved to a Plan-E Government. This called for non-partisan city wide elections, with the mayor not being a popularly elected, nor executive position as executive functions were to be taken over by the new apolitical city manager. This change in turn shifted the composition of the city council, creating a city council made up of exclusively councilors from small geographic areas in the city, and a focusing of policy towards those areas. In 1985, the city voted to bring back a level of geographic representation with a new mixed system where there are some “district councilors” as well as the traditional at large candidates. This led to another shifting back towards a slightly more equal distribution of power geographically. At the same time, the downtown area that had not been represented for years, has in the last decade undergone what many refer to as a rebirth. While these events are extremely complex, it is clear at the very least that in Worcester political power shifting has come to down town as well as a great deal of development, possibly indicating a flaw in the reformers original conception of municipal politics.

We thank the Weiss Summer Research Program for funding this research.

## Poster 93

### Papyrus to Pixels: Creating a Modern Edition of the Iliad

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After seven years of collaborative work, we completed a digital edition of the oldest complete manuscript of the Iliad, the Venetus A. Besides the text of the poem, this manuscript is especially significant for its 9,912 scholarly notes, or scholia, never before completely edited. The resulting corpus is too large and complex to analyze in a precise way without the help of digital methods. We addressed two major issues. First, we assessed how consistently the digital edition follows the project's encoding standards. Because these standards have evolved over seven years, we used software implementing the current standards to identify every instance where our digital text departs from our 2018 standards. We then began work developing a system to analyze the morphology of the Greek texts. A word in Ancient Greek can appear in dozens of different forms. To study patterns in the usage of language and the subject of the text, we need a method of recognizing the various inflected forms a word can take. Using the Kanones system originally developed by Professor Smith, we have begun building a morphological parser with sets of grammatical rules and vocabulary specifically tailored to the texts of the Venetus A manuscript. Beyond this summer, we plan to use the morphologically parsed text to understand better the transmission of the scholia and their relation to one another. Broad literary questions about the content of the poem will be able to be answered with a new, statistical rigor.

We thank Deborah C. and Timothy W. Diggins '80, and the Weiss Summer Research Program in the Humanities, Social Sciences, and Fine Arts for financial support. We are grateful to Pr. Mary Ebbott for her assistance throughout the project.

## Poster 94

### Rogue Elephant or Civil Servant? 1975, The Central Intelligence Agency, and the Campaign to Shape the Intelligence Community's Public Image

J. Ronan and C. Hooper

*Department of History, College of the Holy Cross*

Historians and former CIA officers alike point to 1975 as the "Year of Intelligence." This was the year that the U.S. intelligence community came under the most withering public scrutiny it had encountered up to that time. Journalist Seymour Hersh started the firestorm, publishing NYT expose accusing the CIA of domestic surveillance and illegal operations on American soil. Today, this scandal is frequently recounted as a triumph of investigative journalism - an incident, coming after Watergate, that can be explained in similar black and white terms. Authors like Tim Weiner depict "good" journalists and horrified politicians using the levels of US democracy to expose and rectify the wrongdoing of a secretive organization who overstepped its power. There is something appealing about this way of memory, because it celebrates U.S. democracy as a system that can successfully detect and abuse authority and hold leaders accountable to the public and its standards of morality. My research, however, presents a complicated picture of the 1975 scandal and its impact on CIA. I argue that, rather than bringing the CIA to heel and establishing reliable mechanisms of openness and oversight, actually resulted in the organization developing strategies for better "managing" its image to the American public. In 1975, it cultivated a public face that, paradoxically, could allow the agency better to keep secrets even while pretending to, and at times displaying, greater degree of accountability. Rather than exposing and reforming the CIA, this scandal marked a shift in the Agency's relationship with the public, the media, and Congress- introducing new procedures and tactics designed to protect the Agency from scrutiny and shield certain aspects from view. In this era where the Intelligence community is routinely attacked as partisan and biased, CIA has the ability to learn from 1975 to project the image of strict, national security professionals. CIA has the tools to combat the claims of biased and reform its public image.

We would like to thank the Weiss Summer Research Program for funding this project.

## Poster 95

### With Love, ABiGALE: Synthesizing Holy Cross's Queer History

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College of the Holy Cross has a long and complex history. For the LGBTQ+ community at Holy Cross, most of that history lies in archival files and artifacts. Utilizing various materials like scrapbooks, T-shirts, and newspaper clippings collected by the Office of Diversity and Inclusion as a starting point, we have researched the history and contributions of queer students at Holy Cross. This history has a few major touchstones: the formations of the LGB Support Group in the Chaplain's Office in November 1992, Holy Cross Allies in 1994, the Association of Bisexuals, Gays, and Lesbians (ABiGaLe) in 1997, and the release of *In, Out, and About on the Hill* in 2010. However, the surrounding temporal context *between* these events has long been overlooked, and the first-hand response to it, silenced. The products of this research include branding contributions to the Project Q+ Archive and adding to its available research, a narrative manuscript that goes through the LGBTQ+ History of Holy Cross (available to read and download for free online), and an illustrated introductory chapter of *With Love, ABiGALE*.

We thank the Weiss Summer Research Program for their generosity in funding this project. We also express our gratitude towards the Office of Diversity and Inclusion, Molly Heidemann, and Project Q+, the Holy Cross LGBTQ+ Archive for their assistance and loaning of the artifacts researched, as well as their contributions to the Holy Cross Queer History timeline.

## Poster 96

### Investigation of Protein Splicing Activity of Inteins and the Implications of Salt Sensitivity

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Protein splicing is a post translational modification where an intervening polypeptide (intein protein) excises itself from two flanking polypeptides (extein or external protein) through a self-catalyzed mechanism. Concomitant to the intein splicing out, the exteins ligate together, thus forming the mature polypeptide functional for the cell. We studied an intein that interrupts the DNA Polymerase II, found in the extremophile *Methanoregula boonei* (Mbo). *M. boonei* is an anaerobic methanogen that was isolated from an acidic peat bog and is highly salt-sensitive and produces methane at the lowest pH of any known organism. The *M. boonei* intein has a 64% sequence identity to the PolIII intein from the extremophile *Methanoculleus marisnigri* (Mma), another anaerobic methanogen found in similar environments. My work focused on discovering the conditions that induce optimal activity in the Mbo intein, as well as a mutant designed to have more efficient activity. Based on the organism's optimal growth conditions, we explored the intein's activity under conditions of low salt.

We thank the Alumni / Parents Summer Research Scholarship fund, the National Science Foundation (grant MCB-1517138), and the Camille & Henry Dreyfus Foundation for financial support.

## **Poster 97**

### **Cognitive Control to Food and Reward Cues in Males**

*F. Sorcini, J. Hall, E. Gurchiek, J. Hayaki, and G. J. DiGirolamo*

*Department of Psychology, College of the Holy Cross*

An attentional bias towards unhealthy food cues is implicated in the etiology of obesity and is thought to influence cravings and food consumption. Using an antisaccade task (look away from this cupcake), we recently showed that female undergraduates with a normal weight and no eating disorder had breakdowns in control to unhealthy food cues and these breakdowns in control were significantly associated with their BMI. Though breakdowns in control to unhealthy foods occur in normal weight females, little research has investigated males in eating disorder studies or food-related control. Here we investigated cognitive control to food and reward (money) cues using the antisaccade task in normal weight males. Preliminary results suggest more errors to food cues than neutral cues, and more errors to reward cues than neutral cues. These breakdowns in control were not related to eating disorder tendencies.

We thank the Alumni / Parents Summer Research Scholarship Fund for financial support.

## **Poster 98**

### **Testing the Properties of a SPEX 750M Spectrometer**

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*Department of Physics, College of the Holy Cross*

Currently, an experimental set up in our lab allows the examination of charge transfer collisions between lithium atoms and protons. Adding a spectrometer to the repertoire of laboratory equipment would allow for analysis of light emitted because of excitation collisions in this same experiment. Over the summer, we returned a SPEX 750M model spectrometer back to working order, ran tests to record its capabilities, and integrated it into a computer controlled system. We used LabVIEW to write a series of virtual instruments to control the spectrometer's motor and coordinate it with an integrated data acquisition (DAQ) device, which read the signal from the photomultiplier tube attached to the spectrometer's casing. This process returned values for the grating constant currently installed in the spectrometer (1800 lines/mm), the maximum reliable resolution (0.05 nm), the scan speed of the grating (6009 steps/nm scanned), as well as a set of reliable parameters for experimental scans. In addition, the count rate of the DAQ device and the scan speed of the instrument were used to convert time during the scan to a more useful graph where wavelength is the independent variable.

We thank the Alumni / Parents Summer Research Scholarship Fund for financial support. Special thanks to Pr. Roach for the loan of the USB DAQ device, without which this project could not have been completed.

## Poster 99

### In Pursuit of the Eco-Campus: Rethinking Sustainability Assessments in Higher Education

*E. Dennehy and E. Jones*

*Department of Sociology and Anthropology, College of the Holy Cross*

Achieving sustainable development in higher education necessitates a transformation of the institutions themselves--a feat researchers have been grappling with for nearly two decades. Adhering to the apothegm “what gets measured gets done,” the existing literature has a predominant preoccupation with operationalizing the elusive “sustainable campus.” Consequently, defining report content of sustainability performance assessments has been hailed as the “silver bullet” for the sustainable university problem. However, collation and analysis of existing reports, as well as evaluation of responses from a national survey of college-based sustainability professionals, challenge the perceived instrumentality, inclusivity, and reliability of North America’s most utilized self-reporting sustainability framework, STARS (Sustainability Tracking, Assessment & Rating System). Although further research is needed, this preliminary study contradicts the belief that measuring sustainability performance is sufficient to promote sustainable development in higher education. The effectiveness of popular sustainability assessments is reflected upon, paying particular attention to the overestimation of report functionality by the existing literature, survey participants, and report creators themselves. In addition, guidelines for future reports are generated, and seemingly contradictory viewpoints of report satisfaction and impracticality are examined. While some suggestions to report content are made, this study focuses primarily on the overlooked realms of defining principles for report completion and communication in the pursuit of a more sustainable world.

We wish to thank the Weiss Summer Research Program for its financial support.

## Poster 100

### Investigating Immune Response in Honeybees, *Apis mellifera*, from Injection of LPS

*V. Attaya, K. Ober, A. Sheehy, and J. McAlister*

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The decline in global pollinators is an issue not just economically but more importantly it is a huge loss to ecological diversity that will have profound consequences. Recent research has shown that this decline is multifaceted in origin where many components have been identified where it would be beneficial to form an immuno-fingerprint of the factors that affect global pollinators to help mitigate colony death. In this study the global pollinator investigated upon was the VSH Italian honeybee. This type of honeybee exhibits hygienic behavior which helps prevent the spread of disease in addition to the honeybee immune response. Honeybees’ immune system is composed of antimicrobial peptides (AMP) which when expressed can be measured through real-time PCR. Therefore, the aim of this study was to determine if an injection of LPS (lipopolysaccharide), which is a component of the cell wall of gram-negative bacteria, would cause an increased expression of the defense AMPs. Honeybees were taken from the hive and were then injected with either 2 $\mu$ L of sterilized water, or 2 $\mu$ L of .25mg/mL LPS. The honeybees were fed honey and sugar water solutions and stored in incubators of 32°C in flight cages. Four honeybees were then removed from the flight cages at multiple time points and euthanized. The subsequent extracted RNA was then converted into the complementary DNA used in rtPCR to normalize the AMPs (*defensin1*, *hymenoptaecin*, and, *apidaecin*) against the housekeeping gene of *actin*. Results from the initial trial in this study are inconclusive where further experimentation is needed to troubleshoot technique and housekeeping genes to answer if LPS injection invokes an immune response and further define the honeybee immuno-fingerprint.

We thank the Alumni / Parents Summer Research Scholarship fund for financial support.

## **Poster 101**

### **Hidden Informal Public Alternative Art Spaces: Exploring Perceived Identities and Experiences within the Contemporary Art Scene in Ho Chi Minh City, Vietnam**

*M. Yee and A. M. Leshkowich*

*Department of Sociology and Anthropology, College of the Holy Cross*

Ho Chi Minh City, formerly known as Saigon, is currently experiencing rapid change and growth within its dynamic urban landscape, as well as a fast-growing contemporary art scene. Within the city's maze of interconnected alleyways and bustling streets lie hidden creative art spaces, but only if one knows where to find them. These spaces could be characterized as "informal public alternative art spaces." Drawing from five weeks of ethnographic research (i.e. participant observation and in-depth interviews) and interacting with other scholars' positions of place, space, power, privilege, class, race and nationality in Vietnam and the world, my project explores how people who frequent these spaces imagine Saigon and the claims they make about it; how creatives in Saigon perceive the effects of their identities in relationship to the contemporary art community; how people perceive the dynamics of power and privilege within the contemporary art community in relationship to the perceived identities that others in the community hold; and how the dynamics of spaces themselves attract creatives and get occupied. Finally, this project also explores how social media and online spaces play a role in the community from the eyes of the contemporary artists interviewed.

We thank the Ignite Fund and J.D. Power Center for funding.

## **Poster 102**

### **In the Name of the Father, the Son, and John L. Lewis**

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*Department of History, College of the Holy Cross*

Despite the vast and growing body of research on Southern religion, rarely is attention focused on the experience of Appalachian evangelicals, especially those living in rural coalfields. The little scholarship on industrial Appalachia overwhelmingly flattens the culture to only its poverty, with researchers often assuming backwards social values and self-defeating politics of the highlanders. However, analysis of evangelical sermons, community speakins', and interpersonal correspondence among Appalachians during the heyday of coal mining paints a very different picture of mountain politics. This paper complicates the widely held assumption that evangelical mountain religion catered to capitalist interests or acted as a force against labor rights. It also challenges the idea that evangelical Appalachians are inherently conservative. Instead, this paper shows how working class, mine town preachers translated and nativized radical leftist ideology to their congregants during large-scale, often violent labor struggles. Through the work of homegrown preachers alongside union organizers and communist agitators, Appalachia developed a rich and enduring leftist tradition, kept alive by the highlander's hyper-local focus on family, kin, and community.

We thank the Ignite Fund for their financial support.

## Poster 103

### The Return of the Amateurs?

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In the last three decades, international aid and relief practices have proved to be increasingly professional and standardized, particularly among large international nongovernmental organizations (NGOs). For practitioners and academics alike, amateur aid is, at best, considered outdated (and largely ignored) and, at worst, blamed for high profile failings in humanitarian response. However, despite these perceptions, strong countervailing trends exist. In the United States, decentralized, amateur, private, and voluntary development aid is actually on the rise with over 10,000 grassroots international NGOs (GINGOs) having been established since the early 1990s. This phenomena remains largely unexplored in academic research. This research asks: what is the place for amateur activism in a professionalizing field? To what extent do GINGOs conform with or challenge professional norms in international aid? To answer these questions, we use a “large n” comparative analysis of website homepages from 59 GINGOs active in Haiti and 8 high-profile professional U.S.-based INGOs as well as a “small n” critical discourse analysis of a select sample of homepages. These analyses are performed based on five major criteria derived from the critical literature on humanitarian photography; websites, like images, can serve as a signal for organizations’ values, methods and operations while also shaping public perceptions of the developing world. Focusing on GINGOs’ (1) website quality, (2) branding strategies, (3) norms of practice, (4) output and (5) fundraising strategies as they appear on the homepage findings suggest that on a macro-level GINGOs conform with expectations of amateurism, diverging with professional NGOs on institutional transparency and development of self-image, but on a micro-level converge in their narrative of beneficiaries, relying largely on the “needs-based” approach to development. Future research is needed to determine the origin of this convergence and whether it is indicative of some larger, more consequential trend.

We thank the J.D. Power Center for Liberal Arts in the World for financial support.

## Poster 104

### Immune Fingerprinting of *Bombus impatiens* to Known Pathogens

W. Hoffmann, R. Gegear\*, and A. Sheehy

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The widespread loss of pollinators that has been extensively noted in the last decade has dramatic global impact. Many plants, some of which are essential to the global agricultural market, rely on them for reproduction; perhaps more critically, the loss of global pollinators decreases biodiversity which may itself have grave consequences. Colony Collapse Disorder (CCD) occurs when forager bees abandon their colony, resulting in starvation and death of the queen and worker bees, leading to the eventual collapse of the entire colony. Immune system hyperstimulation may play a role in CCD. The eusocial nature of bees would suggest that foragers may act as pathogen sensors and abandon the hive to protect it from infection. We have characterized the bumblebee immune response to different pathogen mimics to create a quantitated immune fingerprint. The expression of four individual antimicrobial peptide (AMP) genes present in *Bombus impatiens* was examined in response to exposure to peptidoglycan, a component of gram-positive bacterial cell walls. Twenty-four hours post exposure to peptidoglycan, the expression of all four AMPs increased; most notable was the drastic increase in the expression of *hymenoptaecin*. The hymenoptaecin peptide permeabilizes the outer membrane of both gram-positive and gram-negative bacteria. Previous data examining the AMP induction response to  $\beta$  glucans, a component of fungal cell walls, showed a pattern of AMP expression distinct from that of bees exposed to peptidoglycan. These investigations will next examine the immune response to lipopolysaccharide, a component of gram-negative bacterial cell walls, providing a compilation of the bumblebee immune response to three different pathogens that may play a role in CCD. In parallel to these immune response studies, research at WPI has analyzed the behavioral changes of the bees after exposure to all three pathogen mimics, allowing us to begin to integrate aberrant physiological and behavioral responses that may contribute to CCD.

I thank Mr. and Mrs. Joseph T. Murray ‘58 P86,86 for the financial support.

## Poster 105

### Investigation of Cosmic Rays

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Cosmic rays are constantly bombarding Earth, colliding with the atmosphere and showering our planet with subatomic particles as a result of these collisions. The most common subatomic particle to reach Earth's surface is the muon. A single cosmic ray produces many muons, also described as a muon shower. We investigated cosmic rays by building multiple muon detectors or muon telescopes. The telescopes were built to be tilted at different angles from zenith towards the horizon, which allowed us to look at the count rate of muons at different angles. Multiple telescopes were synced in time using a GPS, so that coincidental muon detections between two different telescopes could be recorded. By recording coincidences, the muon showers were directly detected and therefore the cosmic rays were as well. This research focused on how the coincidence detection rate changed as the telescopes were tilted from zenith towards the horizon. Previous measurements of muon showers at angles from zenith found that the count rate was proportional to about cosine squared where the angle was the zenith angle. However, the value of the power of cosine can vary depending on the location of the detectors on Earth. Our result was best fit with cosine ( $\theta$ ). The reason for this difference could be due to imperfections with our telescopes, such as relatively long dead times which cause missed counts.

We thank the Alumni/Parents Summer Research Scholarship Fund for financial support.

## Poster 106

### East-West Asymmetry of Cosmic Rays

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Cosmic rays are, in essence, streams of high energy protons traveling through space. Being positively charged particles, they experience eastward deflection by the Lorentz force when they travel through Earth's magnetic field. When the protons interact with Earth's atmosphere they decay into kaons and pions, which further decay into muons that inherit this deflection as they reach Earth's surface. According to this simple model, more muons would travel eastward, rather than westward, creating an asymmetry in their flux at Earth's surface. One of the purposes of this research was to observe and investigate this asymmetry using muon telescopes. As each telescope has a unique setting for optimal efficiency, we pointed them in both east and west directions to measure the asymmetry. Measurements from one telescope were inconclusive, and another telescope suggested that the flux is greater from a westward direction.

Special thanks to Drs. Daniel J. Wasser and Karen Randall P15 for their financial support used in pursuing this research.

## Poster 107

### Muon Flux Dependence on Zenith Angle

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The Earth is constantly bombarded by cosmic rays, which are mostly protons that are generated by the Sun and other astronomical sources. These protons enter our atmosphere and collide with other larger particles, such as oxygen and nitrogen. Several different subatomic particles are the result of these collisions—one such particle is the muon. The muon has a long lifetime and the capability to reach Earth's surface while other particles may decay before then. We built muon-detecting telescopes that work by recording the ionizing energy of travelling muons. Each telescope has two paddles made of scintillation plastic. When a muon passes through a paddle, it ionizes the plastic atoms and generates photons. These photons enter a photomultiplier tube which sends the photon's signal to a microcontroller. Only the signals that are coincident and arrive from both paddles simultaneously are recorded. This allows us to measure only muons that pass through both paddles and come from a certain region in the sky. This area can be adjusted by tilting the paddles. In this experiment, we tilted the angles of the telescopes by increments of 15 degrees from zenith toward the horizon to observe changes in muon flux. Dependence on zenith angle has been studied by many others, and the relationship between flux and angle is reported to be  $\cos^n(\theta)$ , where n is a constant and  $\theta$  is the angle from zenith. Our value of n was found to be 1.59 with an error of +.27 and -.23. Researchers at Sakarya University in Turkey also measured this relationship, and their value of n was reported as  $1.95 \pm 0.08$ . Error in our measurement can come from the wide acceptance angles of the telescopes. While our research would ideally measure smaller regions in the sky, our telescopes accept muons from areas of around 56 degrees. More accurate measurements can be taken in the future after the telescopes' acceptance angles are reduced.

We thank the Weiss Summer Research program for financial support.

## Poster 108

### Measurement of Average Muon Shower Density

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Cosmic rays are high-energy particles that originate from solar flares and outside the solar system. Cosmic rays collide with nuclei in the Earth's atmosphere to create showers of pions which decay into leptons, such as electrons and muons. We detected cosmic rays through the muon showers they produce using a portable telescope array of plastic scintillators. Muons are the most energetic decay products that ionize the scintillators and cause the scintillators to emit photons. A photomultiplier tube transforms this photon ionization energy into electric pulses that we recorded. Low-energy pulses below a threshold that did not come from muons were excluded. For each telescope, two identical paddles were suspended by PVC piping with their surfaces in parallel to focus their measurements on a certain region of the sky. A two-dimensional solid angle is associated with this region, and this angle is needed to calculate muon flux. We corrected the solid angle of each telescope using a Monte Carlo simulation, as our asymmetric scintillator paddles could not be described by a surface integral with respect to a midpoint. The shower density was estimated from the probability that telescopes contained within a muon shower record that shower. Additionally, we developed a microcontroller upgrade that significantly reduced our telescope circuit board's dead time of 276 ms for each recorded muon to less than 15 ms. Future research is needed to collect more data to support our results.

We thank the Alumni/Parents Summer Research Scholarship Fund for financial support.

## Poster 109

### Risk Factors for Postoperative Urinary Retention in Males Following Carotid Endarterectomy

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Postoperative urinary retention (POUR) is defined as the inability to void despite having a full bladder following a surgical procedure, and has previously been associated with longer procedure length, larger intraoperative fluid volumes, and general anesthesia. Few studies investigate POUR following carotid endarterectomy (CEA). The current study seeks to identify preoperative and intraoperative risk factors as well as postoperative complications associated with POUR. We conducted a retrospective chart review of male patients who underwent CEA between 2014-2018 at Massachusetts General Hospital. Patients were excluded if they had a concomitant carotid-coronary bypass graft, baseline dialysis, or baseline indwelling catheter/straight catheterization. The primary endpoint was POUR, defined as straight catheter or foley catheter placement within 24 hours postoperatively or an emergency department visit for urinary retention within a week of the operation. There were overall 278 patients included, and 37% developed POUR. On unadjusted analysis, POUR was associated with older age, history of benign prostatic hypertrophy, history of urinary retention and no preoperative foley catheter placement. Predictors of POUR on multivariable analysis included age (OR: 1.04, 95% CI: 1.01-1.08), history of urinary retention (OR: 5.40, 95% CI: 2.14-13.6), and intraoperative hydralazine (OR: 1.81, 95% CI: 1.01-3.25). Preoperative foley placement was protective (OR: 0.24, 95% CI: 0.12-0.53). Patients who developed POUR had higher rates of postoperative urinary tract infections, were less likely to be discharged home, and had a longer length of stay. POUR is common in males undergoing CEA and carries risk of complications including UTI, longer length of stay, and less likely discharge to home. Risk factors for POUR include age, history of urinary retention and intraoperative hydralazine. Preoperative foley placement is protective. Given these findings, this study may help identify at-risk patients, and future studies should develop a protocol to reduce the risk of POUR.

We thank Massachusetts General Hospital for financial support.

## Poster 110

### Investigation of the Psychological Processes in Philosophical Inquiry

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By exposing us to novel perspectives, philosophy provides us with opportunities to reexamine the sets of realities we live by every day and attune ourselves to them. Yet many students who are beginners to philosophical investigations often experience great discomfort due to the internal instabilities and become reluctant to engage in a meaningful relationship with the thinkers in the history of philosophy. As a result, they fail to fulfill the objective of the inquiry. In my research, I discovered that a successful philosophical inquiry is facilitated by the psychological process of internalization. My analysis focuses on Hans Loewald's critique of Freudian psychoanalysis, especially of its excessive emphasis on the role of defense mechanisms and its neglect of internalization as a more mature mental function. Following the pleasure principle, defense mechanisms protect our inner world from harmful stimuli temporarily, but at the great cost of distorting realities and of hindering ego development. Alternatively, internalization transforms the object cathexis into a narcissistic cathexis and facilitates a higher level of ego-reality integration. The internalized object possesses the mobility to stay on the periphery of the ego system or merge into the ego proper. In light of this discovery, rather than fixated on specific theories and worldviews, a healthy inquiry of philosophy should maintain fluidity and openness towards possible realities similar to that of the process of internalization.

We thank the Weiss Summer Research Program for financial support.

## Poster 111

### Effect of Simulated Egg Size Reduction on Larval Performance in *Dendraster excentricus*

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Echinoderms make eggs that vary in volume over several orders of magnitude, yet all are able to produce functional larvae that survive to metamorphosis. There are several tradeoffs associated with egg size: smaller eggs allow for increased fecundity, but a decreased investment for each individual offspring, whereas larger eggs result in decreased fecundity but increased parental investment. In order to survive and reach metamorphosis, indirect developing larvae must develop certain essential structures like the ciliary band, the primary larval feeding and swimming structure. We simulated egg size reduction in the sand dollar *Dendraster excentricus*, which have an intermediate egg size among echinoderms, and observed the effect of this reduction on larval development. In order to create half- and quarter-sized “eggs,” we separated blastomeres at the two- and four-cell stages respectively. We investigated several questions: can these larvae successfully reach metamorphosis? If you continue to decrease egg size, do you eventually run out of cells to produce a functional larva? Are certain essential structures, like the ciliary band, prioritized over others? We successfully raised larvae derived from separated blastomeres to metamorphosis and observed differences in ciliary band and nerve cell density in half- and quarter-sized larvae. These findings provide valuable insight into the amount of maternal investment necessary to produce viable offspring and the tradeoffs associated with reducing egg size.

We thank the National Science Foundation for financial support.

## Poster 112

### Interrater Reliability for Neuronal Reconstruction

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Neuronal structure changes due to experience. Our laboratory has previously shown that environmental enrichment increases spatial cognition in mice. We hypothesize that the complexity of hippocampal neurons is greater in mice reared in an enriched environment compared to a standard laboratory environment. In order to test this hypothesis, we have reconstructed hippocampal neurons by using an automated system that allows the user to mark points on a microscope image of a neuron using three axes (X, Y, and Z). The placement of markers is subjective, and therefore the reproducibility of the data must be established rigorously. Samples were collected from male and female groups of enriched mice reared in enriched and standard environments mice. Mouse brain specimens were processed with Nissl stain, which stains the endoplasmic reticulum of all cells, and Golgi stain, which stains about five percent of neuronal cell bodies. Microscope slide labels were obscured and coded, and investigators performing reconstructions were thus blind to the sex or experimental group to which each specimen belonged. Neuronal reconstructions from two independent raters were compared to assess interrater reliability of measurements taken from the reconstructions: dendritic length and dendritic complexity.

We thank the Alumni/Parents Summer Research Scholarship program for financial support.

## **Poster 113**

### **Developing Pattern Separation using Fear Conditioning**

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In behavioral neuroscience, pattern separation involves distinguishing between similar memories. This study analyzed how mice discriminate between two similar contexts after fear conditioning. In mice, freezing is a common behavioral fear response, so this was the primary measure used to operationally define fear memory. In this study, there were two different contexts that varied in odor and visual cues. 16 male and female C57BL/6J mice were randomly assigned one of the contexts as the “shock context,” in which the mice would receive a mild aversive footshock. A multi-day pattern separation training paradigm was used to train the mice to express the fear association with the “shock” but not the “no shock” contexts. The pattern separation phenomenon was assessed by calculating discrimination ratios to test for a significant difference in freezing between the two contexts. After six days of pattern separation training, the mice consistently exhibited significant discrimination between the two contexts. During the last stage of the experiment, the training was ended to monitor extinction of the discrimination between the two contexts. In comparison to past literature, the mice in this study took longer to learn to discriminate between their “shock” and “no shock contexts.” These mice also did not exhibit a decrease in discrimination after several days of extinction training. These unexpected outcomes could be related to stressful early life experience of the mice that were subjects in this experiment.

We thank the Alumni/Parents Summer Research Scholarship program for financial support.

## **Poster 114**

### **Recency Discrimination in the Novelty Preference Paradigm**

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As specific forms of episodic memory, both temporal and spatial order memory can be investigated through object recognition tasks that allow measurement of preferences based on recency and displacement. In the novelty preference paradigm, C57BL/6J mice were exposed to two different objects in two different arrangements in consecutive trials. This experiment was conducted using 16 mice in two batches which were counterbalanced by the object type presented first and also by the time of day at which the sexes were tested. It was predicted based on previous literature that the mice would explore the initially presented object in a novel, displaced location the most and that the initially presented object in a familiar location would be the second most explored object. The recently presented objects were expected to garner the least attention regardless of location. However, using both automated and hand scoring methods to track the exploration of the mice, our results indicate that these expected preferences either were not evident or were opposite to what was expected. This discrepancy may be due to preference towards certain zones within the test arena. Also, the lack of large differences between the objects and spatial configurations may play a role. Finally, we plan to test whether mice reared in an enriched environment show enhanced temporal and spatial preference/discrimination in this task compared to mice reared in standard laboratory conditions.

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## **Poster 115**

### **Revising the Preoperative Protocol in Arthroplasty Patients to Better Benefit Postoperative Recovery**

*E. Keleher, J. M. Drew, and A. Abdeen  
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The current recommended protocol before any surgical procedure receiving general anesthesia is no food or liquid intake after the midnight before surgery. These guidelines are emplaced to reduce the risk of pulmonary aspiration or regurgitation. Following this protocol, patients awaken from surgery extremely dehydrated and malnourished. This state of health for a recovering patient can increase the risk of complication both during intra-and postoperative stages. This is highly important for arthroplasty patients, who are asked to get up and move around immediately after surgery. When a patient is unable to complete this task due to dizziness levels caused by dehydration, recovery is prolonged and physical therapy is delayed. This then places the patient at risk of implant rejection and failure. By revising the current preoperative fasting protocol to reduce fasting time, the hope is to better benefit patients in their postoperative recovery. Instead of fasting with no food or liquids midnight before surgery, patients will be recommended to follow the new protocol. The new protocol encourages patients to drink an Ensure Clear protein drink, as well as Gatorade and other clear liquids up to two hours before arrival time. Patients will still be advised to avoid all solid foods after midnight before surgery. This change in protocol is new and up-and-coming, but the answer on whether there are significant differences in postoperative recovery time between the old protocol and the new protocol patients is unanswered. This study is being performed to find an answer and to spread the news to other practices to help the greater good. The question we aim to answer is: "In patients undergoing total hip and knee arthroplasty, does the use of preoperative oral liquid carbohydrates, reducing the total fasting period, decrease the postoperative recovery time and risk of complications compared to patients receiving the standard protocol of no food or drink after midnight before operation?"

We thank BIDMC sponsors for financial support.

## **Poster 116**

### **Examining Female Selfhood and the Struggle for Independence Through Fiction in the Eighteenth and Nineteenth Century**

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English and American laws between the late Eighteenth and Nineteenth century restricted women from gaining independence and rendered them inferior hostages to the male sex. I studied women's lack of social and political freedom through an examination of marriage laws and a thorough reading of four primary texts -- A Vindication on the Rights of Woman (1792) and Maria (1798) by Mary Wollstonecraft, The Tenant of Wildfell Hall (1848) by Anne Brontë, and The Awakening (1899) by Kate Chopin. In addition to reading these texts, I engaged in research of both primary and secondary sources which aided me in forming a coherent narrative on female selfhood. My findings evidenced a struggle in the domestic and political realm for women to have their own internal spaces and cultivate psychological, emotional and artistic selfhood. Fiction was used as a tool in three of my primary texts to provide narratives on the struggle for female independence, just as women today are coming forward publicly to share their own narratives in support of movements such as #MeToo and #TimesUp. As evidenced by the news and continual inequality of the sexes, the issues which these authors raised hundreds of years ago are still infiltrating society and restricting female independence. Through my summer research I discovered how powerful women's narratives and stories are in highlighting the injustice of laws and calling for social action.

I would like to thank the Weiss Summer Research Program for graciously sponsoring my research experience.

## Poster S1

### Characterizing the *Enkurin* Gene's Role in Male Fertility in

*Drosophila melanogaster*

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School*

In many animals, successful reproduction requires sperm cells to swim toward and then fertilize an egg. Defects in sperm motility can therefore lead to infertility. Previous work in mice identified a gene called *enkurin* that is required for correct sperm swimming; males in which this gene was disrupted were severely sub-fertile. To further study the functions of this gene, we have developed *Drosophila melanogaster* fruit flies as an alternative model system. We found previously that RNAi knockdown of *enkurin* caused the males to be extremely sub-fertile, which was due to an inability of sperm to reach the proper storage organs of the female reproductive tract. These results suggested a motility defect. Our current experiments have used a putative null allele of *enkurin* generated by CRISPR/Cas9. Like RNAi males, homozygous mutant males are severely sub-fertile and produce sperm that fail to localize properly within the female. We are currently using these males, in conjunction with fluorescently labeled sperm, to develop microscopy methods to image and quantify sperm motility. We have also expressed the enkurin protein in *E. coli* and are in the process of purifying the protein product to raise an antibody. Our results suggest that the *enkurin* gene has a conserved function in sperm motility across diverse animals. Thus, this initial work may lead to a better understanding of important reproductive mechanisms in other organisms, including humans. Future experiments using an enkurin antibody will allow us to determine the localization of the enkurin protein in mature sperm and to test hypotheses about the protein's interactions. We will also continue with the imaging of *enkurin* mutant sperm and quantify the motility patterns that likely cause the sub-fertile phenotype.

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## Poster S2

### “You Knew Him Well”: Gendered Epistolary Patterns in Conrad’s Letters and Their Effect on *Heart of Darkness*

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In 2008 all of the surviving correspondence of Polish-British author of nautical tales Joseph Conrad (1857-1924) was published in the nine-volume *Collected Letters of Joseph Conrad* (Cambridge University Press, 2008). Since then, these letters largely have been employed to provide moderate support for a claim within a journal piece rather than provide a rich foundation for new formal or thematic readings of Conrad’s work. To redress this, this project tracked epistolary patterns across his decades of letters. By identifying and following these patterns, both formal and thematic, among the letters I discovered a marked difference between how Conrad in his letters addressed men and women. Almost exclusively, his male interlocutors received short, clinical, business-like letters, whereas women were sent longer, and more intricate letters filled with Conrad’s dark philosophy and ruminations on the world around him. To focus this analysis into a discrete article for publication, I studied Conrad’s correspondence with his long-time friend G. F. W. Hope and his colleague John Galsworthy, and discussed how and why these letters contrast with those sent to Conrad’s aunt, Marguerite Poradowska, Edith Wharton, and Ada Galsworthy. I then argue the epistolary patterns discerned in his letters to women, which reveal much about Conrad’s state of mind, shape his novel *Heart of Darkness* (1899). In applying the same pattern seen in his personal letters to his published writing, I displayed a reading which shifts the focus away from the male-dominated novella to the few episodes involving women, which highlight a more intimate reading of Conrad’s view of the human toll of Empire.

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## Poster S3

### What Do Graffiti Tell Us About the Middle East: Case Studies of the West Bank and Egypt

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It is believed by people that art reflects society. The surroundings of the artists, including a certain culture and prevailing social values, have more or less impact on their works. The talented reproduce what they see through paint brushes or musical notes, and many of them even express their attitudes and opinions through their works. Art cannot be properly interpreted without previous knowledge of what is happening at a particular point of time. On the other hand, art influences the society, too; it is capable to bring political changes. Throughout history, it is not an unusual practice for the government leaders to use art as a means of propaganda. Graffiti are writings and drawings on public walls or other surfaces. There is an increasing number of people in Egypt and the West Bank choosing graffiti as a political method to convey their demands to the government and international society. The research focuses on the artists’ motivations and people’s demands reflected in these paintings. It examines how they have changed over time in Egypt and the West Bank along with the events happened in the society. In addition, the artists community has also diversified. More women and international activists are currently involved in creating street arts in the Middle East. The research further investigates the relationship between these different groups of artists, and with the local communities. All the images of graffiti are gathered from printed publications, including books and news, and internet. As part of the research, a website is also created to archive these amazing graffiti in the West Bank and Egypt. It documents the authorship, background, and changes made to the graffiti.

We thank the Weiss Summer Research Program for financial support.

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